HOW REAL IS THE FEAR?
INVESTIGATING THE BALASSA-SAMUELSON EFFECT IN CEC5 COUNTRIES IN THE PROSPECT OF EMU ENLARGEMENT

Mihály András Kovács*

Paper to be presented at the conference on
Monetary Strategies for Accession Countries

Budapest, 27–28 February 2003

*Senior Economist, Economics Department MNB

Abstract

The paper presents a simple but comprehensive framework for the evaluation of the Balassa-Samuelson (BS) effect. This framework makes it possible to test the validity of the assumptions of the BS model against real world data, and to disentangle the different sources of relative price movements. Our method is used to give numerical estimates on the BS effect in the CEC5 countries for the 1990s. Other empirical studies are also reviewed, in order to receive a more comprehensive picture of the empirical validity of the BS model.

The results show that the BS effect on CPI inflation in the CEC5 countries has not exceeded 2% per annum vis-à-vis Germany for the past few years. The figures obtained are somewhat different from the actual rates of real appreciation in the countries considered, which confirms our prior view, that the BS effect is only part of the story in the CEC5s. The difference may be ascribed to several other factors as well. First, traded real appreciation has been a persistent trend in most countries, violating relative PPP. Second, other factors, such as changes in sectoral wage rates, pricing behaviour and intermediate product prices, have also contributed to the development of the non-tradable and tradable price ratio. As these estimates are based on a period when the productivity differentials were higher than the current figures, it is very likely that, as the catching-up proceeds, the BS effect will continue to decrease in magnitude. This would suggest that real convergence should not endanger the fulfilment of the Maastricht Treaty inflation criterion.

1. Introduction

Since the opportunity to join the common market has come within reach for the accession countries, economic debate regarding the costs and benefits, and especially timing, of EMU membership has flared up. This debate has been well structured in the sense that most authors agree that, in the longer term, EMU membership is beneficial for both the accession and the majority of current EMU countries. The traditional arguments in this respect are built on the strong trade relations and historical ties between these countries. Furthermore, as most of the accession countries are small open economies, it is also frequently argued that monetary independence and the resulting exchange rate volatility may be damaging for long-term macroeconomic development in the accession area.

Buiter (2000) and Szapáry (2000) and later Buiter and Grafe (2002) came to the conclusion quite early that the earliest possible EMU entry strategy for the accession countries would be highly beneficial, mainly by avoiding unnecessarily volatile capital flows and exchange rates.

Csajbók and Csermely (2002) advocate early EMU membership on a more complex ground, by presenting a detailed cost benefit analysis in terms of GDP gains from EMU membership. They argue that the costs of complying with the Maastricht criteria and giving up monetary independence are temporary, while the gains via a decreasing risk premium and expanding international trade are permanent.

While the 'when' seemed to be more obvious, the 'how' remained very questionable. Most of the authors above and others, including Halpern-Wyplosz (2001) and Hobza (2002), have raised a number of caveats related to the issue of nominal convergence and, more specifically, the real exchange rate.

The traditional argument goes on by saying that due to the equilibrium real appreciation, arising mainly from the BS effect, these countries cannot achieve an EMU consistent inflation level and stable exchange rate at the same time. This may cause problems at least in two respects. First, the equilibrium real appreciation together with disinflationary efforts prior to accession may require nominal appreciation during the ERM2, which may be inconsistent with the exchange rate

corridor. Second, due to the presence of nominal rigidities, the nominal appreciation required for disinflation may cause unnecessary output losses.

Several possible solutions have been proposed to tackle this problem. Buiter (2000) argues in favour of an asymmetric ERM2 band, and a reinterpretation of the inflation criterion of the Maastricht Treaty in terms of tradable price inflation. The argument is further elaborated by Buiter and Grafe (2002), who suggest a flexible treatment of the ERM2 period as was in effect done in the case of Italy, Finland and Greece. By contrast, Szapáry suggests setting the inflation criterion of the Treaty in terms of the average rate of inflation within EMU instead of the average rate of the three countries with the lowest inflation. But even without such a modification one 'solution' could be to have the equilibrium real appreciation in a range complying with the Maastricht Treaty.

Finding the possible rate of equilibrium real appreciation requires at least an assessment of the most prominent factor, the BS effect, in these countries. It is important to note, however, that since the BS effect is a sectoral story, *real convergence* does not inevitably imply a higher *traded-non-traded* productivity differential, i.e. real appreciation.

