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José García Solanes

Real Exchange Rate Appreciation in Central and Eastern European Countries

Why the Balassa-Samuelson Effect Does Not Explain the Whole Story

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José García Solanes

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Abstract

This working paper surveys the determinants of the significant real exchange rate appreciations experienced by the currencies of Central and Eastern European (CEE) countries with respect to the euro since the mid 1990s. After analysing the reasons why the Balassa-Samuelson model cannot account for the entire real exchange rate appreciations, the two parts of the model are estimated using quarterly data of six CEE economies, and compared with previous findings in the literature. It is found that relative sector prices cannot explain the variations in the real exchange rates, because continuous increases in the purchasing power of these countries create additional demand for their differentiated tradable goods. Since tradable goods of these economies are clearly differentiated from those of the euro zone, this phenomenon —accompanied by quality improvements in the tradable sector of these countries—creates steady upward trends in the terms of trade that are channelled into external real exchange rates. Finally, we derive exchange rate policy prescriptions for these countries' run-up strategies of towards the euro.

Key words

Balassa-Samuelson effect, panel cointegration, market segmentation, quality bias.

Resumen

Este documento de trabajo presenta una panorámica de los determinantes de las importantes apreciaciones que han experimentado los tipos de cambio reales de los países del centro y este de Europa (CEE) con respecto al euro desde principios de la década de 1990. Después de analizar las razones por las que el modelo de Balassa-Samuelson no puede explicar completamente la magnitud de tales apreciaciones, este documento estima las dos partes del modelo utilizando datos trimestrales de seis economías de la CEE, y los compara con los resultados obtenidos anteriormente en la literatura sobre este tema. Se descubre que los precios relativos sectoriales no pueden explicar las variaciones de los tipos de cambio reales porque los continuos aumentos del poder de compra de estos países crean una demanda adicional de sus productos comercializables. Como los productos comercializables de estas economías están claramente diferenciados de los de la zona euro, este fenómeno —acompañado de mejoras de calidad de los mismos— crea tendencias crecientes y sostenidas en los términos de intercambio, que se canalizan hacia los tipos de cambio reales externos. Finalmente, se derivan prescripciones para la política de tipo de cambio de estos países en el marco de sus estrategias de acercamiento al euro.

Palabras clave

Efecto de Balassa-Samuelson, cointegración con datos de panel, segmentación de mercados, sesgo de calidad.

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Real Exchange Rate Appreciation in Central and Eastern European Countries: Why the Balassa-Samuelson Effect Does Not Explain the Whole Story

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1. Introduction

AN important feature of the Central and Eastern European (CEE) countries is that they have experienced an almost steady and substantial appreciation in their real exchange rate (RER) since the beginning of their transition period [1].

Although this phenomenon is a common, or even a stylised fact, of most transition economies, it deserves special attention in the particular case of the CEE countries, given the process of economic integration with the EU in which they are involved. More specifically, it is crucial to assess the extent to which these real appreciations are an equilibrium outcome for at least two reasons. First, in the case of disequilibria, the RERs will be misaligned, throwing doubt on the sustainability of the current account deficits, which, in general, these countries run. In turn, this situation would make the real convergence process more problematic. Second, if real appreciations are above equilibrium, some of the convergence criteria established in Maastricht would be more difficult to achieve, which in turn would darken the prospects of monetary unification with the Euro zone. In fact, excessive real appreciation would trigger either an increase in internal inflation in countries that have chosen a fixed exchange rate against the euro—such as Estonia and Lithuania—, or excessive appreciating tensions in the nominal exchange rate in countries that participate in the ERM2 system, such as Slovenia. The first case involves difficulties for the fulfilment of the inflation criterion—to keep the domestic inflation rate under the 1.5% threshold above the average inflation level of the Euro zone—, whereas the second is a problem for the exchange rate criterion—maintaining the nominal exchange rate within ± 15% fluctuation bands around the central nominal rate against the euro.

To answer the question raised in the preceding paragraph, many works have tried to quantify the contribution of the Balassa and Samuelson (BS) effect to the above-mentioned RER appreciations. As is well known,

1. In the annual report on the economic transition of the CEE countries, the European Bank for Economic Development extends this feature to Romania and Bulgaria.

the BS hypothesis explains the appreciating trends in the RER as a result of relative productivity improvements in the tradable sector (with respect to the non-tradable one) of a specific country as opposed to a foreign country or zone. If the BS effect is important, as is usually the case in countries with high potential for productivity gains—either because they use the existing resources efficiently or because they adopt new technologies—RER appreciation will not endanger the competitiveness of the tradable sector. On the other hand, if the appreciating trend in RER obeys other factors, such as inflationary pressures in a setting of flourishing domestic demand, the countries in question would experience a loss of competitiveness and a deteriorating effect on their current account.

Although some discrepancies exist concerning the magnitude of the BS effect [2], the general result in the available empirical studies is that it does indeed contribute to the tendency for the RER to appreciate in CEE countries [3]. However, some recent estimations—notably Égert (2002b), Mihaljek (2002), Kovács (2003), Flek, Marková and Podpiera (2002), Mihaljek and Klau (2004), Blaszkiewicz et al. (2004) and Cincibuch and Podpiera (2004) —detect lower impacts (although always statistically significant) than the analysis performed during the first half of the 1990s. In accordance with the European Commission (2002), the higher values obtained in the former empirical analysis could be attributed to some influences that blur and exaggerate the BS effect during the transition period. For instance, the fact that economic restructuring towards market economies during those years was accompanied by the increased motivation of domestic firms in maximising profits, instead of optimising production and employment, generated an important reallocation of workers out of the industrial sectors. This phenomenon, coupled with deregulation in prices of a substantial part of the service sector, created an additional and spurious correlation between increases in the apparent productivity of labour in the tradable sector, on the one hand, and increases in prices in the non-tradable sector on the other [4].

2. The surveys by Breuss (2003: 33-34) and Blaszkiewicz et al. (2004) on the empirical estimations of the BS effect in these countries, applying both time series and panel data methodologies, illustrate this point. The results vary depending on *a)* the sample periods and the countries considered, *b)* the econometric methodology, *c)* the way of building the relevant data.

3. As emphasised by Égert (2002a) and Mihaljek (2002), there is no empirical work in the frame of the CEE countries putting into doubt the presence of the BS effect in those economies.

4. The generalised increase in the prices of services, after being liberalised from the strong regulation prevailing during the communist phase, gave rise to the cost recovery effect outlined by Krajnyak and Zettelmeyer (1998).

In the already extensive literature on the BS effect in the CEE countries we observe that a survey of the main contributions is still lacking. Furthermore, to our knowledge there is no comprehensive analysis of the forces that push the RER of these countries beyond the levels suggested by the BS hypothesis.

To fill these gaps, this paper surveys and analyses the causes and main consequences of RER appreciation in the case of six CEE economies: the Czech Republic, Estonia, Lithuania, Latvia, Poland and Slovakia, for which reliable and homogeneous data may be obtained from Eurostat on a quarterly basis. Our work is composed of two parts. In the first part, we survey the theories and factors that cause the rise in the RER in the CEE counties, and draw implications concerning the nature of RER developments. We place special emphasis on the BS hypothesis and on the other factors that may be added to improve the performance of this model in the special context of our study. In the second part, we undertake econometric analysis to quantify the contribution of the BS hypothesis and probably other real factors to the appreciating trend in the RER of the six CEE countries of our sample. We analyse bilateral exchange rates, taking the German mark (and the euro since 1999) as the external benchmark.

To achieve these objectives we test the model following a two-phase strategy, which diverges from the procedure used so far in the literature in the context of the CEE countries. In the first phase, we test the first part of the BS hypothesis (denoted BS-1 hereinafter), which relates the difference in productivities with the difference in prices of the tradable and non-tradable sectors. In the second phase, we check the PPP hypothesis in the tradable sectors, which is an essential prerequisite for the fulfilment of the second part of the BS hypothesis (BS-2). We believe that this two-step strategy overcomes the difficulties of recent empirical analyses on this topic, in which the fulfilment of PPP in the tradable sector is taken for granted from the outset.

After verifying that PPP does not hold in the tradable sectors of the countries of our sample, we investigate the factors that may explain the evolution of the tradable-based RER, named RER(T) hereafter. We find that increases in the demand for differentiated domestic tradables that are steered by higher economic growth and improvements in the quality of these goods introduce an upward bias in the prices of tradables of these countries, leading to trend appreciations in the RER(T).

The remainder of this paper is organised as follows. Section 2 briefly describes the evolution of the RER in each country of our analysis. In section 3 we explain the BS hypothesis and the way other factors proposed

in the literature may affect the RER. Section 4 surveys the vast empirical literature devoted to testing this model in CEE countries. In section 5 we elaborate the fundamental variables of the relationships that will be used in the empirical analysis, and verify visually whether the BS hypothesis is supported by the data. In section 6 we test the two parts of the BS model. In section 7 we investigate the factors that explain the non-fulfilment of the BS-2 hypothesis in the studied group of countries. Section 8 derives some policy implications. Finally, section 9 summarises the main findings and conclusions.

2. Appreciating Trends in the RER of the CEE Countries

GRAPHIC A.1 in the appendix shows the evolution of two real exchange rates, RER(C) and RER(D), calculated by deflating the nominal exchange rate of each CEE country vis-à-vis Germany with national consumer price indices and internal demand deflators, respectively, for the period 1995-I to 2004-III. Indices are defined in such a way that increases (decreases) in RERs reflect real depreciations (appreciations). As can be seen, the appreciating trend exists in each country and for both RER, except for RER(D) in Poland. The annually average RER(C) appreciations, in increasing order, are: Poland, 2.7%, the Czech Republic, 3.5%, Latvia, 4.0%, the Slovak Republic, 4.3%, Estonia, 4.5% and Lithuania, 5.6%.

Let us concentrate on the evolution of RER(C) in each country of our sample. In the case of the Czech Republic, the appreciating trend is apparent for the whole period except for three short episodes in 1997, 1999 and 2003. Until 1977, this real appreciation took place through a positive inflation differential with respect to the EU. After the financial crisis of that year, the nominal appreciation of the Czech koruna has been the main channel. In Estonia, RER appreciation has followed a continuous trend, fuelled by a positive inflation differential. However, there are two phases that show different trajectories depending on the strength of the inflation differential: during the first one, which runs until 1999, a high positive (although decreasing) inflation differential pushed the RER rapidly downwards, whereas during the second one a stabilised inflation differential of around 1% per year led the RER to appreciate in a steady but less pronounced trajectory. In Lithuania, the RER clearly appreciated until 2000 as a result of relatively high developments in inflation. Since then, the RER has followed a horizontal path as a result of the stabilisation of domestic inflation at the level prevailing in the Euro zone.

The development of the RER(C) shows marked differences in the case of Poland with respect to the other CEE countries. In that country, two phases with different signs may be clearly discerned. The first one corre-

sponds to a rapid and uniform appreciation (only interrupted in 1999) that lasted until the end of 2001. The second one corresponds to a depreciation of the RER that started in 2002, channelled through a nominal depreciation accompanied by a declining inflation differential with respect to the Euro zone. Finally, in the Slovak Republic we discern a uniform appreciating trend, except for the years 1998 and 1999. Until 1995, the RER appreciation could be explained by nominal appreciation of the domestic currency, while in the following years, a positive inflation differential with respect to Germany was the main factor that pushed the RER upwards.

The observed trend appreciation in the CEE countries has raised the issue of whether this reflects adjustment not justified by fundamental factors, or whether it corresponds to an equilibrating reaction to underlying real shocks. Concerns about possible overvaluation of the RER of CEE countries have been further heightened by the high current account deficits that have recently re-emerged in these countries. In the following two sections we analyse the Balassa and Samuelson hypothesis and other theoretical explanations that the recent literature has provided to answer these questions. We will also explain the extent to which the already abundant empirical research on this topic has lent support to each of these factors and theories.

3. The Balassa and Samuelson Hypothesis

THIS model, formalised independently by Balassa (1964) and Samuelson (1964), considers a small open economy with two sectors that produce two composite goods: tradable (Y_T) and non-tradable (Y_N), each one obtained with constant-return production functions. Assuming, for instance, Cobb-Douglas functions, the quantities produced in each sector are:

$$Y_T = A_T L_T^{\beta} K_T^{1-\beta}, \tag{3.1}$$

$$Y_N = A_N L_N^{\alpha} K_N^{1-\alpha}, \tag{3.2}$$

where parameters A_i, L_i, K_i stand for total productivity, labour and capital in the respective sectors $(i = T, N)$, and the coefficients β and α are the intensity of labour in the production function of sectors T and N, respectively. According to what is well established and demonstrated in the empirical evidence, we assume that $\alpha > \beta$. Furthermore, it is assumed that: *a)* the price of tradable goods measured in foreign currency (P_T^*), and the interest rate in terms of tradables $(1 + R)$, are determined in the world markets. These are natural implications of the international mobility assumption for both tradable goods and capital; *b)* PPP holds in the tradable sector; *c)* labour is perfectly mobile across sectors inside the country, but less mobile between countries; *d)* wages are led by developments in the tradable sectors, and then translated to the non-tradable sector (wage equalisation across sectors, as a result of labour mobility inside the country).

3.1. The first part of the Balassa and Samuelson hypothesis (BS-1)

Profit maximisation in the tradable sector implies:

$$(1 - \beta) A_T L_T^{\beta} K_T^{-\beta} = 1 + R. \tag{3.3}$$

$$\beta A_T L_T^{\beta-1} K_T^{\beta-1} = W_T, \tag{3.4}$$

where W_T is the real wage in units of the tradable good.

From (3.3) we derive that:

$$\frac{K_T}{L_T} = \left[\frac{(1-\beta)\ A_T}{1+R} \right]^{\frac{1}{\beta}}. \tag{3.5}$$

By substituting into (3.4), we obtain a relationship between the rates earned by the two factors of production:

$$W_T = \beta A_T \left[\frac{(1-\beta)\ A_T}{1+R} \right]^{\frac{1-\beta}{\beta}}. \tag{3.6}$$

From equations (3.3) and (3.4), after eliminating A_T, we obtain:

$$\frac{K_T}{L_T} = \frac{(1-\beta)\ W_T}{\beta + R}. \tag{3.7}$$

Profit maximisation in the non-tradable sector, when wage and productivities are measured in terms of the tradable good, leads to:

$$(1-\alpha)\ A_N L_N^{\alpha}\ K_N^{-\alpha}\ \frac{P_N}{P_T} = 1 + R, \tag{3.8}$$

$$\alpha A_N L_N^{\alpha-1}\ K_N^{1-\alpha} \frac{P_N}{P_T} = W_N. \tag{3.9}$$

Adopting the same procedure as for sector T to derive the real wage in sector N:

$$W_N = \alpha A_N \left[\frac{(1-\alpha)\ A_N}{(1+R)} \right]^{\frac{1-\alpha}{\alpha}} \left(\frac{P_N}{P_T} \right)^{\frac{1}{\alpha}}. \tag{3.10}$$

By equalising (3.6) with (3.10), we obtain the internal price ratio:

$$\frac{P_N}{P_T} = \left(\frac{\beta}{\alpha} \right)^{\alpha} \frac{A_T^{\frac{\alpha}{\beta}} \left(\frac{1-\beta}{1+R} \right)^{\frac{\alpha(1-\beta)}{\beta}}}{A_N \left(\frac{1-\alpha}{1+R} \right)^{1-\alpha}}. \tag{3.11}$$

Applying logs to equation (3.10) and arranging terms we obtain:

$$p_N - p_T = \frac{\alpha}{\beta} a_T - a_N + \alpha \left[c - \left(\frac{1-\beta}{\beta} - \frac{1-\alpha}{\alpha} \right) R \right], \tag{3.12}$$

where $c = \log \beta + \log (1-\beta)^{\frac{1-\beta}{\beta}} - \log \alpha - \log (1-\alpha)^{\frac{1-\alpha}{\alpha}}$. This term is one constant that depends exclusively on technical parameters of the production function. Since $\alpha > \beta$, the term c has an ambiguous sign, but the coefficient of the (log of the) real interest rate is clearly positive.

By differentiating (equation 3.12), we derive a systematic relationship between relative productivity shifts and variations in the internal real exchange rate, that is, the price of non-tradable goods expressed in terms of tradable goods:

$$\Delta p_N - \Delta p_T = \frac{\alpha}{\beta} \Delta a_T - \Delta a_N . \tag{3.13}$$

Equation (3.13) indicates that because $\alpha > \beta$, productivity growth in the tradable sector has a positive impact on the relative price, which is higher than that of productivity increases in the non-tradable sector. Consequently, faster and/or equal productivity growth in the tradable sector relative to the non-tradable sector will push up the relative price of non-tradable goods: the higher the α/β ratio the greater the increase. This is the so-called *internal* version of the BS hypothesis, and was first formulated by Baumol and Bowen (1966).

As may be easily shown, when total productivity increases of each sector are equal, there is an increase in the internal relative price caused by the increase in the average productivity of labour in sector *T*:

$$\Delta p_N - \Delta p_T = (\alpha - \beta)\Delta(y_T - l_T). \tag{3.14}$$

The mechanism through which increases in productivity in the tradable sector are transmitted to increases in prices in the non-tradable sector is well known. Since the price of tradable goods is determined in the international market, productivity increases in this sector determine nominal wage increases that also spread over the non-tradable sector by virtue of labour mobility (and/or centralised union negotiations). As a result, the relative price of non-tradable goods will rise.

Under the frame of two countries, applying (3.12) and assuming that they have the same production functions, it is easy to derive the equation that links the difference in productivities to the difference in prices of sectors *T* and *N*:

$$dp = relp - relp^* = \frac{\alpha}{\beta} (a_T - a_T^*) - (a_N - a_N^*), \tag{3.15}$$

where *relp* and *relp** are the difference between the (logs of) prices of the two domestic sectors at home and abroad, respectively. This expression is usually named the first part of the BS hypothesis.

Equation (3.15) establishes that the difference between the productivities of the tradable and non-tradable sectors of two countries determines the difference between the relative prices of the two non-tradable sectors. Economies that have a particularly high productive tradable sector will exhibit a relatively high price of non-tradable goods. The opposite will be true in countries where the productivity improvements take place in sector *N*.

3.2. The second part of the Balassa and Samuelson hypothesis (BS-2)

The second stage of the BS hypothesis establishes a relationship between the real exchange rate and the difference in prices of sectors *T* and *N*. To obtain this relationship, we first define the real exchange rate as the relative price of the general goods basket produced abroad—measured in domestic currency—with respect to the same basket of goods produced at home. In logs we have:

$$q = (e + p^*) - p, \tag{3.16}$$

where e is the (log of the) nominal exchange rate defined in domestic currency units per foreign currency, and superscript (*) denotes a foreign country. An increase (decrease) in q indicates a real depreciation (appreciation) of the domestic currency. In each country, the aggregate price level is composed of prices of tradables and non-tradables according to the following weighted averages:

$$p = \lambda p_N + (1 - \lambda) p_T. \tag{3.17a}$$

$$p^* = \lambda^* p^*_N + (1 - \lambda^*) p^*_T. \tag{3.17b}$$

The coefficients λ and λ^* are the weights of non-tradable goods in the consumer basket of the domestic and foreign country, respectively. Substituting equations (3.17a) and (3.17b) into (3.16), we obtain:

$$q = (e + p^*_T - p_T) - \lambda (p_N - p_T) + \lambda (p^*_N - p^*_T). \tag{3.18}$$

Assuming that $\lambda = \lambda^*$, this expression simplifies to:

$$q = (e + p^*_T - p_T) - \lambda(relp - relp^*). \tag{3.19}$$

The first parenthesis in expression (3.19) stands for the natural log of the RER calculated with the prices of tradable goods, and is known as the external RER. By assuming that PPP holds in T sectors, as is accepted in the traditional derivation of the BS hypothesis, this parenthesis is equal to zero, and the second part of the BS may be written as:

$$q = -\lambda(relp - relp^*). \tag{3.20}$$

According to (3.20), there is a negative relationship between the difference in the relative price ratios and the CPI-deflated real exchange rate: an increase in the price differential causes RER appreciation, which is more pronounced as the weight of goods N in the consumers' basket increases. It is worth noting that the second part of the BS hypothesis, as presented in equation (3.20), crucially relies on the fulfilment of PPP in the tradable sector.

3.3. The complete BS hypothesis

Joining the two BS parts we obtain the complete Balassa and Samuelson hypothesis:

$$q = -\lambda\left[\frac{\alpha}{\beta}(a_T - a_T^*) - (a_N - a_N^*)\right], \tag{3.21}$$

which indicates that the appreciation in the real exchange rate should be equal to the increase of the productivity differential transmitted to the CPI via the non-tradable inflation pass-through.

3.4. The influence of demand factors

In so far as capital may flow freely across countries, changes in relative demand for tradable goods, which lead firms to modify the aggregate proportion of produced goods, will not alter the real interest rate. Consequently, firms in both sectors will continue to employ the initial optimal ratio of pro-

duction factors and the shift in the aggregate structure of production will take place at constant returns. This means that the production possibilities frontier between tradables and non-tradables is a straight line.

Furthermore, since the slope of this straight line measures the internal price ratio, it is clear that changes in the relative demand for tradables do not modify the relative price of tradables in terms of non-tradables. In other words, the relative price of goods T and N depend only on supply factors—productivities developments—and is independent of consumer demand patterns.

The validity of these arguments is proven with the help of equations (3.22) (3.23) and (3.24) obtained for an individual small country, which we present below. In effect, by operating through equations (3.5) to (3.7) we obtain:

$$\frac{K_T}{L_T} = \frac{(1-\beta)\, W_T}{\beta (1+R)} \,. \tag{3.22}$$

$$\frac{K_N}{L_N} = \frac{(1-\alpha)\, W_T}{\alpha (1+R)} \,. \tag{3.23}$$

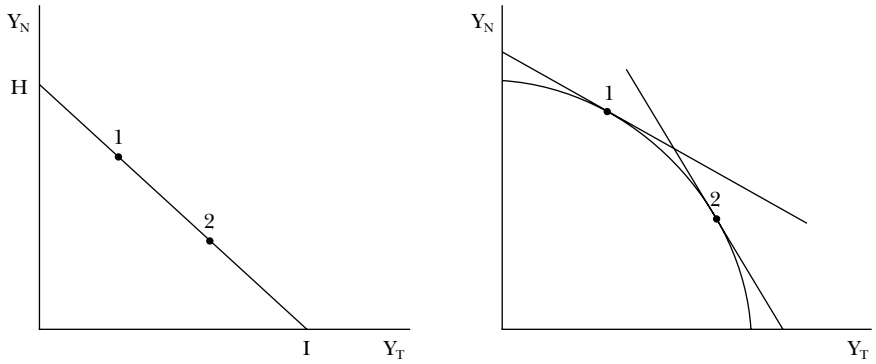
As regards the slope of the production possibilities frontier (PPF), we may obtain this expression:

$$\frac{\partial Y_N}{\partial Y_T} = \frac{A_N (1-\alpha)^{1-\alpha}\, \alpha^{\alpha}}{A_T (1-\beta)^{1-\beta}\, \beta^{\beta}} \left(\frac{1+R}{W_T} \right)^{\alpha-\beta} = -\frac{P_T}{P_N} \,. \tag{3.24}$$

Given that W_T is determined exclusively by technical conditions of sector *T,* shifts in relative demand do not affect the ratios of production factors if the real interest rate remains constant (it is exogenously determined in the world capital market). Consequently, the PPF is a straight line, and, by (3.24), we derive that the relative prices do not change.

These results are shown graphically in graphic 3.1. Graph *a)* of this graphic reflects the case where R is constant. From the initial situation given by point 1, an increase in the relative demand for tradable goods leads the economy to point 2 along the straight line *HI,* which is the production possibilities frontier; the prices ratio remains constant. Graph *b)* depicts the case where imperfect capital mobility makes the production possibilities frontier a concave curve. Here, the same shift in demand increases the relative price of tradable goods with respect to non-tradable as a result of the following process: since the T sector uses the capital factor more intensively

GRAPHIC 3.1: An increase in the relative demand for tradable goods

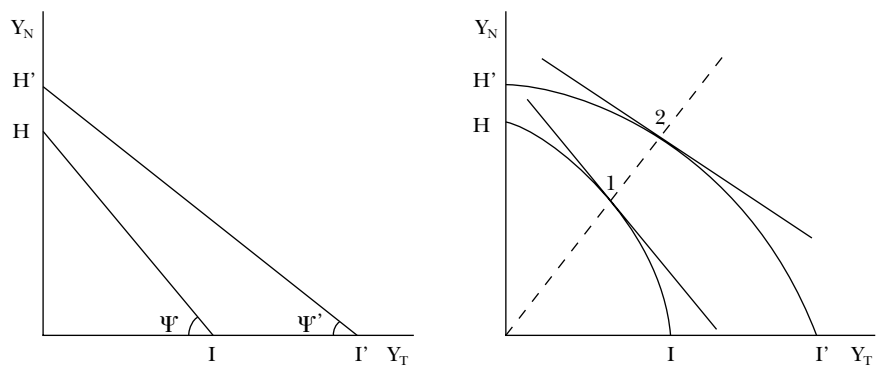


a) Perfect capital mobility *b)* Imperfect capital mobility

than the *N* sector, the increase in the production of tradable goods pushes the real interest rate up. This contributes to dampen the production stimulus in the *T* sector. Furthermore, the reduction in the demand for *N* goods pushes P_N downwards. Consequently, the slope of the PPF is higher, in absolute terms, than in point 1.