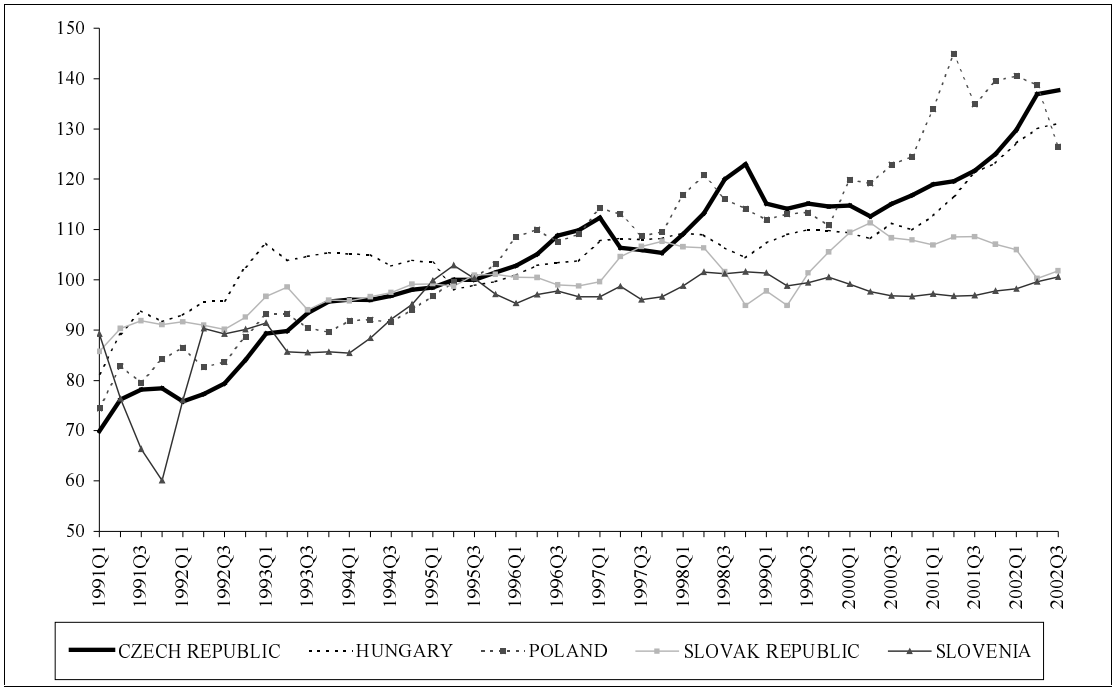
On the other hand, the BS effect was not the only possible factor of real appreciation in these countries, especially in the early years of transition. As is well known in international economics, real exchange rates may reflect persistent trends if a country's underlying fundamentals are changing over time.[1] As rapidly changing economic fundamentals are one of the most important characteristics of transition economies, the assessment of actual exchange rates in relation to some equilibrium value is a really formidable task. As shown by pioneering econometric evidence provided by Halpern and Wyplosz (1997), equilibrium exchange rates are expected to appreciate as transition proceeds. However, it is very difficult to give a precise estimate of the equilibrium rate of real appreciation.

The figures (Figure 1) clearly show the existence of trend appreciation in five Central and Eastern European Countries, such as the Czech Republic, Hungary, Poland, the Slovak Republic and Slovenia (hereinafter CEC5) since the start of the transition. Between 1991 and 2002, all five countries experienced real appreciation in the range of 2% to 6% per annum. It is also obvious that the first half of the nineties was

[1] Williamson (1994).

characterised by much sharper appreciation tendencies than the latter part of the decade. While between 1991 and 1993 real appreciation ranged from 3.6% to 10.3%, after 1993 the annual rate decreased to 0.7%–4.4%.

Figure 1
CPI based real exchange rate levels in the CEC5*
(Real effective indices, 1995=100)



*Sources: IFS, BoS.

The underlying factors of the real appreciation in the two stages of transition were presumably markedly different. Several authors, such as Halpern-Wyplosz (1997), Kovács (1998) and Corricelly and Jazbec (2001), argue that in the early nineties the deregulation of goods and labour markets and financial deepening were the main explanations behind the real appreciation observed. At that time productivity improvements had been modest, in some countries even negative, compared to those in developed countries.

In the late nineties, after a period of successful transition, the CEC5 began to resemble the former catching-up European countries, such as Spain, Portugal or Greece, prior to EU accession. In a recent paper[2] the National Bank of Hungary (MNB) argues that by 2001 Hungary had become in several respects similar to the formerly mentioned

[2] Csajbók and Csermely (2002).

countries, in terms of both nominal and real convergence. Indeed, for almost all of the CEC5 a high share of trade with the EU, and a high share of intra-industry trade, relatively sound legal infrastructure and sustainable financial conditions had been reported.[3]

These advances in their economic system s also meant that more standard channels of real exchange rate determination had started to play a dominant role in the appreciation, with the BS effect playing the most influential role. While the productivity differentials hypothesis seems to be supported by several authors,[4] relatively little focus has been given to other potential explanations. While, in general, the real appreciation may have been associated with productivity improvements within the CEC5 in relation to the developed economies, the productivity differential has much less explanatory power within the CEC5. Table 1 shows that the higher real appreciation was not necessarily associated with the higher sectoral productivity differential at all. For example, the Czech Republic, experiencing the highest annual real appreciation had the smallest productivity differential, while Hungary, the country with the highest productivity improvements, experienced the second smallest real appreciation.