Let us now represent graphically the Balassa and Samuelsson effect under each scenario. Assume, for instance, a relative increase in the productivity of sector *T* ($\Delta a_T > \Delta a_N$). Graph *a)* in graphic 3.2 represents the case of perfect capital mobility. The PPF is a straight line which shifts from *HI* to *H'I'*. The new line is flatter than the initial one, indicating that non-tradable goods become relatively more expensive. In this case, the new ratio of prices is determined exclusively by productivity factors. Demand factors determine the point that consumers choose in each line, without affecting the slope. Graph *b)* in the same graphic depicts the case of imperfect capital mobility. The relative increase in the productivity of sector *T* shifts the PPF curve outwards, but with a bias in favour of sector *T*. Additional information about

GRAPHIC 3.2: An increase in the relative total productivity of the tradable sector



a) Perfect capital mobility *b)* Imperfect capital mobility

the relative strength of demand is necessary to determine the new price ratio. Assuming, for instance, that consumers maintain the same demand proportion, the consumption bundle will move from point 1 to point 2, and the price ratio (P_T/P_N) will decrease, indicating that non-tradables become relatively more expensive than tradables. As can be seen in graphic *b),* the slope in point 2 of the curve *H'I'* is less pronounced than in point 1 of the curve *HI*.

4. Survey of the Empirical Literature

THE empirical studies carried out during the 1980s generally verify the BS effect in several groups of countries. Hsieh (1982), for instance, found that productivity-differential variables correctly explain trend developments of the real exchange rates of Germany and Japan with respect to their trading partners during the period 1973-1983. This author used sectoral productivity and aggregate wages as the explanatory variables. Marston (1987) built non-traded and traded productivity series using OECD sectoral output and employment data, and found that labour productivity differentials between sectors *T* and *N* satisfactorily explained the long running appreciation of the yen against de US dollar during the seventies and early eighties.

More recent studies, during the 1990s and 2000s, tend to confirm the BS effect less easily in the case of developed countries than in the framework of developing economies. As regards developed countries, Froot and Rogoff (1991) found no strong support for the relationship between differences in sectoral growth productivities and real exchange rate evolution in EMS countries during the period 1979-1990. Asea and Mendoza (1994) derived the propositions of the BS hypothesis from a two country neoclassical model and tested them with data of 14 OECD countries between 1975 and 1990. They found that, whereas productivity differentials satisfactorily explain the trend changes in the relative price of non-tradables, these supply-side factors cannot account for deviations from PPP in the tradable-goods sector. Using OECD data for the period between 1970 and 1985, De Gregorio, Giovannini and Krueger (1994) concluded that demand-side factors might explain these short run deviations of relative prices of non-tradables with respect to their long-term trend, which is correctly explained by the BS effect.

Heston, Nuxol and Summers (1994) also found strong BS effects for a variety of OECD countries during the seventies and eighties. Alberola and Tyrväinen (1998) tested the productivity hypothesis for non-tradable relative prices using various lengths of data periods up to 1995 in eight EMU countries. Their results showed that, although there seemed to be a long-term relationship along the lines of the BS effect, the coefficients estimated were not close to the values predicted by the model. However, after allowing for the

changes in sectoral wages they obtained estimates near to those required by the BS hypothesis. Canzonery, Cumby and Diba (1999) tested BS-1 and BS-2 using a panel of 13 OECD countries. Their results revealed that the relative price P_N/P_T reflects the relative labour productivities in the T and N sectors (first part or domestic version of the BS hypothesis), but the evidence is somewhat mixed as far as the PPP in the T sector is concerned. Thus, whereas PPP seems to hold when DM exchange rates are examined, it shows large and long-lived deviations when US dollar exchange rates are considered. The results of Canzonery (1999) reflect those of of Asea and Mendoza (1994) mentioned above.

Finally, it is worth mentioning the results of MacDonald and Ricci (2001), who extended the BS framework to assess the effects of productivity improvements in the distribution sector on the real exchange rate of ten developed economies during the period 1970-1992. They found that although this sector has a non-tradable nature, any increase in their productivity was also transmitted to RER appreciation, as in the case of the tradable sector. This result would reflect the fact that the tradable sector uses a substantial share of services and retail activities as intermediate inputs.

As regards emerging economies, empirical results are more favourable to the BS hypothesis. In a study referring to a group of fast growing Asian countries, for instance, Ito, Isard, and Symansky (1997) found that trend changes in non-tradable prices were induced by productivity improvements in these countries. However, along the lines of Asea and Mendoza (1994), they also found that PPP for tradable goods was rejected by the data, and argued that this explains why the response of RER to the productivities differentials was less than predicted by the BS hypothesis. In a study referring to the real exchange rate of the Taiwanese currency against the US dollar, Wu (1996) reached the conclusion that the trend appreciation of the Taiwanese dollar was caused more by nominal appreciation and increase in unit labour costs than by productivity increases. Finally, in an empirical study of seven Asian countries, Chinn (1998) reached a similar conclusion for the currencies of Thai, Malaysia and Philippines.

The empirical analyses devoted to transition economies deserve special attention, not only because they have proliferated in recent years, but also because the results have important implications for the catching up process of these economies, with respect to more advanced neighbours, triggered by market liberalisation. Tables 4.1 to 4.3 summarise the results and the techniques applied in selected empirical studies of the BS effect in CEE countries. These tables complement the information reported by Mihaljec and Klau (2004) and Blaszkiewicz et al. (2004) by adding many new and re-

cent results. The presentation follows a chronological order. For the works that belong to the same year, the alphabetic order is the guide. Table 4.1 shows the papers referring to the internal transmission of the BS hypothesis, which is the part that we name BS-1. Table 4.2 describes the studies devoted to the external transmission, which links productive differentials between two countries with inflation differentials or the real exchange rate between two countries or areas. The latter is what we call the whole BS hypothesis.

Before making any judgment concerning the values of the estimates, two caveats are in order. First, since the year when the transformation process started in the CEECs is relatively recent, the estimations have been obtained with very short data sets that typically do not allow the authors to filter out some cyclical influences. It is important to bear this feature in mind because the BS effect should be viewed as a long-term tendency. Second, there are some difficulties surrounding the measurement of the BS effect, which can be grasped by glancing at the tables. Breuss (2003) enumerates six technical hitches: *a)* How can we differentiate between tradable and non-tradable goods? *b)* How can we measure relative prices for both sectors? *c)* Should we use labour productivity or total factor productivity? *d)* What is the most suitable econometric procedure? Should we rely on single country data series or on panels composed of several countries? *e)* Which BS effects should we concentrate on, those referring to single or isolated countries or those embedded in a more general theory of RER determination? *f)* Can the BS effect for a multi-country world only be simulated with a multi-country general equilibrium model? The way in which these difficulties are tackled must be carefully justified, and we shall attempt to do so when presenting our own results in sections 6 and 7 of this paper. Although these reservations generate uncertainty concerning the size of the BS effect, it is obvious that the effect plays an important role in the CEE countries.

Let us first analyse the content of table 4.1. As can be seen, the approaches vary considerably, depending on the dependent variable used in the specified equation, the way the branches of activity are grouped into tradables and non-tradables, the additional macroeconomic variables that are included, and the estimation method that is applied. The description of additional variables is accompanied by the signs (*) and (/), indicating that the variables are statistically significant or not significant, respectively. The estimated effect is measured either by a percentage point in the relative rate of internal inflation per annum, or by the coefficient of the productivity differential, which is also the slope of this explanatory variable in the regression equation. The latter indicates the extent to which internal inflation reacts to a one-per-cent increase in the productivity differential.

TABLE 4.1: Internal transmission mechanism

Autor(s) countries period	Dependent variable	Tradable sector	Non tradable sector	Other explanatory variables	Estimation method	The BS effect
Rother (2000) Slovenia 1993-I to 1998-IV	$p_N - p_t$	Manufacturing	Remaining sectors, excluding agriculture	ΔMon. Base: -0.3 (*) G/GDP: 1.2 (*) GDP p.c. (influence of demand) (/)	Dynamic time series regressions	Slope: 1.0 (long run) BS effect: 2.6%
Begg et al. (2002) Nine CEECs 1990-1998	$\Delta p_N - \Delta p_t$	Consumption of non-food goods	Services	GDP p.c. (/) Variation in the rate of inflation (/)	Regression with panel data. GLS and SUR estimations	2% a year
Bitans, Slakota and Tillers (2001) Latvia 1993-I to 2000-IV	$\Delta p_N - \Delta p_t$	Manufacturing sector	Retail sale and wholesale' hotels and restaurants' construction		Time series regressions	Slope: 0.50 Price elasticity to output growth: 0.13 to 0.49
Cipriani (2000) Ten CEE countries 1995-1999	$\Delta p_N - \Delta p_t$	Industry and mining (goods CPI basket)	Residual services		Panel regressions	0.5 to 0.7%
Coricelli and Jazbec (2004) 19 transition countries (Including 8CEE countries) 1990-1998	$\Delta p_N - \Delta p_t$	Manufacturing, mining, energy, construction	Rest, excluding agriculture	C/GDP (*) G/GDP (*) Structural misalignment (*)	Panel regressions	0.9 to 1.2% BS more relevant in the second transition phase
Eur. Commission (2002) 19 transition economies Early 1990s to 1999.	$\Delta p_N - \Delta p_t$	Industry	Services	C_N/C: 1.7 (*) G/GDP: 0.7 (*) L_T/L_N (Structural reforms): -0.6 (*)	Panel regression	Slope: 0.9
Halpern and Wyplosz (2001)9 CEEC countries1991 to 1999	$\Delta p_N - \Delta p_r$	Consumer goods	Services	GDP p.c.: 0.03 (*) Variation in the rate of inflation (*) Exch. Rate system (*)	Panel GLS regressions	Slope: 0.45 3%
Sinn and Reutter (2001) Six transition countries 1994 to 1999	Δp	Manufacturing and agriculture	Rest		Statistical simulations	TU: 0.1 EST: 4.1 CZE: 2.9 PO: 4.2 SVN: 3.4 HU: 6.9

TABLE 4.1 (continuation): **Internal transmission mechanism**

Autor(s) countries period	Dependent variable	Tradable sector	Non tradable sector	Other explanatory variables	Estimation method	The BS effect
Arratibel, Rodríguez Palenzuela and Timan (2002) 10 CEE countries 1990-2001	Δp_t Δp_N	Food, beverages, clothing and footwear, furnishings, household equipment, routine maintenance household	Health, communications, recreation and culture, education, restaurants and hotels, miscellaneous goods and services	Exch. rate regime (*) Budget deficit (*) GDP p.c. (/) Wage growth (*) Unemployment (*) Oil price (/) Terms of trade (*)	Method of moments applied to panel data	Insignificant
Backé et al. (2002) 4 CEE countries 1992-2000	$\Delta p_N - \Delta p_t$	Manufacturing	Rest		Cointegration and panel regressions	PO: 9.43 SVN: 3.48 CZE: 0.79 HU: 5.58
Jazbek (2002) 9 transition economies, including Slovenia 1993-2001	$p_N - p_t$	Industry: activities for which more that 10% is exported	Services	C_N/C: 1.68 (*) G/GDP: 0.75 (*) L(ind.)/L(serv.): –0.65 (*)	Cointegration analysis Bivariate VAR models	Panel: Slope: 0.9; BS effect: 1.5% SVN: Slope: 1.7
Newton College (2004) 23 countries, including five CEE countries 1993-2003	$\Delta p_N - \Delta p_t$	Industry	*a)* Rest *b)* Rest excluding agriculture, fishing and forestry	$\Delta W_T - \Delta W_N = 0.7\%$ (*)	Panel regression Cross section regression	Slope: Panel: 0.60 Cross-section: 0.66
Égert (2005a) 6 transition countries 1991-2003	Δp	Manufacturing industry, transport and telecommunications, hotels and restaur.	Remaining market-based sectors		Cointegration techniques DOLS incorporating lags and leads	Sub-period 1996-2002: BU: -1.5% UKR: 0.1% CRO: 0.8% RO: 1.4% RUS: 1.0% TU: 0.4%

The most striking feature is the fact that some earlier works, such as those of Rother (2000), Begg et al. (2002), Halpern and Wyplosz (2001), Sinn and Reutter (2001) and Backé et al. (2002), provide very high estimates, ranging from 2 to 9.4%, compared with more recent estimates. The reason is that during the first half of the nineties, the CEEs were subject to strong structural transformations, which artificially increased the correlation between productivity differentials and internal relative inflation. The explanation is as follows: several decades of central planning resulted in ex-

cessive protection and the stimulus of industrial production at the expense of private housing, consumption goods and services. This was reflected at the start of the nineties in over-employment in heavy industries and distorted price levels in the whole economy. The most evident cases were the under-valuation of both the internal price ratio P_N/P_T and the RER. However, as the process of deregulation of goods and labour markets and financial deepening took their course, labour force flowed from the tradable sector towards the non-tradable. Since the ensuing productivity increases in the tradable sector during this phase was mainly due to labour shedding, the relationship between real productivity growth and the appreciation of the RER underlying the BS approach become blurred. In order to overcome this obstacle and obtain more accurate estimations, the European Commission (2002) estimated the BS effect including specific variables representative of the structural reforms, such as the labour ratio L_T/L_N, in the regression equation. With the presence of this variable, which turned out to be statistically significant, the estimated BS effect was under 2% per year.