Table 1
Real appreciation and sectoral productivity differentials of the CEC5 vis-à-vis Germany

Annual change (%)	Real appreciation	Productivity	Period Covered
Czech Republic*	4.4	2.4	1994-2001
Hungary**	2.3	6.2	1992-2001
Poland	5.3	na	1995-2001
Slovakia***	4.3	3.3	1995-2001
Slovenia*	1.9	4.1	1992-2001

* CPI excluding regulated prices
** CPI excluding food+ regulated prices
*** Value added deflator

Table 1 suggests that the BS effect is only one aspect of the observable real appreciation within the CEC5. This presentation has been prompted by this proposition. In the paper we attempt to give a simple but comprehensive accounting model for real exchange rate determination. This framework is then employed to decompose real exchange rate movements within the CEC5 countries. Several interesting results emerge from the analysis. First, the BS effect for the CEC5

[3] See for example the more recent EBRD transition reports.
[4] See Égert (2002c) for an extensive overview of the models and test applied in the BS analyses of accession countries.

countries seems to be less than 2% annually, which is of similar magnitude to that estimated by Alberola et al. (1998) for Spain, and Canzoneri et al.(1998) for a few non-core EMU countries, prior to EMU membership. Though not unilaterally, other important determinants of real appreciation have also emerged. First, the CPI-based real appreciation has a high correlation with the tradable-price-based real appreciation, indicating that nominal exchange rate movements play a significant role in the development of the real exchange rate. Second, the BS hypothesis is only one of the explanations for internal real exchange rate movements. In the Czech Republic and Slovakia, non-traded-traded relative wages have increased systematically, thereby reinforcing real appreciation. In the Czech Republic and Slovenia, mark-ups in the traded and non-traded sectors have evolved differently, indicating possibly changing demand elasticity in the markets. Finally, in almost all countries, the CPI-based real appreciation has been influenced by VAT and perhaps commodity price changes.

The paper is set up as follows. Section two discusses the assumptions of the textbook BS model, indicating possible sources of contradiction to real-world observations. Section three summarises empirical research on the BS model regarding both developed and non-developed countries. Section four presents our simple theoretical framework for the analyses. Section five presents the results, and section six offers conclusions.

2. The BS model

Since the publication of the seminal papers of Balassa (1964) and Samuelson (1964), economic policy debate has never been so lively on this academic issue than these days, with particular regard to the link between accession and the Balassa-Samuelson effect.[5] This is not surprising as, on the one hand, EMU membership offers an excellent natural experiment to these countries on the theory of real exchange rate determination during the catch-up process, and, on the other hand, the Maastricht Criterion on inflation gives explicit political relevance to this topic.

[5] A simple proof for the popularity of the Balassa-Samuelson model in accession country analyses. Entering + Balassa + Samuelson + effect in the Google search engine finds 2230 occurrences, while for + Balassa + Samuelson + effect + accession 742. This latter number is very high in relative terms compared with the economic significance of these countries. Anecdotal evidence also indicates that the Balassa-Samuelson effect is mentioned by several daily political newspapers every day, at least in Hungary.

By the mid nineties, the BS model had received formal derivation from several authors.[6] All related papers agree that the BS model relies on the following assumptions:

1. Perfect competition in the goods market
2. Perfect international capital mobility
3. Perfect intranational labour mobility
4. No role for regulation and intermediaries

Perfect competition in the goods market assures that, in the long run, *PPP* holds for traded goods, which implies that only the relative price of non-tradables matters. Perfect intra-national labour mobility assures that *nominal wages* are similar in the traded and non-traded goods sectors of the economy, while perfect international capital mobility determines traded and non-traded *real wages*, i.e. the relative price of non-tradables in the model. Condition four is necessary for the simple decomposition of costs into *wages and capital costs*, so that other costs do not complicate the issue.

Not surprisingly, none of these assumptions seems to be valid in *absolute* terms in the real world. PPP does not seem to be valid in its absolute form at the macro level even for tradable prices. There are several possible explanations for this:[7]

First, tradable price indices usually contain many products which, due to the structure of consumption and production, are not necessarily similar across countries. This causes an *aggregation bias.* This means that even when the LOP holds for every individual good, persistent relative price changes may run contrary to the PPP hypothesis.[8]

Second, there are several possible explanations for the deviations from the LOP for traded goods. In a real-world economy, products are differentiated and produced under monopolistic competition. This means that the same products may vary in price across the different markets, due to *price discrimination* and *adjustment costs*.

[6] See Asea-Mendosa (1994), Obstfeld-Rogoff (1996) and Balvers-Bergstrand (1997).
[7] See Froot and Rogoff (1995) for an excellent review.
[8] Simply the BS hypothesis in itself would cause such persistent relative price changes for a broader price index, but for traded prices one can imagine several other factors, like change in the relative price of agricultural products or other commodities like oil.

Krugman (1987) derives optimal price setting under variable nominal exchange rates for a monopolistically competitive firm. *Pricing to market* means that after a nominal appreciation of the local currency, local import prices of foreign producers increase less than the change in the nominal exchange rate, as under optimal price setting, firms take their decisions taking into account the price elasticity of demand. In the end, this means that exchange rate swings, in large part, are absorbed by the profit margins of companies. However, under monopolistic competition it is not only the exchange rate-induced price adjustment that may contribute to the deviations from the LOP. Changes in consumer preferences may also cause demand elasticity to change, which, via changes in the mark-up, may in turn lead to differing prices in different markets, given the same costs.

Adjustment or menu costs may also explain the deviation from the LOP even in the case of traded goods. If prices are not fully flexible, that is they are only adjusted after certain time intervals, the result may be a temporary deviation from the LOP. In the NOEM literature, Gali and Monacelli (2002), Smets and Wouters (2002) use models which can produce highly persistent deviations from the LOP. Using a Calvo (1983) type of price setting, the persistence in the deviation depends on the probability of individual price changes over a certain time period.

At first sight, perfect *capital mobility* seems to be the closest to the theoretical model, although country and exchange rate risks create a heavily segmented international capital market. In chapter seven of Obstfeld and Rogoff (1996) a simple model is presented showing how credit market imperfections may slacken convergence of capital /labour ratios. *Labour mobility* is also far from perfect within national economies, due both to the high costs incurred in transferring skilled labour between sectors and to labour market regulations.

Intermediaries may also have a very strong influence on the validity of the BS hypothesis. In the real world production process, it is not only wages and capital costs that determine total production costs, as imported or intermediate products may also play a major role. Shocks to the price of highly volatile commodities, especially oil, may induce trend change in relative prices without any relationship with traded and non-traded productivity. Although in a market economy *administrative prices* cannot substantially deviate from the market level in the long run, government regulation

[9] See Rogoff (1996).

may have a very persistent effect on government prices. As the latter constitute a substantial share in the CPI,[10] this might also distort the analysis of the BS effect.

3. Empirical results regarding the BS effect

In a formal examination of the empirical relevance of the BS effect, Balassa (1964) first regressed the real exchange rate on productivity in a cross section of twelve industrial countries, and found strong evidence in support of the hypothesis. The conclusion was confirmed in a similar regression by Balassa (1973). By contrast, Officer (1976) obtained much less favourable results. Officer argues that Balassa's results are extremely sensitive to the year chosen and the countries included.

More recent evidence on comparable national price levels is more conclusive about Officer's view. Using the Summers and Heston ICP database,[11] Rogoff (1996) concludes that a scatter plot of GDP per capita and real exchange rates shows developed and less developed countries as separated into two clubs. While investigating the whole sample there seems to be a positive relationship between the two variable concepts, the correlation disappears within developed and non-developed economies. However, this is not the only shortcoming of the early regressions presented above. As it is readily obvious from the theoretical models of the BS effect, the model cannot necessarily predict the link between *aggregate* productivity and the real exchange rate. It simply requires that productivity should grow more in the traded sectors of the catch-up countries than in the non-traded sectors, compared to the corresponding sectors of richer countries. Consequently, the BS effect may be associated in principle with both rising and falling *aggregate* productivity, compared to a richer country.

This also means that the ‘correct’ test of the BS hypothesis would require sectoral data for productivity. Nevertheless, this is still not the end of the story. From the previous section it becomes clear that a correct scientific testing of the BS hypothesis would require simultaneous testing of the four assumptions listed on page 8. Although there have been an increasing number of attempts, especially since the nineties, to test the BS effect in the sectoral context, relatively few papers have endeavoured to assess all the assumptions of the model simultaneously. In the following review of the

[10] It is around 20% of the CPI in Hungary.
[11] See Summers and Heston (1991).

literature, we will divide our discussion into developed and non-developed economy regressions for two main reasons. First, as already mentioned, the empirical validity of the BS model seems to be strikingly dependent on the country group considered. Second, in view of the high persistence of real exchange rate movements, the considerably longer data series available for the developed economies may generate different results from those relevant to the non-developed economies.

3.1. Empirical results in developed economies

Among the first papers to test the BS hypothesis as a sectoral story was Hsieh's (1982). The author ran sectoral time series regressions on German and Japanese real exchange rates vis-à-vis the US dollar. The explanatory variables employed were sectoral productivity and aggregate wages. The significance of productivity terms was established, though, as pointed out by Froot and Rogoff (1995), the inclusion of the ULC-based real exchange rate on the right hand side of the regression may have induced instability problems. Marston (1987) used OECD sectoral output and employment data to construct non-traded and traded productivity series, arguing that the sectoral productivity might provide a good explanation of the real appreciation of the yen against the US dollar during the seventies.

Asea and Mendosa (1994) formalised a two country neo-classical growth model so as to derive two key propositions of the BS model, i.e. non-tradable relative prices may be explained by productivity differentials, whereas deviations from PPP can also explained by trend movements in non-tradable relative prices. Using the long-term trend of OECD sectoral data, the authors found that while productivity differentials provided a good explanation of trend changes in the relative price of non-tradables, deviations from PPP cannot be linked to the former.

Similarly, using sectoral OECD data for the period between 1970 and 1985, De Gregorio et al. (1994) provided evidence on trend changes in non-traded-traded relative prices. However, compared to Asea and Mendoza (1994), they also controlled some possible demand side factors at various time horizons. Their results indicated that in the short run demand side factors seemed to be much more important in explaining relative prices, while long-term regressions leave room in the explanation only for TFP factors.