In the late nineties, after a period of successful transition, the evolution of the RER was determined by more standard—and market oriented—variables, with the BS effect playing the dominant role. However, since the BS was only one determinant—among others—of the observable RER appreciation, many empirical studies delivered modest values for this effect, at least for the CEE countries as a whole. The average values of the twenty-one empirical estimations surveyed in this paper, calculated according to the meta-analysis methodology for both individual countries and the CEE countries as a whole, are presented at the bottom of table 4.3. For individual countries, the results go from 0.2 for Estonia to 3.6 for Lithuania. The low value in the case of Estonia may be rationalised by the fact that the degree of openness of this country is very high and, consequently, the share of non-tradable goods in the CPI basket is relatively low. As far as the value for Lithuania is concerned, the high internal BS effect obeys the fact that the relative sector productivity of this country has been extremely high [5]. For the CEE countries as a whole, the average internal BS effect amounts to 1.4% per year.

Table 4.2 offers the main features of the empirical works that estimate the whole BS effect in the CEE countries generally with respect to the euro

5. According to the calculations of Blaszkiewicz et al. (2004), the ratio of relative labour productivities in Lithuania, during the period 1996-2003, was 6.0, which is largely the highest value across the CEEC and Baltic countries.

TABLE 4.2: External transmission mechanism

Autor(s) countries period	Dependent variable	Tradable sector	Non tradable sector	Other explanatory variables	Estimation method	The BS effect
Pelkmans Gros and Perrer (2000) 10 CEE countries with respect to the EZ 1997-1999	$p - p^*$	Relative GDP			Regression analysis with cross section data	3.3 to 4.0%
Darvas (2001) Four CEE countries vis-à-vis Germany 1991-1999	RER	Industry	Services	Net assets (/) Terms of trade (/) Real interest rate (/)	State space models Regressions	HU and SVN: modest effects CZE: more significant effects
De Broeck and Slok (2001) Ten transition countries against the rest of the world 1993-1998	REER	Industry and Construction	Services		Cross sectional regressions	BS effect: Average: 1.4 to 2% CIS countries: not significant
Golinelli and Orsi (2002) Three CEE countries vis-à- vis the Eurozone 1993-1 to 2000-8	$\Delta p - \Delta p^*$	Industry	Rest	Output gap (demand-side pressure) (*) Money gaps (/)	Multivariate cointegration Multivariate VEqCM	CZE: 4.3% HU: 2.1% PO: 5.1%
Taylor and Sarno (2001) Nine transition countries against Germany 1992-1997 Monthly data	RER	Time trend		Real interest-rate differential (*)	Non-linear: – cointegrat. (STAR, ESTAR and LSTAR mod.) – multiv. B-Nelson decomposition	Slopes: SVN: 0.2 SVK: 0.4 BU: 1.7 LIT: 1.8 HU: 0.9 LAT: 1.7 PO: 1.1 CZE: 0.6 RO: 0.6
Zumer (2002) Slovenia vis-à-vis the Germany 1992-2001	$\Delta p - \Delta p^*$	Manufacturing	Construction and services	Relative mark-ups and other factors: (*)	Simple accounting framework Components of of the RER	0% in 1993-1996 1.4% in 1997-2001
Breuss (2003) 17 Transition economies Data base 1997	$\Delta p - \Delta p^*$	Manufacturing, business service agriculture	Services	Multi-country world model	Simulations with the GTAP5 world CGE model	Slopes: PO: 0.9 HU: 0.3 Rest (average): 0.56
Burges, Fabricio and Xiao (2003) Baltic countries with respect to the euro area 1997-2001	$\Delta p - \Delta p^*$ RER	Manufacturing	Services	Net foreign assets (*) Slopes: EST: –0.18 LAT: –0.15 LITH: –0.18	Statistical accounting Cointegration vectors	MPL TFP EST: 0.6% 0.5% LAT: 0.7% 0.5% LIT: 0.5% 0.3%

TABLE 4.2 (continuation): **External transmission mechanism**

Autor(s) countries period	Dependent variable	Tradable sector	Non tradable sector	Other explanatory variables	Estimation method	The BS effect
Égert et al. (2003) 9 CEE countries with respect to Germany 1995-I to 2000-IV	$\Delta p - \Delta p^*$ RER	Industry (Agriculture)	Services	Share of N goods in the CPI basket (**) Regulated prices (*)	Panel cointegration techniques	CRO: 1.2% LIT: –0.2 CZE: –0.1 PO: 2.4 EST: 0.4 SVK: 1.2 HU: 1.1 SVN: 1.1 LAT: –0.1
Kovács (2003) 5 CEE countries vis-à-vis Germany 1992-2001	$\Delta p - \Delta p^*$	Manufacturing	Market services, construction, retail trade, transport and telecommunications	Relat. VA price (*) Relat. mark-ups (*) Relative wages (*)	Computation of the RER components	CZE: 1.6% HU: 1.9 SVK: 1-2% SVN: 1.06
Lojschova (2003) SVK, CZE, HU, PO 1995-I to 2002-IV with respect to the euro area	$\Delta p - \Delta p^*$	Manufacturing	Services and construction	Relative intersect. wages (*) Real interest rate differential (/) $\Delta p_r - \Delta p_{r^*}$ (*)	Panel regressions OLS regressions for individual countries	Slopes: Indiv. Pooled SVK: 2.7 1.7 CZE.: 1.1 1.3 HU: 2.8 0.8 PO: 3.4 2.0 BS effect (aver.): 2.5%
Fischer (2004) 10 CEE countries vis-à-vis 21 OECD countries 1993-1999	RER (CPI based)	Industry	Services Intermediate sector: Agriculture	G/GDP (*) C/GDP (*) Real int. rate (*) Relative TOT (*) Real raw prices (*)	Panel analysis SUR estimations Fixed effects Static and dynamic methods	0.7 to 2.2 % (Partially attributed to the investment demand channel)
Mihaljek and Klau (2004) 6 CEE countries vis-à-vis the euro area 1993-2003	$p - p^*$ $\Delta p - \Delta p^*$	Manufacturing, mining, transport and communication, tourism	Energy, Construction and services		OLS regressions for individual countries	CRO: 0.17 PO: 0.12 CZE: 0.98 SVK: 0.18 HU: 0.56 SVN: 1.18
Arghyrou, Boinet and Martin (2004) 5 CEE countries vis-à-vis the EMU 1990-1 to 2004-12	RER	Differential of potential output		Differential of output gaps (*)	Cointegration methodology Linearity tests and Non-linear models	Slopes: CZE: 0.87 SVK: 1.12 HU: 0.68 SVN: 0.13 PO: 0.65
Oomes (2005) Slovakia with respect to the euro area 1993-2004	ΔRER (RER CPI-based and PPI-based)	Manufactured goods	Market services	G/GDP: 0.45 (*) Administ. prices (/)	Cross section and cointegration tests Descriptive analysis	Slope: 0.93 Equilibrium RER appreciation: 3%
Wagner (2005) 8 CEE countries vis-à-vis eleven west European countries 1994-2001	$\Delta p - \Delta p^*$ ΔRER	Manufacturing, mining and quarrying, electricity, gas and water supply	Construction, real estate and business activity	P. c. GDP growth (*) Total C growth (*) Intersectoral wage-differential (*)	Bootstrapping inference	$\Delta p - \Delta p^*$ CZE: 0.26 LIT: 0.51 EST: –0.27 PO: 0.80 HU: 0.94 SVK: –0.07 LAT: –0.22 SVN: 0.68

area or vis-à-vis Germany. The same general comments as for table 4.1 apply in this case. The only difference is that the estimates are now lower because they are relative values—in terms of inflation of RER variations—with respect to a foreign area. The quantified effect goes from 0.6 in the case of Slovakia, to 2.0% in the case of Poland. The result for the CEE area is 1.3%, which is under the critical 1.5% ceiling established by the inflation criteria of the Maastricht Treaty. Table 4.3 reports the works that estimate both the internal and external transmission mechanism of the BS model, and the results of the meta-analysis computations.

To sum up, the empirical studies reviewed in this section provide some evidence supporting BS effects in CEE countries. Although the magnitude of the effects strongly depends on periods, and on the techniques adopted to filter the correct influence of productivity, recent estimations agree with the fact that the BS effect is rather modest and that it is not sufficient to explain the observable RER appreciations in catching-up countries.

The literature reviewed in the preceding tables has proposed and used some complementary determinants to explain the appreciating tendency in the RER of transition economies:

I) Demand factors operate through several channels, and have been proxied by different types of variables, such as the real interest rate differential (Grafe and Wyplosz, 1999; Darvas, 2001; Taylor and Sarno, 2001; Lojschova, 2003; Fischer, 2004), real income per capita and government spending as a percentage of GDP (Rother, 2000; Arratibel, Rodríguez Palenzuela and Timan, 2002), the budgetary deficit (Arratibel, Rodríguez Palenzuela and Timan, 2002), the share of private consumption over GDP (Coricelli and Jazbec, 2004; Fischer, 2004), the growth rate of consumption (Wagner, 2005), total consumption (Wagner and Hlouskova, 2004), and the share of consumption of non-tradables over total consumption (European Commission, 2002; Jazbek, 2002). Some authors used variables representative of the business cycle to capture the influence of demand (Golinelli and Orsi, 2002; Arghyrou, Boinet and Martin, 2004). Finally, other authors resorted to policy variables such as the increase in the monetary base (Rother, 2000; moey gaps, Golinelly and Orsi, 2002 and policy measures in response to shocks, Jakab and Kovács, 1999).
Taylor and Sarno (2001) and Arghyrou, Boinet and Martin (2004) tried to quantify the relative size of supply and demand-side effects by distinguishing between underlying structural changes in the RER, caused predominantly by supply factors, and short-term

TABLE 4.3: Internal and external transmission mechanism and meta-analysis estimations

Autor(s) countries period	Dependent variable	Tradable sector	Non tradable sector	Other explanatory variables	Estimation method	The BS effect
Kovács and Simon (1998) Hungary vis-à-vis Germany 1991-1996	Δp ΔRER	Manufacturing, excluding agriculture, mining and energy	Market services, construction, retail trade, transport and telecom (excluding public admin.)		Simple statistical methods	Δp: 1.9% ΔRER: 2.9%
Jakab and Kovács (1999) Hungary 1991-1998	Δp_N, Δp_t ΔRER	Industry	Services	Dem. shocks (*) Pricing behav: (*) Policy react. to shocks (/)	SVAR model of the RER Monte Carlo simulations	ΔRER: 1.9%
Égert (2002a) 5 CEE countries vis-à-vis Germany and USA 1991-1 to 2000-12	$\Delta p_N - \Delta p_t$ ΔRER	Industrial sector	Productivity growth of this sector is neglected		Panel cointegration techniques	Infl. Diff. ΔRER CZE: 0.1 – 0.6 0.2 – 0.6 HU: 1.3 – 2.6 2.6 – 3.5 PO: 0.9 – 3.2 3.2 – 1.5 SLK: –0.36 – 0 –0.36 – 0.15 SVN: 0.5 – 1.3 1.0 – 2.2
Égert (2002b) 5 CEE countries vis-à-vis Germany and USA 1991-I to 2001-IV	$\Delta p_N - \Delta p_t$ ΔRER	Industrial sector	Productivity growth of this sector is neglected		Panel cointegration analysis Estimation of a bivariate VECM	ΔRER Panel: 0.63 Individual countries CZE: 0.16 SLK: –0.4 HU: 0.72 SVN: –0.24 PO: 2.33
Blaszkiewicz et al. (2004) 9 CEE countries with respect to the euro area 1995-2003	$\Delta p_N - \Delta p_t$ ΔRER	Two options: *a)* Industry *b)* Industry, agriculture, forestry and fishing	Services		Panel cointegration tests Estimation methods for heterogeneous dynamic panels: FMOLS and PMGE	CPI inflat. ΔRER BU: –0.7 0.31 CZE: 1.0 0.05 EST: 1.8 3.92 HU: 0.9 1.2 LIT: 0.6 1.80 PO: 1.3 1.91 RO: 1.5 1.81 SLK: 0.4 1.81 SVN: 1.1 1.18

TABLE 4.3 (continuation): **Internal and external transmission mechanism and meta-analysis estimations**

Autor(s) countries period	Dependent variable	Tradable sector	Non tradable sector	Other explanatory variables	Estimation method	The BS effect
Kuzmina and Labakovs (2004) Latvia vis-à-vis Sweden, Germany and UK 1996-I to 2003-II	$\Delta p_N - \Delta p_t$ ΔRER	Manufacturing, mining, and quarrying	Services and construction		Cointegration methodology	Internal inflat.: 1-2.8% ΔRER: 0.84-1.76%
Wagner and Hlouskova (2004) 8 CEE countries with respect to the euro area 1993-2001	$\Delta p - \Delta p^*$ ΔRER	Manufacturing, mining and quarrying, electricity, gas and water supply	Construction, real estate and business activity	Real sect. wages (*) Real p. c. GDP (**) Total consumption (*)	Panel cointegration Bootstrapping methods	1994-2001 ΔRER CZE:–0.12 LIT: 0.66 EST: + 0.52 PO: 0.17 HU: –0.20 SVK: –0.50 LAT: + 1.14 SVN: 0.68 Δp CZE: 0.7 LIT: 0.9 EST: 0.2 PO: 0.2 HU: 1.4 SVK: 0.3 LAT: 1.2 SVN: 1.1 Sub-period 2000-2001: Smaller estimates
Égert (2005b) Estonia vis-à-vis FIN, SWE, GER and UK 1993-I to 2002-IV	Δp ΔRER	Manufacturing, agriculture and mining	Public services, energy, construction	Regulated prices (*)	Cointegration tests Descriptive statistics	Good support to BS-1 Impact on inflation: 1% Weak evidence for BS

Meta-analysis estimations of Balassa-Samuelson effects

	CZE	EST	LAT	LIT	HU	PO	SVK	SVN	CEEC's
Internal transmission	2.3	0.2	1.1	3.6	3.1	1.9	1.2	0.8	1.4
External transmission	0.9	0.6	1.0	2.0	1.4	0.9	0.8	1.2	1.1

RER variations around the trend-path induced by demand shocks. In both papers the latter movements are assumed to follow non-linear adjustment. These authors show that the permanent trend component largely dominates the temporary component for each country, although the temporary component is of varying importance across countries. For example, according to the estimates of Arghyrou, Boinet and Martin (2004), for the Czech Republic, an increase of 1% in the potential output differ-

ential—as representative of the BS effect—caused a long-run appreciation in the RER, which is 35 times greater than that originated by an increase of 1% in the cyclical output differential. In Hungary the multiplicative factor was 4, 2, but in Slovakia it reached 112.
As shown in tables 4.1 to 4.3, the vast majority of authors that include demand-side factors in their empirical estimations found that these variables played a significant role, albeit more limited and transitory than supply-side shocks. Moreover, the impact sign of the demand shocks is not unanimous. These results also confirm that real shocks are likely to be far more important than nominal disturbances in driving RER movements in transition countries.