Canzoneri et al. (1998) sought to assess the possible relevance of dual inflation in EU countries from the early seventies to the early nineties. The paper intended to assess the feasibility of the Maastricht criterion in high-inflation EU countries. Several important conclusions have emerged from their analyses. First, Canzoneri et al. argued that the ratio of relative labour productivity to prices exhibited mean reversion. This means that the sectors studied might have been aptly described by a certain class of production functions and relative wages and that mark-ups did not play a long-term role in changing relative prices of non-tradables. Second, in contrast to Asea and Mendosa (1994), they concluded that PPP seemed to be valid in the traded sector for all of the European countries studied. The two results combined fully substantiated the BS hypothesis for EU countries.

A similar investigation was presented in a study by Alberola et al. (1998), with slightly different conclusions, though. Using various lengths of data periods leading to 1995 in eight of the EMU countries, the productivity hypothesis was tested for non-tradable relative prices. The results revealed that though there seemed to exist a long-term relationship between relative prices and productivity, the coefficients estimated were nowhere near what this theory would have required. However, if controlling for the changes in sectoral wages, estimates were closer to the expected theoretical relationship. Thus, in contrast with the Canzoneri paper, Alberola et al. argued that European data contradicted the labour mobility assumption of the BS hypothesis.

In their most recent paper Macdonald and Ricci (2001) further expanded the original BS model by endowing the distribution sector with an explicit role. Having used annual data pertaining to the period between 1970 and 1992 in ten developed economies, the authors established the significance of the productivity of the distribution sectors on the real exchange rate. Surprisingly, however, the estimated relationship suggested that any increase in productivity induced real exchange rate appreciation, similarly to what was the case in the traded sector. Macdonald and Ricci (2001) argue that this phenomenon may be explained by important services and retail sector supplies to the traded sector.

3.2. Empirical results in non-developed economies

Of non-developed economies, the 'wave' of empirical research on the BS model first reached *Southeast Asian* economies, which is hardly surprising as following the publication of Marston's paper on Japan (1987), it was safe to assume that the real exchange rate could be explained satisfactorily by productivity in fast-growing Asian countries. Using sectoral data in the APEC region, Takatosi et al. (1996) decomposed the real exchange rate movements into the external and internal components of real exchange rates. The conclusions of the paper were similar to those of Asea and Mendoza's (1994) in the sense that productivity provided a good explanation of trend changes in non-tradable prices; however, PPP for traded goods seemed to be strongly rejected by the data. Actually, a considerable part of real appreciation detectable in these countries was attributable to the real appreciation of the traded real exchange rate rather than to fast sectoral productivity growth.

Using a co-integration approach, Wu (1996) sought to explain the trend appreciation of the Taiwanese against the US dollar in the eighties. Relying on impulse response analyses, Wu argued that both changes in the nominal exchange rate and relative productivity exerted permanent effects on the real exchange rate. It was also found that the role of unit labour cost was significant. Finally, Wu arrived at the conclusion that while the productivity differential would have depreciated the Taiwanese currency, this was more than offset by nominal appreciation and increase in unit labour costs, which in turn caused real appreciation. This result clearly rejected the predictions of the BS model as far as traded PPP and labour mobility were concerned.

Using sectoral data for nine Asian countries, Chinn (1998) arrived at a similar conclusion. The explanatory power concerning non-tradable relative prices of productivity was firmly established. Likewise, the high persistence of traded real exchange rate movements was also identified. Interestingly, Chinn also found that the real price of oil had significant explanatory power in several countries.

And finally, due to the high real appreciation observed, and with respect to prospective EU and EMU membership, literature on BS has also reached *transition economies*. This again was a safe bet as substantial real appreciation has been experienced in most of these countries since the early nineties. However, as already mentioned, the issue is even more complex in this case than in the countries mentioned above. As the process of transition generated significant changes in

relative prices in almost all sectors of the economy, though with increasing importance, the productivity hypothesis seemed to be only one side of the coin.

In our view, as far as these countries are concerned, literature is of two kinds. Mainly due to the lack of data valid for a sufficiently long time sequence, one type of such literature is on the regressions that were run on whole economy aggregates. Using a selection of usually aggregate explanatory variables including aggregate productivity, Halpern-Wyplosz (1997, 1999) produced estimates of manufacturing dollar wage equations in 80 countries. The significance of increasing aggregate productivity pertaining to dollar wages was established, and the results also indicated that real appreciation could be associated with several transitional factors such as financial deepening and goods and labour market deregulation. The authors also argued that the real appreciation detected was also the result of the initial under-valuation of the currencies in the countries concerned relative to their long-term equilibrium value.

Krajnyák and Zettelmeyer (1997) used panel techniques to estimate the regression equation of a similar form. When the countries affected were decomposed with respect to the various regions in these countries, it was found that the equilibrium real exchange rate appreciated in the most advanced CEEs, while it remained relatively flat for most of the CIS countries. The study also concluded that real exchange rates had been substantially below the estimated equilibrium rate in most of the countries studied even in 1996. Nevertheless, as the time series horizon of the data was very short, and the standard errors of the equations were so large in both studies, it would be hard to find any statistically significant under- or over-valuation of real exchange rates.

Also dealing with the aggregate level, De Broeck and Slok (2001) estimated whole-economy real exchange rate equation for several CEE and Baltic countries for the period between 1993 and 1998. Their results suggested that a substantial portion of real appreciation might be explained on the basis of productivity gains in EU accession countries. By contrast, productivity gains were not obvious in the case of former CIS countries. The paper also presented the cross-sectional regression of the aggregate real exchange rate and productivity in 1999 for a large number of non-transition countries. The elasticities thus obtained implied 1 per cent catch-up results in 0.4 per cent real appreciation. This regression was also used to illustrate real exchange rate movements in these countries between 1993 and 1999. A general pattern was outlined in the analyses, namely that EU accession countries had

completed initial under-valuation by convergence in per capita GDP; however, in case of the rest of the countries, declining under-valuation was associated with declining per capita GDP.

Darvas (2001) employed state space models to estimate equilibrium exchange rate models as well as the exchange rate pass-through simultaneously and separately for four accession countries. Explanatory variables included aggregate productivity in some cases, and sectoral productivity in others. In addition to productivity, several other variables like net assets, terms of trade and the real interest rate were also included in the regressions. The results indicated that sectoral productivity movements had relatively modest transmission into equilibrium real exchange rates in Hungary and Slovenia, however, more significant coefficients were found in the case of the Czech Republic and Poland on the aggregate level. At the same time, the significance of other explanatory variables remained largely controversial.

Dubravko (2001) explained relative inflation equations with sectoral productivity differentials in six CEE accession countries. The significance of the productivity differential was again supported, though the author argued that productivity gains alone were unable to fully explain the inflation differential vis-à-vis that in Euroland.

Given that longer sectoral time series has become available for researchers, the more recent literature pursued sectoral investigations on non-traded-traded relative prices. A higher level of disaggregation provided an excellent opportunity to tackle the hypotheses of the BS model separately, not fully comprehensively, though.

Using simple statistical methods, Kovács and Simon (1998) assessed the importance of internal and external movements in the real exchange rate in Hungary based on the sectoral decomposition of SNA data. Their results indicated that sectoral productivity differentials had excellent explanatory power in the real appreciation of the forint, which was partially offset by the real depreciation of the traded real exchange rate.

Jakab and Kovács (1999) used a simple two sector, small open economy model to derive identification restrictions in the SVAR model of the Hungarian real exchange rate. Using these restrictions, they isolated various shocks from real exchange rate fluctuations in Hungary during the period between 1991 and 1998. The primary importance of productivity shocks for non-tradable relative prices was established ; as far as the traded real exchange rate was concerned, it was tradable supply shocks that played the most prominent role.

Rother (2000) ran dynamic time series regressions for Slovenia in the period between 1993 and 1998. Besides sectoral productivity variables, the effect of monetary and fiscal policies was also examined. The results indicated that in the short run government policies might have had significant impact on the relative price of non-tradables to tradables. In the long run, however, these effects phased out, and productivity-related explanations were able to fully underpin relative price changes.

Halpern and Wyplosz (2001) estimated a simple system of equations pertaining to nine accession countries in order to test the relationship between FDI and productivity, wages as well as relative prices. The results indicated that FDI had significant impact on productivity, which induced/resulted in/brought about an increase in real product wages. According to their argument, this might cause the services to industrial goods ratio to increase. Though it seems clear that FDI increases productivity on a general ground, when it came to the estimated elasticity and the sectoral composition of FDI, it was much less clear whether it was the inflow of FDI that had caused a traded-non-traded productivity gap. Nevertheless, the estimated service to industrial goods price regression supports the view that increased industrial productivity increases service prices compared to industrial goods prices.

Coricelly and Jazbec (2001) decomposed non-traded-traded relative price differentials applicable to several accession countries into different structural components. The decomposition revealed that, while the first phase of transition the process had been dominated by special factors such as the deregulation of goods and labour markets, in the second, more recent period the productivity channel started to gain importance. Jazbec (2002) employed former framework so as to give an estimate of the BS effect in Slovenia.

In a series of papers, Égert et al. (2001), Égert et al. (2002) and Égert (2002a, 2002b, 2002c) tested both the role of non-tradable prices in real exchange rate movements and that of productivity in explaining non-traded versus traded inflation. Using time series and panel co-integration methods, the author, similarly to others (Kovács-Simon (1998), Jakab-Kovács (1999), Darvas(2001), Dubravko (2001)), found that sectoral productivity growth was able to acquire good explanatory power for the relative price of non-tradables. The link between relative non-traded prices and the real exchange rate was, however, much less unambiguous. Égert et al. (2002) explained this result with persistent traded price-based real exchange rate movements,

the low share of non-tradables in accession country CPIs and the role of regulated and food prices in the index.

When the aforementioned empirical efforts are summarised, several general tendencies emerge. First, sectoral productivity gains have explained non-traded-traded relative prices relatively successfully. Second, a few studies have confirmed the significance of relative wages in explaining real appreciation. Third, persistent deviations in the traded real exchange rate have also been observed. And, last but not least, intermediate prices, e.g. the real price of oil, and government regulations have also influenced the real exchange rate significantly.