II) Structural transformation and institutional factors. Several proxies have been suggested to capture the influence of these changes on RER appreciation in transition economies, with generally significant results: labour factor reallocation (European Commission, 2002; Jazbek, 2002); real wage appreciation and intersectoral wages (Backé et al., 2002; Kovács, 2003; Lojschova, 2003; Newton College, 2004; Wagner and Houskova, 2004; Wagner, 2005), price deregulation (MacDonald and Wojcik, 2004; Égert et al., 2003; Égert, 2005b) [6]; value added taxes (Kovács, 2003), variations in mark-ups (Kovács, 2003; Zumer, 2002), and commodity price changes (Fischer, 2004; Arratibel, Rodríguez Palenzuela and Timan, 2002). Finally, MacDonald and Ricci (2001) have highlighted the incidence of productivity increases in the distribution sector [7].

III) Some authors intended to explain the evolution of the equilibrium value of the RER using models that combine the BS effect with balance of payments approaches. For instance, Stein (2002) used the NATREX approach to evaluate the impact of EU enlargement on the equilibrium value of the euro, and Smidkova, Barrell and Holland (2003) estimated the equilibrium effective RER of five CEE countries using the fundamental equilibrium real exchange rate (FEER) approach. The simulations of the last authors for the period 1995-2005 showed an increasing trend in FEER of about 5% per annum in the 5 CEE countries included in

6. Price deregulation turns out to be significant because the share of regulated prices in the general price index is still low in the CEEC (between 13 and 24% in the year 2002, according to the estimations of Backé et al., 2002).

7. Since services and retail sector supplies are important in tradable industries, efficiency and productivity improvements in that sector represent an additional channel of price increases in the non tradable sector.

their analysis. However, these results crucially depend on the level of current-account deficit that is assumed sustainable in the long term. Smidkova, Barrell and Holland (2003) considered that a reasonable deficit is 4% of GDP.

Following this general avenue that emphasises the interdependence of several factors, Barrell et al. (2001) simulated the NiGEM macromodel of the IMF to determine the equilibrium exchange rate of the accession countries and the effects that their economic growth would have on the old EU members. They found that in 2001 the Slovenian currency was in equilibrium and that the rest of CEE currencies were somewhat overvalued.

5. Empirical Analysis: Sector Classification, Measurement of Variables and Descriptive Results

5.1. Data sources and sector classification

The data set used in this study consists of quarterly data presented on an annual basis. We calculate productivities of labour, sectoral prices and real exchange rates for the period studied (1995-I to 2004-III). All the series are transformed into natural logarithms, and then converted into indices, with the fourth quarter of the year 1995 being the base. The panel data set covers six New Member States (NMS) of the EU: Czech Republic, Estonia, Latvia, Lithuania, Poland and the Slovak Republic. Although the euro zone would be the appropriate foreign reference for this kind of analysis, we take instead Germany as a benchmark for two reasons: *a)* data for the euro zone are not available at the disaggregation and frequency levels required by our empirical analysis; *b)* all the above countries have substantial economic exchanges with Germany. The source of data for all countries is New Cronos of Eurostat.

In order to calculate productivity and relative prices, it is crucial to correctly classify the economic branches into tradable (open) and non-tradable (sheltered) sectors. The task is not straightforward because no consensus exists on this issue. As stressed by Nuti (2001), it is very difficult to make the distinction since many tradable goods *(T)* are inputs in the non-tradable sector *(N)*. The way followed is frequently conditioned by the availability of data sources. Fortunately, the data base that we use in this work allows us to

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Sections 5 to 7 reproduce some of the results derived in García Solanes; Sancho Portero and Torrejón (2006).

achieve a higher degree of disaggregation and rigour than is commonly obtained in the literature [8].

Following the categories established in the statistics of the United Nations, the tradable sector includes all the tradable economic activities specified in the official statistics, excluding agriculture. As in many other empirical analyses, we exclude agricultural activities from the classification for two broad reasons: *a)* since the share of the agricultural trade of each country with Germany is relatively small, the bulk of exports corresponds to industrial goods; *b)* the exchanged volumes of agricultural goods are biased by the distortions created by the Common Agricultural Policy of the EU-15, and by the protectionist and subsidy policies, which are still in force in the NMS.

The non-tradable sector includes the construction industry and five categories of private services, and excludes public services because of the lack of data on production and/or employment for those activities.

5.2. Price differentials and productivity measurements

We define the relative price of non-tradables with respect to tradables as the ratio of the two corresponding sectoral GDP deflators. To obtain deflator indices we first measured the aggregate production, which, for each sector is the value added *(VA)* taking into account the items *(j)* specified above:

$$VA_i = \sum_j VA_i(j) \qquad i = T, N. \tag{5.1}$$

We measured each added value in both nominal *(CVA)* and real terms *(BVA),* using current prices and the prices of the base year (1995), respectively, and then we calculated the price deflators, P_T and P_N, according to the following expressions:

$$P_i = \frac{CVA_i}{BVA_i} \qquad i = T, N. \tag{5.2}$$

8. The details of previous classifications are explained in Égert (2002a) and García Solanes and Torrejón (2004).

To obtain the average productivities of labour, we first computed total labour employment in each sector, EM_T and EM_N, respectively, according to the following formula:

$$EM_i = \sum_j EM_i(j) \qquad i = T, N. \tag{5.3}$$

Then, we calculated average productivities *(*PRL_T and PRL_N*)* with these expressions:

$$PRL_i = \frac{BVA_i}{EM_i} \qquad i = T, N. \tag{5.4}$$

5.3. Descriptive analysis

As explained above, the BS hypothesis postulates that the currencies of the faster growing countries will tend to appreciate in real terms with respect to the currencies of other, slowly growing economies [9]. To verify this in a simple and descriptive way, graphic A.2 (see the appendix) show the evolution of the difference in GDP growth and the variation of the CPI-based real exchange rate of each individual country with respect to Germany during the period covered by this study, in the NMS group. Dashed lines represent the differences between growth rates (GDIF), whereas solid lines indicate variations in the real exchange rate (RERVAR). Taking into account that, according to our definition, an appreciation of the real exchange rate means a lower value of this variable, we should find that: *a)* a negative correlation between GDIF and RERVAR, in the sense that positive values of the first variable are accompanied by negative values of the second, and *b)* an upward trend in the dashed line should be accompanied by a downward trend in the solid line, and vice versa.

The graph does not allow us to draw clear conclusions. The parallel trajectories of the two lines are as frequent as the divergent ones in almost all countries. The case where the two lines diverge the most is Poland. In order to obtain a more accurate judgment with this descriptive analysis, we regressed RERVAR over GDIF, on the basis of both individual pair of countries and panel data. The OLS results are presented in table 6.1 and confirm our

9. Note that economic growth is usually pushed by innovations and productivity increases in the tradable sector.

first impressions: in all cases, the estimations are not statistically significant, and have a wrong sign in 11 over 14 equations. Consequently, at first sight there is no sign that the complete BS hypothesis holds in the group of countries considered in this study.

TABLE 5.1: Difference in GDP growth and real exchange rate variations with respect to Germany.
$RERVAR_{i,t} = \vartheta_0 + \vartheta_{1,i}\, GDIF_{i,t} + \epsilon_{i,t}$
(1995-IV - 2004-III)

NMS	$\vartheta_{1,i}$
Czech Republic	0.173 (0.73)
Estonia	–0.115 (0.78)
Lithuania	0.650 (0.03)
Latvia	1.634 (0.00)
Poland	1.364 (0.03)
Slovak Republic	0.219 (0.57)
Panel	0.350 (0.02)

* t-values within brackets.

6. Empirical Analysis: Econometric Results

WE apply here recent panel stationary and cointegration techniques to test the two stages of the BS hypothesis in the area under study, since we believe that this methodology, based on pooled observations, increases the reliability of the estimates when the observed period is relatively short. Panel and cross section techniques have already been applied by Halpern and Wyplosz (2001), De Broeck and Slok (2001) and Égert (2002a), among others, in the context of Central and Eastern European transition countries, and by Drine and Rault (2003) and García Solanes and Torrejón (2004) using data from a large group of Latin American countries.

Before performing the cointegration tests, we applied panel unit-root tests to all variables of interest. The empirical results from executing the Levin, Lin and Chu (2002) and Im, Pesaran and Shin (2003) tests suggest that each of the six variables contains one unit root [10], which justifies further investigation into whether the variables maintain the long run relationships derived from our model. In the following lines we apply cointegration tests and estimate the cointegration vectors when justified.

6.1. The first stage of the BS hypothesis. Cointegration tests

According to equation (3.15), we should test the following relationship:

$$dp_{it} = \theta_0 + \theta_T da_{T_{it}} - \theta_N da_{N_{it}} + \varepsilon_{it}. \tag{6.1}$$

However, since the theoretical model postulates that the coefficient of da_N, which stands for $(a_N - a_N^*)$, is equal to minus one, we may include the retriction that $\theta_N = 1$ in our tests and, consequently, estimate the relationship between the composed variable $(dp + da_N)$ and da_T.

10. The results may be obtained from the authors upon request.

By assuming that all panel members share the same parameters (homogeneous model), the relationship to be tested is:

$$(dp + da_N)_{i,t} = \theta_0 + \theta_T\, da_{T_{it}} + \varepsilon_{it}. \qquad (6.2)$$

Given that $\alpha > ß$, the coefficient of a_T should be positive and higher than unity.

Table 6.1 shows the results of the three versions of the Pedroni (1995) test for homogeneous panels (standard, with one constant and with one trend) and one explanatory variable, conducted for the studied group of countries. As can be seen, the null hypothesis that the two variables are not cointegrated can be rejected at 1%, or even at less that 1%, with all of the models considered. Consequently, we cannot reject the idea that there may be one cointegration relationship between the variables *dp*, da_N and da_T for homogeneous panels, which permits us to estimate one homogeneous cointegration vector. The results are presented in table 6.2.

TABLE 6.1: BS-1: Cointegration test with Pedroni (1995) method for homogeneous panels. Restricted model: $(dp + da_N)_{i,t} = \vartheta_0 + \vartheta_T\, da_{T_{it}} + \epsilon_{it}$ (1995-IV - 2004-III)

Statistics	NMS		
	Standard	Constant	Trend
$T\sqrt{N}(\hat{\rho}_{NT} - 1)$	–6.613*	–7.110*	–7.242*
$\sqrt{NT(T-1)}\,(\hat{\rho}_{NT} - 1)$	–6.521*	–7.011*	–7.141*

Notes:

[1] Statistic correspond to the two standardised statistics of the Pedroni (1995) test. They follow atypical left-tail normal distribution.

[2] Level of significance: 1% (*), 5% (**), 10% (***).

[3] Statistics come from the residuals obtained with the OLS estimations.

[4] H_0: there is no cointegration between the two variables.

[5] Cointegration test for one explanatory variable.

To check the robustness of the results, the homogeneous restricted model is estimated by OLS and DOLS (with one and two leads and lags) procedures. We verify that the results are favourable since the *p*-values are very close to zero in all cases; furthermore, the values of $\hat{\theta}_T$ presented in table 6.2 are positive and higher than unity, as specified by the theory. Though the results are statistically significant in all cases, the estimations

obtained with DOLS are more reliable that those provided by OLS because the former are affected by smaller bias. Furthermore, according to the parsimonious principle, DOLS(1) must be selected, which includes one independent term with fixed effects and one lead and lag. It turns out then that the internal inflation is sensitive to the variations in the productivity differential.