4. Our accounting framework

The foregoing observations question the simultaneous validity of the four key assumptions of the BS model presented on page 8. Given these differences between theory and empirical results, it is tempting to use a relatively comprehensive framework for assessing the deviations from the various assumption of the BS model simultaneously. To the best of our knowledge, such a test has not been performed so far either for developed economies or accession countries. In this section we present our simple, but comprehensive framework used for evaluating these problems.

The real exchange rate between two countries can be decomposed into two main components: [12] the relative prices of tradables between the countries involved and the relative non-tradables to tradables price ratio between the two countries. For the purposes of simplicity, in what follows, we refer to them as external and internal real exchange rates:[13]

[12] The decomposition of equation (1) had been developed by Isard and Symansky (1996) and Kovács and Simon (1998).
[13] Kovács and Simon (1998).

$$RER = \frac{P}{EP^*} = \frac{1}{E}\left(\frac{P_T}{P_T^*}\right)^{a}\left(\frac{P_N}{P_N^*}\right)^{1-a} = \left(\frac{P_T}{EP_T^*}\right)\cdot\left(\frac{P_N / P_T}{P_N^* / P_T^*}\right)^{1-a} \quad (1)$$

where[14]

RER is the CPI-based real exchange rate,

E is the nominal exchange rate (home/foreign),

P^*_T, P_T are CPI tradable prices abroad and at home,

P^*_N, P_N are CPI non-tradable prices abroad and at home and

α is the share of tradables in the CPI.

The external exchange rate is usually dominated by nominal exchange rate movements and is stable in the long run.[15] It is a well-known fact that the BS effect is closely related to the internal real exchange rate – differences in productivity developments in the two sectors are translated into a trend increase in non-tradable-tradable relative prices.

In terms of price setting, the usual assumption is applied, namely that prices are set as a mark-up over unit labour costs.[16] However, this formula assumes that the role of intermediaries is negligible in the period examined. This is clearly not the case in transition economies, where the entire structure of production changes continuously, and the ratio of intermediate products to value added prices may contain significant trends. For this reason, we cannot neglect the role of intermediaries. Rather than explicitly modelling price setting with intermediaries, we simply assume that there is a term called 'the other factor' that can capture the difference between value-added deflators and final (CPI) prices. Consequently, this term also reflects the effect of indirect tax changes. We can formalise our previous statements in the following equations:

The ratio of non-tradable to tradable value-added deflators is determined by the usual pricing formula:

$$\frac{P_N^{VA}}{P_T^{VA}} = \frac{m_N}{m_T}\,\frac{W_N / PROD_N}{W_T / PROD_T} \quad (2)$$

[14] As can be seen, in (1) we assume that the composition of the CPI basket is similar both abroad and at home. Although empirically CPI weights vary from country to country, the magnitude of differences is not large; thus, we can use this simplification without losing too much information.

[15] See Rogoff (1996).

where

P_N^{VA}, P_T^{VA} are value-added deflators in non-tradables and tradables

m_N, m_T are mark-ups in non-tradables and tradables

W_N, W_T are wage rates in non-tradables and tradables

$PROD_N$, $PROD_T$ are labour productivity rates in non-tradables and tradables.

The difference between CPI prices and value-added deflators can be straightforwardly captured by what is called the 'other' multiplicative factors.

$$\frac{P_N}{P_T} = \frac{o_N}{o_T} \frac{P_N^{VA}}{P_T^{VA}} \tag{3}$$

where

o_N, o_T are other effects in non-tradables and tradables.

Combining (1) with (2), the following formula for CPI prices can be obtained:

$$\frac{P_N}{P_T} = \frac{o_N}{o_T} \frac{m_N}{m_T} \frac{W_N / PROD_N}{W_T / PROD_T} \tag{4}$$

We assume that similar equations are valid both abroad and at home.

From (4) it is clear that changes in the internal exchange rate are driven by four main factors of non-tradables to tradables:

- changes in the difference between relative *value-added prices and CPI prices*,
- changes in relative *mark-ups*,
- changes in relative *wages* and
- changes in relative *productivity*.

Of these four factors, only *the fourth is the BS effect* in a strict sense.[17]

[16] This formula can be derived under mild theoretical assumptions. See Varian (1992).

[17] In a strict sense, the BS effect is related to total factor productivity, which may deviate from labour productivity owing to changes in capital intensity. Due to lack of capital stock data, we use labour productivity measures. However, as the capital intensity of the CEC5 keeps increasing during the catch-up period, by adopting this methodology we may overestimate the BS effect.

5. Evidence

The simple accounting framework presented above was computed for the CEC5 countries by Central Bank experts as a joint research project. The results of the project have already been published in the NBH and BSI working paper series;[18] we use the results as inputs in our discussion. While basically the same the methodological framework was used for each country, some more room was left for individual experts in respect of the calculation. This means that, although we did not systematically rely on the same sources of data, the concept nevertheless was maintained.