TABLE 6.2: BS-1: Estimation of the cointegration vector. Homogeneous restricted model: $(dp + da_N)_{i,t} = \vartheta_0 + \vartheta_T\, da_{T_{i,t}} + \epsilon_{i,t}$ (1995-IV - 2004-III)

	NMS		
	OLS	DOLS(1)	DOLS(2)
$\hat{\vartheta}_N$	1	1	1
$\hat{\vartheta}_T$	1.213	1.256	1.290
	(0.00)	(0.00)	(0.00)
$\bar{R}^2$	0.704	0.919	0.925

Notes:

[1] Figures within parentheses indicate p-values.

[2] OLS estimations were performed with one constant. DOLS(1) and DOLS(2) estimations include one and two leads and lags, respectively.

We now check whether the size of the common parameter $\hat{\theta}_T$ fully satisfies the BS-1 hypothesis in each area, under the restriction $\hat{\theta}_N = 1$. More specifically, let us test the hypothesis:

$$H_0 : \theta_T \geq 1, \qquad H_1 : \theta_T < 1. \tag{6.3}$$

According to the results of the test that we present in table 6.3, we cannot reject the null hypothesis. The values of the *t* statistics shown in the columns one and five—which come from the estimation DOLS(1)—and the corresponding *p*-values for NT-K degrees of freedom, specified under the statistics, do not allow for rejection. Moreover, it can be observed that the confidence intervals at 95% built for the parameter $\hat{\theta}_T$ encompass values that are equal or higher than unity. Thus, the confidence interval is 1.18-1.33. Therefore, there are not reasons to reject the hypothesis that the values of $\hat{\theta}_T$ are equal or higher than unity.

TABLE 6.3: Test of the first part of the BS hypothesis. Homogeneous restricted model: $H_0 : \vartheta_T \geq 1$ $H_1 : \vartheta_T < 1$ (1995-IV - 2004-III)

NMS	t_{NT-K}	H_0 of C.1	CI at 95%	BS-1
NMS	6.38 (0.99)	NRH_0	1.17670 1.33478	*Holds*

Notes:

[1] The values in italics carrespond to the quantiles of the distribution t_{NT-K}.

[2] The values within parentheses are the p-values of the corresponding quantiles.

[3] The test is left tail.

[4] If the null hypothesis H_0: $\vartheta_T \geq 1$ is not rejected, there is no reason to reject the first part of the BS hypothesis, in the context of the homogeneous restricted model.

[5] The intervals of cofidence are built with a coefficient of 95%. The corresponding cells indicate the upward limits in each case.

We may conclude then that the first part of the BS model holds under the restricted model where $\theta_N = 1$ and $\theta_T \geq 1$.

6.2. The second stage of the BS hypothesis. Cointegration tests

As explained above, the PPP hypothesis in the tradable sector is the corner stone of the BS-2. The procedure to verify whether this relationship is satisfied consists of two steps. In the first one, we check for cointegration between the domestic and the German price indices of national tradable sectors, both of them denominated in domestic currency. If cointegration exists, we should subsequently test whether the cointegration vector is not statistically different from [1, 1].

We will consider the homogeneous model, testing the following equation:

$$e_{i,t} = \gamma_0 + \gamma_p \, dp_{T_{it}} + \varepsilon_{it}. \tag{6.4}$$

This equation includes a homogeneity restriction, according to which the coefficients of prices are constrained to be the same values. The rationale is to secure a sufficient number of degrees of freedom. In equation (6.4) the dependent variable is the nominal exchange rate. Although the theoretical framework of the PPP model does not specify which variable should be dependent, in the case of the NMS it seems appropriate to assign this role to the nominal exchange rate because for these countries, during the ob-

served period, flexibility in the exchange rates has been more frequent than strong peg systems. If PPP holds, the two variables of the equation should be cointegrated, and the coefficient γ_p should not be statistically different from unity.

In order to obtain more reliable results, we approximate prices of the tradable sectors by the index of industrial production, which has been calculated on harmonised basis by Eurostat for all countries of our sample since December 2000 [11]. We use the two versions provided by this data base: the index that excludes the prices of energy (IPI), and the index that includes the energy prices (IPI[E]). Our observation for this test relies on monthly data and covers the period going from December 2000 to May 2006.

Table 6.4 shows the Pedroni (1995) cointegration statistics for homogeneous panels. Numbers with bold type represent the results obtained with IPI, and numbers with cursive writing reflect the results calculated with IPI(E). It is apparent that the null hypothesis of non-cointegration cannot be rejected. Consequently, we may not assert that there is a long-term relationship between the prices of tradable goods (industrial products) in the studied panel, which indicates that PPP(T) is not supported by the data of our sample.

TABLE 6.4: Cointegration test of the BS-2 with the Pedroni (1995) method for panel data.
Homogeneous model for NMS: $e_{i,t} = \gamma_0 + \gamma_p \, dp_{T_{i,t}} + \epsilon_{i,t}$
(2000-XII - 2006-V)

Statistics	NMS		
	Standard	Constant	Trend
$T\sqrt{N}(\hat{\rho}_{NT} - 1)$	**1.103**	**0.425**	**0.459**
	1.116	*1.116*	*1.105*
$\sqrt{NT(T-1)}\,(\hat{\rho}_{NT} - 1)$	**1.094**	**0.423**	**0.460**
	1.106	*1.106*	*1.094*

Notes:

[1] The two statistic are standardised, and follow a typical left-tail normal distribution.

[2] Level of significance: 1% (*), 5% (**), 10% (***).

[3] The statistics are obtained from the OLS residuals of three different models.

[4] H_0: there is no cointegration between the two variables.

[5] Cointegration test for one explanatory variable.

11. We performed the same tests with the quarterly series of tradables that we obtained by deflacting the value added in the tradable sector, as explained in section 5. We obtained very similar results to those presented in tables 6.4 and 6.5, which are available upon request.

6.3. The second stage of the BS hypothesis: Unit-root tests

To obtain additional evidence that the RER(T) is not stationary in levels, in a second step we also apply unit root and stationarity tests to both IPI and IPI(E), using three alternative methods. For two of them (Levin, Lin and Chu, 2002; Im, Pesaran and Shin, 2003), the null hypothesis is that each member of the panel has a unit root; for the Hadri (2000) test, the null hypothesis is that each member of the panel is stationary in levels. It is obvious that for a result to be completely reliable, it should simultaneously comply with the verdict derived from each of the three methods.

The results are presented in table 6.5. The common verdict with Levin, Lin and Chu (2002) and Im, Pesaran and Shin (2003) tests is that the null hypothesis is not rejected, which implies that each member in both panels has a unit root. This result fully satisfies that of the Hadri method with a constant, according to which the null of stationarity is clearly rejected at 1% of significance. Furthermore, it agrees with the results of the cointegration test presented in table 6.4. In conclusion, the RER elaborated with IPI does not converge towards a long-run equilibrium value in any country of the sample, which in turn indicates that industrial prices and nominal exchange rates do not support the PPP in the group studied.

TABLE 6.5: Unit root tests applied to the real exchange rate calculated with industrial price indices. (2000-XII - 2006-V)

Statistics	Standard	Constant
Levin, Lin and Chu (t*)	–0.579 *–1.227*	–1.748 *–0.818*
Im, Pesaran and Shin (W)		–0.282 *1.334*
Hadri (Z)		**8.369*** ***11.164***

Notes:

[1] For the Levin and Chu test, the H_0 is: unit root (common unit root process).

[2] For the IPS test, the H_0 is: Unit root (individual unit root process).

[3] For the test of Hadri, the H_0 is: not unit root (individual unit root process).

[4] Level of significance: 1% (*), 5% (**), and 10% (***).

Our empirical results concerning the fulfilment of PPP in some CEE countries go in the same direction as those of Égert (2002b), Égert et al.

(2003), and Blaszkierwicz et al. (2004) obtained applying similar methodologies.

To get a visual impression of these properties, we plot the evolution of the two components of RER(T) for each country in graphic A.3 of the appendix. This graph shows the trajectories of the domestic (solid line) and the German (dashed line) price indices, denominated in the domestic currency of each NMS. As can be seen, the domestic index, P_T, increases more than the German index expressed in domestic currency, EP^*_T, contributing to widen the gap between the two variables during the period of the sample, which implies a continuous appreciation of the RER(T) except in Poland. It seems then that, with the exception of Poland, the RER(T) follows an upward trend in the countries of this area, which excludes reverting to a long-term equilibrium value.

Let us summarise all the results we have obtained so far while testing the BS hypothesis in the area of our sample: 1) The first part of the BS hypothesis is supported by the data of the NMS countries, as a result of their transition and catching-up processes, with respect to Germany. 2) The second part of the BS hypothesis is not satisfied because PPP does not hold in the tradable sector. In fact, national RER(T) exhibit general appreciating trends. In the following section we analyse the likely factors that drive the movements of RER(T) in the NMS group of countries.

7. Beyond the BS Hypothesis: The Real Exchange Rate of Tradable Goods

IF the failure of PPP(T), which is largely documented in many recent empirical works, is not accounted for correctly in the estimations of the complete BS hypothesis, the empirical results will be distorted by the typical omitted variable problem and will not be reliable. The correct way to solve this problem is to add to the estimation equation a variable that conveniently takes into account the permanent variations in the RER(T). However, this procedure requires a previous investigation of the factors that generate these permanent adjustments [12]. While several authors have identified serious departures from PPP in the tradable data of the CEE countries, to our knowledge, there is no paper that goes deeply into the likely sources of the problem. In a survey on the equilibrium exchange rates in transition economies, Égert, Halpern and MacDonald (2005) reflect the same views and suggest analysing the sources of PPP(T) failure as an extension of the standard BS model.

By using the broader framework of the New Open Economy Macroeconomics (NOEM), the external RER can be split into three components [13]:

$$q_T = (\gamma + \gamma^* - 1)\,\tau + (1 - \gamma^*)\,(e + p^*_H - p_H) + (1 - \gamma)\,(e + p^*_F - p_F). \quad (7.1)$$

Where subscripts H and F refer to tradable goods produced in the domestic and foreign country, respectively, and γ (γ^*), is the share of domestic (foreign) tradable goods within the tradable basket of domestic (foreign) consumers. τ stands for the terms of trade, which are defined as:

12. Blaszkiewicz et al. (2004) simply suggest including the log of the external real exchange rate as an additional explanatory variable in the complete BS equation. However, this procedure does not serve to unravel the likely factors that generate permanent adjustments in the RER(T).

13. For a detailed derivation, see García-Solanes, Sancho-Portero and Torrejón (2006). A similar decomposition may be found in Benigno and Thoenissen (2003) and in Lee and Tang (2003).

$$\tau = e + p^*_F - p_H. \tag{7.2}$$

If, as pointed out by Obstfeld and Rogoff (2001), consumers of each country prefer home produced tradables compared to those produced abroad (home bias), both parameters γ, and (γ^*) will be bigger than ½ and the first parenthesis of the equation (7.1) will be unambiguously positive.

As it is apparent in equation (7.1), the tradable-based real exchange rate may appreciate *a)* either because the terms of trade improve (τ decreases) or *b)* because the same traded goods—those produced at home and/or those produced abroad—achieve higher prices in the domestic market than in the foreign one (market segmentation) [14]. In turn, increases in the terms of trade may be due either to improvements in quality of the domestic tradable goods (Cincibuch and Podpiera, 2004) or to productivity increases of the domestic country (Égert, Labrèche-Révil and Lommatzsch, 2004; Benigno and Thoenissen, 2003). While factors *a)* inflict an appreciating trend on the RER(T), which is usually the case in countries experiencing a catching-up process, factors *b)* add volatility to the variations of the RER(T) within two non-arbitrage bands.

The results that we obtained testing the BS-2 lead us to suspect that the determinants of the steady RER(T) appreciation in the NMS group of countries correspond to the *a)* group. To verify this hypothesis, we estimate the following equation, in which the RER(T) is driven by developments in the terms of trade:

$$q_{T_{i,t}} = \delta_0 + \delta_\tau \tau_{i,t} + \upsilon_{i,t}\,. \tag{7.3}$$

The results obtained by applying both OLS and DOLD procedure to the panel data of our sample are presented in table 7.1:

14. Market segmentation may be caused mainly by transportation costs (Rogoff, 1996), non-competition practices, such as *pricing-to-market* behaviour (Krugman, 1987), and non-tariff barriers.

TABLE 7.1: The real exchange rate built with prices of the tradable sector. Homogeneous model: $q_{T_{i,t}} = \delta_0 + \delta_\tau \tau_{i,t} + \upsilon_{i,t}$ (1995-IV - 2004-III)

	NMS		
	OLS	**DOLS(1)**	**DOLS(2)**
$\hat{\delta}_\tau$	1.094	0.838	0.777
	(0.00)	(0.00)	(0.00)
$\bar{R}^2$	0.350	0.853	0.869

Notes:

[1] p-values within brackets.

[2] OLS estimations were performed with a constant. DOLS estimations include one and two leads and lags.

As can be seen, the terms of trade are highly statistically significant and affect the RER(T) with the expected sign. The estimated $\hat{\delta}_\tau$ parameter indicates that a 1% appreciation in the terms of trade causes 0.84% appreciation in the external real exchange rate.

The next step is to ascertain the likely factors that appreciate the terms of trade in the NMS group of countries. Our first candidate is quality improvements in the tradable sector, as suggested by Cincibuch and Podpiera (2004). Indeed, as documented by Filer and Hanousek (2001) and Mikulková and Stavrev (2001), among others, the variety and quality standards of tradable goods have evolved positively since the end of the communist era. During several decades of communist regimes, uniform standards in tradable goods were imposed on domestic consumers who, in addition, were affected by repressed tastes and very low purchasing power. Once these economies started their restructuring process towards market economies at the beginning of the 1990s, the quality of *T* goods increased at the same pace as convergence of GDP made its course. As a result, domestic prices of tradable goods began to increase—and the terms of trade to improve—at the same pace of quality of these goods, converging towards the levels of the EMU countries [15].

Since quality improvements cannot be measured objectively, it is interesting to find appropriate proxies. We suggest the per capita GDP differential on the grounds of two broad considerations. First, this differential reflects broad differences in national productivity, which, as mentioned above,

15. The process is likely to continue in coming years since the quality gap is still wide and the difference in prices is still large. According to the estimations of Maier (2004), by 2004 tradable price levels in these countries were still 50% lower than in the euro area.

also goes with quality improvements. The second reason is the *agents heterogeneity* effect stressed by Helpman (1999), which operates as follows: as wealth increases, the heterogeneity of agents widens and differences in the consumer patterns become more pronounced. This phenomenon requires a new composition in the consumer basket that gives a higher weight to *T* goods in the NMS. Indeed, MacDonald and Wojcik (2004) and Arghyrou, Boinet and Martin(2004) showed that, in the particular case of CEE countries, the expansion of the internal demand, steered by higher levels of income and wealth is not biased towards the demand of services but instead towards the demand for tradable goods. One likely explanation is that the consumers of the CEE countries react in the face of income increases by purchasing this type of goods, after being deprived of qualified tradable goods during several decades of central planning. The result is another bias that improves the terms of trade.

To test econometrically whether RER(T) is led by RID (by the intermediate channel of the terms of trade), we estimate the following equation with panel data of the NMS group:

$$q_{T_{i,t}} = \delta_0 + \delta_y (y - y^*)_{i,t} + \upsilon_{i,t}\,, \tag{7.4}$$

where q_T is the natural log of RER(T), and $(y - y^*)$ is the real income differential, measured as the difference between the natural logs of the real GDP indices of each NMS and Germany. If our hypothesis is correct, the estimated value δ_y should be negative.

The results, for the homogeneous model, in which it is assumed that the coefficient δ_y is the same for each country, are reported in table 7.2.

TABLE 7.2: The real exchange rate built with prices of the tradable sector. Homogeneous model: $q_{T_{i,t}} = \delta_0 + \delta_y (y - y^*)_{i,t} + \upsilon_{i,t}$ (1995-IV - 2004-III)

	NMS		
	OLS	**DOLS(1)**	**DOLS(2)**
δ_y	–1.017	–1.001	–1.082
	(0.00)	(0.00)	(0.00)
$\bar{R}^2$	0.695	0.776	0.807

Notes:

[1] p-values within brackets.

[2] OLS estimations were performed with a constant. DOLS estimations include one and two leads and lags.

We verify that the estimations are highly statistically significant with each of the three methods employed, and that the sign of δ_y is always the expected one. These results show that a one percent increase in the relative income of a NMS country with respect to Germany gives rise to an average appreciation in its RER(T) of approximately the same amount.

An additional proof of our hypothesis consists of estimating the complete BS model that we obtain when (7.3) is introduced in (3.19). Taking into account that the differential of relative prices (the second parenthesis in the equation 3.19) is explained by the productivity differentials between sectors of each country, the econometric model for the homogeneous case will be:

$$q_{i,t} = \delta_0 + \delta_y (y - y^*)_{i,t} + \delta'_a \left[\hat{\theta}_{T,i} (a_T - a^*_T)_{it} - (a_N - a^*_N)_{i,t} \right] + \upsilon_{i,t}, \qquad (7.5)$$

where $\hat{\theta}_{T,i}$ stands for the values that we obtained by estimating the heterogeneous version of the BS-1 model [16]. According to what has been explained in the preceding paragraphs, it is expected that: $\hat{\delta}_a < 0$, $\hat{\delta}_y < 0$.

Table 7.3 shows the results of a panel regression of the CIP-based real exchange rate on the real income and the productivities differentials.

TABLE 7.3: The BS hypothesis without PPP in the tradable sectors. Homogeneous model:
$q_{T_{i,t}} = \delta_0 + \delta_y (y - y^*)_{i,t} + \delta'_a [\hat{\vartheta}_{T,i} (a_T - a^*_T)_{it} - (a_N - a^*_N)_{i,t}] + \upsilon_{i,t}$
(1995-IV - 2004-III)

	NMS		
	OLS	**DOLS(1)**	**DOLS(2)**
$\hat{\delta}_y$	–0.399	–0.531	–0.642
	(0.00)	(0.00)	(0.00)
$\hat{\delta}'_a$	–0.806	–0.738	–0.756
	(0.00)	(0.00)	(0.00)
$\bar{R}^2$	0.394	0.735	0.790

Notes:

[1] p-values between brackets.

[2] OLS estimations were performed with a constant. DOLS estimations include one and two leads and lags.

16. These values come from the cointegration vector of the heterogeneous model. For a detailed derivation and explanation, see García Solanes, Sancho Portero and Torrejón (2006).

As can be seen, the estimated parameters have the expected sign and are highly statistically significant with all three estimation techniques applied. According to the results of table 7.3 obtained with the DOLS(1) procedure, a one percentage point increase in the productivity differential causes an average appreciation in the RER equal to 0.74% in the group of NMS countries.

Summarising, the results indicate that quality is as important as the productivity differential in explaining the remarkable appreciation of the RERs of the CEE countries during the last ten years. The range of values for $\hat{\delta}_a$ gives rise to BS effects that are in line with the recent estimations of the BS external mechanism we surveyed in section 4 of this paper. Indeed, since the difference between productivities increases between the NMS and Germany is close to 2.3% per annum on average during the studied period, it follows that the average BS effect in these countries is around 1.7% per annum.

8. Policy Implications

THE strong real appreciations of the CEE countries' currencies over the last twelve years has led many researchers to estimate the extent to which these real appreciations can be associated to the BS effect. Our estimations show that the BS effect explains only part of the story, because its external adjustment mechanism is affected by the failure of PPP in the open sector. It seems that the appreciation of the tradable-based RER contributes as much as the BS effect to the total appreciation of the RER. Taking into account that the increase in the average productivity differential between the CEE countries and the euro zone is around 2.3 percentage points per annum, the joint contribution of the BS effect and the quality bias to the RER appreciation is around 3.4 percentage points per annum. This steady real appreciation raises two important concerns. The first one is the extent to which it is an equilibrium phenomenon, and the second is the policy dilemma that it inflicts on catching-up countries that hope to participate in the ERM2 and then the EMU.

A far as concerns about equilibrium and sustainability of the RER are concerned, it seems that if appreciations obey productivity growth (BS effect) and quality improvements in tradable goods, they do not threaten international competitiveness, and the external deficit generated during the process will be the result of optimal intertemporal decisions. In other words, the current account deficit will be sustainable. Consequently, these real appreciations should not be counteracted by economic policies. This assessment is reinforced by the fact that the catching-up process has been mainly fed by FDI flows and other capital inflows not subject to sudden future reversals. In fact, these flows have contributed to raise the equilibrium value in the RER of the CEE countries because they have mostly been spent on productive infrastructure and human capital. As CASE (2005) has recently emphasised, in the CEE countries as a whole there has been a strong shift in capital inflows towards technological and capital intensive sectors. During more recent years in particular, FDI flows have been directed towards export-oriented industries. Investors have made important efforts to elaborate new designs and brands, and to improve the quality of the domestically pro-

duced tradable goods. The net result for the RER has been an equilibrium appreciation [17].

Of course, as a natural by-product in this process, FDI flows have also generated pressures in the demand side of the economy. It is clear that they have also contributed to increasing the demand of consumers and to widening the current account deficit. However, given that demand increases in the CEE countries find compensatory current and/or future responses in the supply-side of the economy, it would be misguided to adopt measures to correct them.

Within this general context, accession to the single market has been a positive supply shock that feeds and reinforces the prospects of productive improvements in the CEE countries. All in all, although it is very difficult to precisely judge the nature of RER adjustments in catching-up countries, many signs point to the fact that in the CEE countries they are mostly an equilibrium phenomenon. However, some analysts such as Bulir and Smidkova (2005) consider that, in 2004, the currencies of the three big CEE countries, the Czech Republic, Poland and Hungary, could be somewhat overvalued, a conclusion reached by simulating a multi-country general equilibrium model.

Obviously, as remarked by Begg et al. (2002) and Buiter and Grafe (2002), the danger exists that part of the RER appreciation responds to bubbles unrelated to fundamentals, in which case the economy is subject to the risks of short-term capital flights. But this has much to do with the policy dilemmas that we shall examine in the following paragraphs.

If our estimations are correct, and RER appreciations of around 3.4% per annum are imposed in the coming years by productive factors and positive supply shocks, the immediate question is: to what extent are such appreciations a setback for countries that want to participate in the ERM2? In fact, such real and necessary real appreciations may be accomplished either by incurring higher rates of inflation than the Euro zone partners or by appreciating the nominal exchange rate. In their run-up to monetary integration, the CEE countries therefore face conflicting policy objectives. On the one hand, if they opt to fix the exchange rate adopting, for instance, a currency board with respect to the euro, they will be forced to squeeze inflation under the limit stipulated by the Maastricht Treaty. Their authorities will be obliged to apply restrictive fiscal policies that could push the countries towards economic recession.

17. Benácek, Prokop and Visek (2003) consider that FDI is the main culprit when explaining RER appreciations in transition and catching-up economies.

On the other hand, if the countries adopt flexible exchange rates within the ± 15% band around the central parity with the euro, as permitted by the ERM2, the RER appreciation pressure will be channelled through nominal appreciation. Are the ERM fluctuation fringes sufficiently wide to allow for the BS and other supply side effects? Simulation of productive pressure on the RER points to a total appreciation in the nominal exchange rate of 24.8% over seven years, which, under normal circumstances, might be allowed by the total band (30%). In this sense, the BS effect and the quality bias are unlikely to represent an absolute obstacle if the stay of NMS countries within the ERM2 is not excessively long. Moreover, these real appreciation pressures should diminish as the catching-up process proceeds. However, the bandwidth might not be sufficient if speculative capital inflows suddenly and strongly push the nominal exchange rate outside the bands. Large and volatile capital flows could undermine attempts to meet the exchange rate criteria.

For the reasons explained above, once the decision to participate in the ERM2 will be taken, the CEE countries are advised to enter with the highest flexibility in the exchange rate permitted by the stipulated band (± 15%), except for some very particular cases [18]. Furthermore, it is crucially important that their authorities *a)* choose correctly the year to enter the ERM2, *b)* calculate an appropriate central parity with respect to the euro, and *c)* limit the stay within that system to the required two-year period, which is the minimum interval during which countries are not allowed to adjust the central parity of their currency vis-à-vis the euro. As necessary complements of the exchange rate policy, monetary policy should adopt an inflation target coordinated with the European Central Bank, and domestic governments should implement prudent fiscal policies and create sound budget institutions. Finally, Doyle et al. (2002) also suggest completing price liberalisation and labour-market reforms before joining the ERM2 as a way of minimising subsequent supply shocks.

18. Cincibuch and Vávra (2001) also advise flexible exchange-rate strategies for the NMS countries. García Solanes and María-Dolores Pedrero (2005) analyse the exchange-rate systems that seem most appropriate for each of the NMS of the EU, and the different policy strategies that they should adopt to successfully overcome the monetary integration process. In the case of some small and very open economies such as Estonia, the advised exchange rate arrangement is a fixed peg to the euro within the frame of the ERM2.

9. Conclusions

THE real exchange rates of the New Member States of the EU have experienced strong appreciations against the currencies of the EU countries since the beginning of the 1990's. Many empirical estimations of the Balassa-Samuelson effect in the context of the NMS show that, although the differential of productivities is an important and significant determinant of internal dual inflation (the link that we name BS-1), its power to explain the evolution of the real exchange rate—which is known as the external transmission mechanism of the BSH—is lower than previously stated. The survey of the estimations of the BS effect and of other factors that appreciate the RER in the NMS countries, presented in this paper, document extensively this point.

In order to discover the additional forces that push up the RER in these countries, we have performed independent estimations of each part of the BS hypothesis, using quarterly data of six NMS, and taking Germany as the foreign benchmark. After verifying that the BS model fails in the second step because PPP does not hold in the tradable sector, we focus on the determinants of the external RER, that is, the RER calculated with prices of the tradable sectors as deflators.

The election of the countries of our sample is constrained by the database (New Cronos of Eurostat) used to calculate the variables of interest with a sufficient degree of disaggregation (factor productivities, price indices and real exchange rates at sectoral levels). We apply recent unit root and cointegration tests for panel data, and focus on the period 1995-I to 2004-III. The sample period begins in 1995, purposely omitting several years in which data for the NMS countries were distorted by important transition problems.

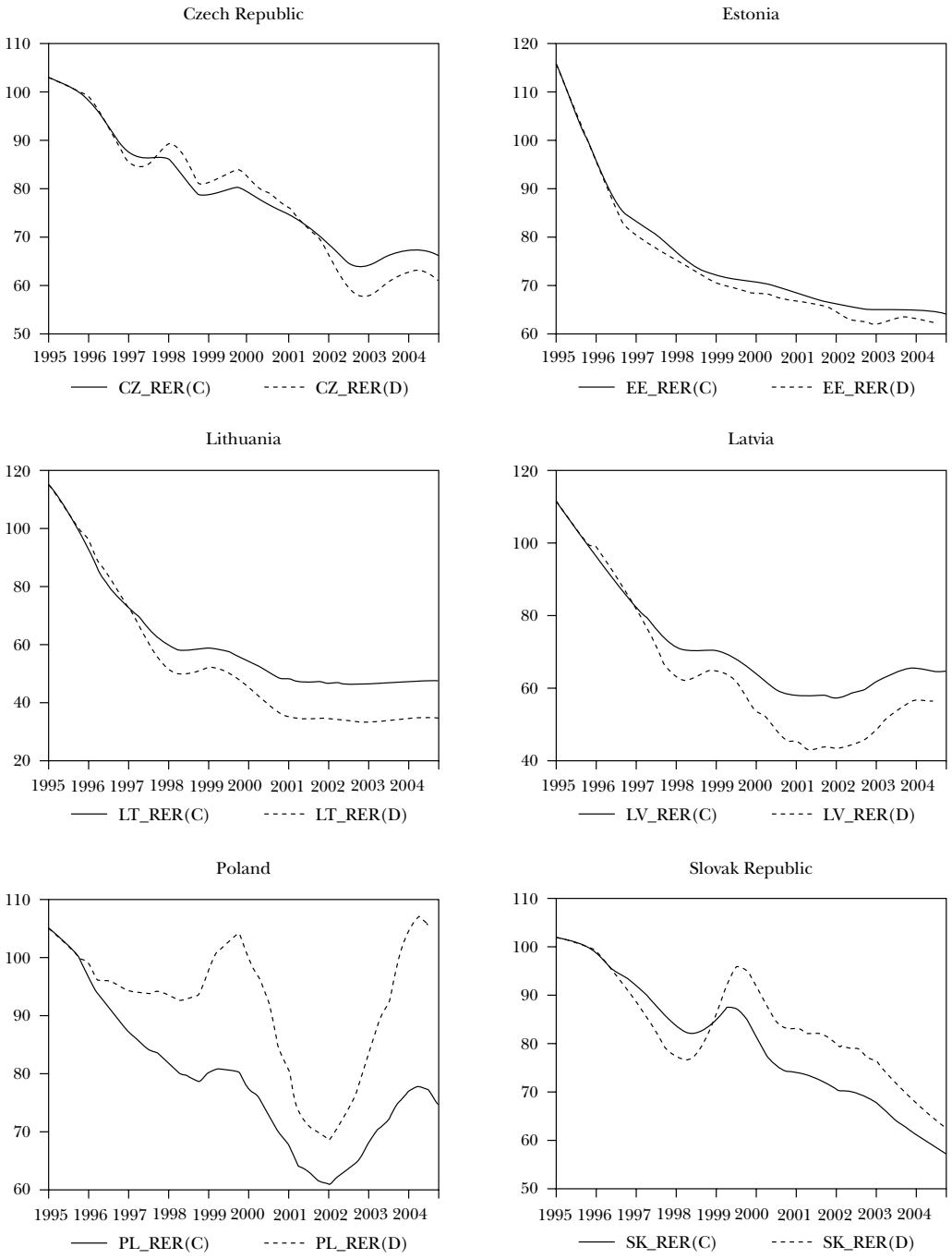
Our main results may be summarised as follows: 1) the first part of the BS hypothesis—which relates the productivities differential with the internal dual inflation—holds very well in the NMS group; 2) however, the second part of the BS model is not fulfilled due to PPP failure in the tradable sectors; 3) the RER(T) clearly follows an upward trend in the NMS countries. It therefore seems that: *a)* the trend appreciation of the external RER in the NMS countries is caused by a continuous improvement in the

quality of their tradable goods, linked to the increase in their general productivity with respect to Germany and the euro area in general.

Our findings suggest two main policy implications. First, RER appreciation in the NMS group as a whole is basically an equilibrium phenomenon, since the explanatory factors are productivity increases and quality improvements in the *T* sector. Overall, the equilibrium level of the RER in the CEE countries increases about 3.5 percent annually as a result of equilibrating forces from the supply-side of the economy. Obviously, this appreciation will lose strength as the quality standards and productivity levels become more similar to those of the most advanced EU countries. Second, taking into account this appreciation, the CEE countries are advised to enter the ERM2 with the maximum exchange rate flexibility permitted by the system, that is, taking advantage of the wide ± 15% stipulated band. Furthermore, they should carefully determine the central parity and limit their stay within the system to the required two-year period, in order to avoid destabilising pressures triggered by short term and reverting capital flows.

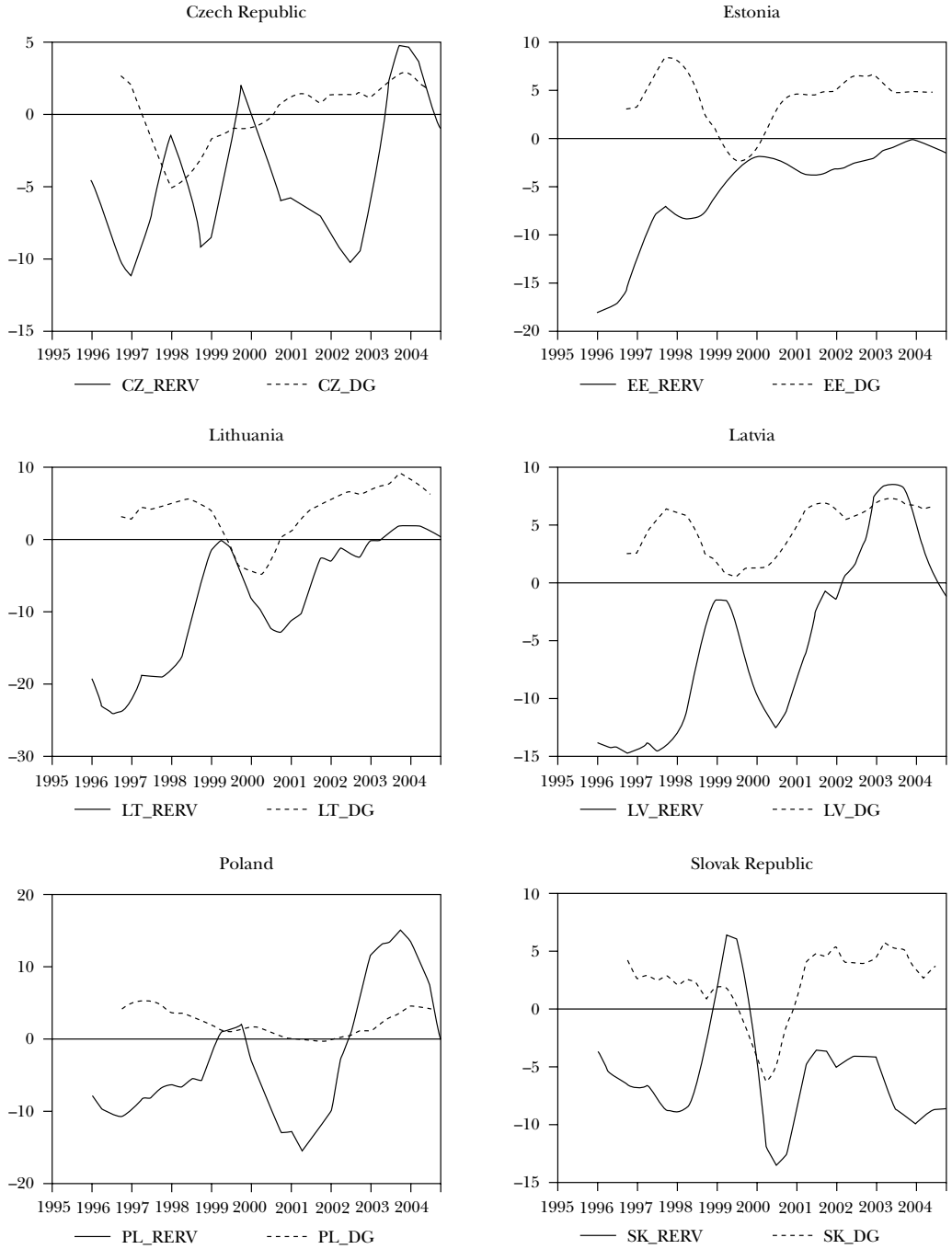
Appendix

GRAPHIC A.1: Real exchange rates (RER[C] and RER[D]) of six New Member States of the EU with respect to Germany (1995-I - 2004-III)

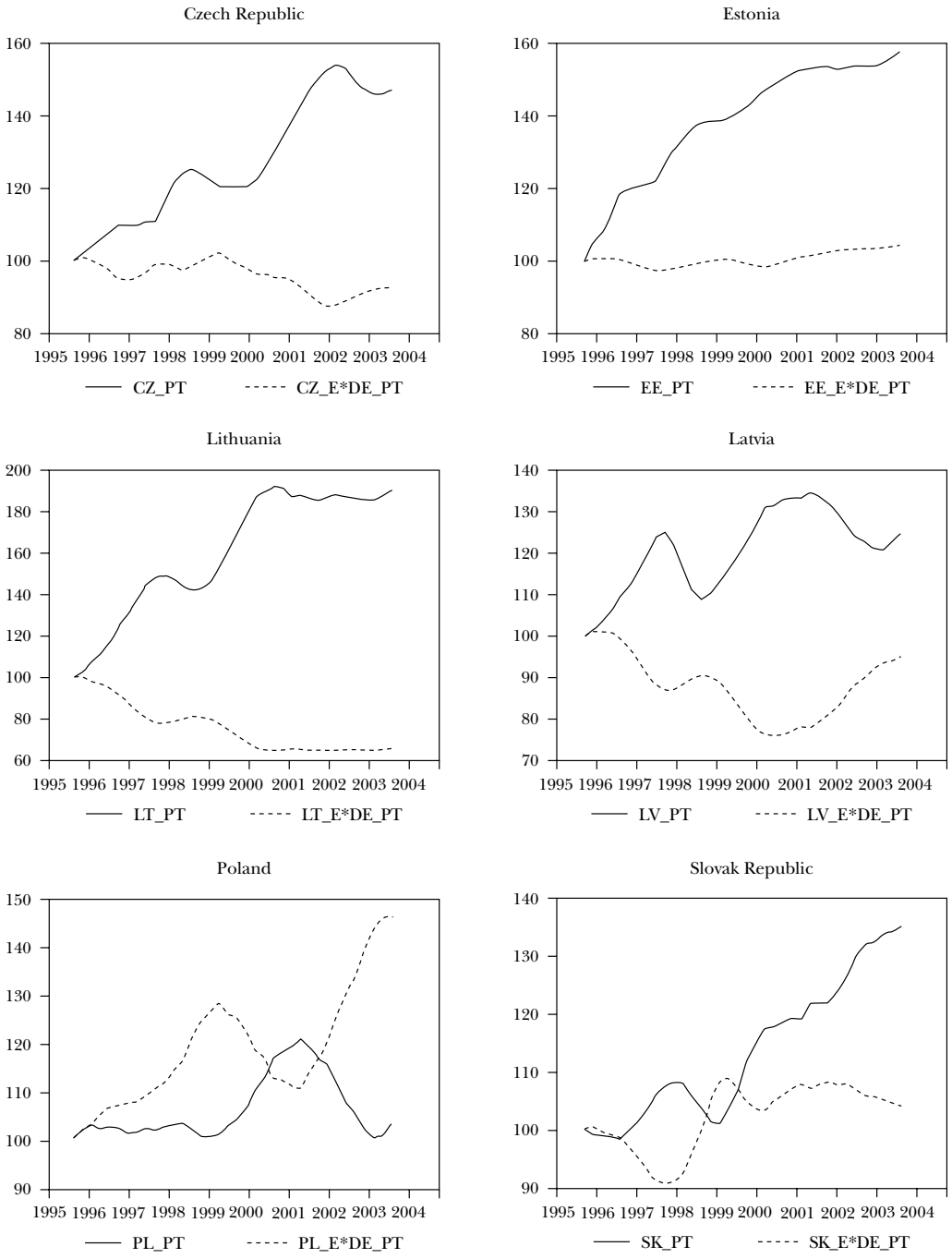


RER(C): Real exchange rate calculated with CPI indices.
RER(D): Real exchange rate calculated with internal demand deflators.

GRAPHIC A.2: Difference in GDP growth (DG) and real exchange rate variations (RERV) with respect to Germany. Six New Member States of the EU (1996-I - 2004-III)



GRAPHIC A.3: Domestic (solid line) and German (dashed line) price indices of tradable goods, denominated in domestic currency, in six New Member States of the EU (1995-I - 2004-III)



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