The manner in which data periods were selected was the sole discretion of country experts, so that both data availability and economic relevance could be achieved. The period analysed was also been divided into early and late transition phases, so that structural stability in the study patterns could be detected. We opted for Germany as a benchmark, in order to assess real appreciation due to the BS effect in the five countries. Either the EU or Euroland could have also been used; however, no detailed productivity and price series were readily available for such aggregates. Our choice of Germany meant that we did not lose too much information, Germany being the largest economy in the EU and also the most important trading partner of CEC5.

We adopted a methodology similar to the one applied by Kovács and Simon (1998). Manufacturing was classified as a tradable sector, whereas non-tradables were defined as the sum of the following categories: market services, construction, retail trade, transport and telecommunication. The state sector was excluded from the analyses for two main reasons. First, prices in this sector are largely distorted by the discretionary policies of the individual governments. Second, the measurement of output in the state sector was based on artificial assumptions about productivity, rather than on observing real output. Energy and agriculture were also excluded, as the role of government in determining prices was non-negligible in both cases.

Table 2 shows the results of the decomposition for Equation (1). Two sub-groups can be observed in the CEC5 countries. While Hungary and Slovenia experienced very modest real appreciation, annual real appreciation in the other three countries, namely the Czech Republic, Poland and Slovakia, was around 4%–5%. As concerns the

[18] See Kovács et al. (2002) and Zumer (2002).

importance of external and internal real exchange rates, dispersion was even more accentuated in these countries. In the Czech Republic and Slovakia, the bulk of real appreciation occurred through an external component, while in Poland and Slovenia it was internal real appreciation which proved to be the most significant. The situation seems to have been the most balanced in Hungary, where internal real appreciation was slightly higher than external appreciation.

Table 2

Decomposition of the CPI-based real exchange rate

Annual change (%)	Total	External	Internal	Period Covered
The Czech Republic*	4.4	2.8	1.6	1994-2001
Hungary**	2.3	1.0	1.5	1992-2001
Poland	5.3	1.6	3.7	1995-2001
Slovakia***	4.3	2.7	1.8	1995-2001
Slovenia*	1.9	0.4	0.9	1992-2001
* CPI excluding regulated prices				
** CPI excluding food+ regulated prices				
*** Value added deflator				

It is tempting to argue that internal real appreciation in these countries accounted for the size of the BS effect, which stood at 1%–2% in most cases, except Poland, where it was close to an annual rate of 4%. However, Equation (4) makes it clear that some further refinement is required – the role of relative mark-ups, wages and intermediaries should also be considered, in addition to productivity.

Table 3 contains a more detailed description of the non-traded-traded relative price ratio.[19] In the next few paragraphs, we briefly summarise the results for the individual countries.

Table 3

Components of the non-traded/traded relative price ratio

Annual change (%)	Prices (CPI)	Productivity	Wages	Markups	Other	Period covered
Czech Republic*	5.8	2.4	2.3	-3.0	4.1	1994-2001
Hungary**	5.2	6.2	-0.2	-0.3	-0.4	1992-2001
Slovakia***	3.3*	3.3	1.9	na	na	1995-2000
Slovenia*	6.8	4.1	-0.7	0.1	3.2	1992-2001
* CPI excluding regulated prices						
** CPI excluding food+ regulated prices						
*** Value added deflator						

Compared with variations in productivity, the other factors seem to have had more explanatory power in the *Czech Republic*. The most dominant change in other factors was modifications to VAT in 1997. While productivity accounted for less than half of

[19] Unfortunately, the Polish contributors did not complete this decomposition in the project, while the Slovakian co-author carried out only a certain part of the analyses below.

the relative price changes, relative wages also changed substantially, and mark-ups in the non-traded sectors declined compared with the traded sectors. The decline in relative non-tradable mark-ups may in part represent cyclical behaviour, but the effect of the micro level restructuring after 1997 also needs consideration. A simultaneous increase in relative wages can offer some evidence of the adverse BS effect.[20]

A glance at the results reveals that *Hungary* seems to approximate the theory predicted by the BS model the best. Relative productivity movements explain relative price movements quite well, while the effect of wage mark-ups and other factors seems to be of very modest importance. In our view, the presence of the BS effect in such a textbook form in Hungary can be explained by the crawling peg exchange rate regime maintained for a 6-year period between 1995 and 2001. Predictable currency depreciation within the system enabled producers to set prices less erroneously than in regimes with nominal exchange rate volatility. At the same time, the crawling peg regime also gave wage-setting policies some sort of nominal anchor.[21] These results provided for the possibility of smooth variations in both the price-setting behaviour and productivity of companies, although at the cost of higher inflation.

Improved productivity was instrumental in relative price changes in *Slovakia*, where productivity and relative prices actually increased one for one. Relative wages rose by approximately 1.9% annually, which must have been offset by mark-up and other effects. The relative wage increased again which as in the case of the Czech Republic might indicate some adverse BS effect.

Relative price changes were the most marked in Slovenia; and the bulk of the increase can be explained by improved productivity. Other factors also played a dominant role, while the importance of wages and mark-ups was negligible.

[20] Compared with the original BS model, productivity price relationship in the adverse BS effect works in the opposite direction. Thus, increased demand for services pushes up non-tradable wages, which, through labour mobility, forces the traded sector to increase productivity. See Grafe-Wyplosz (1997).
[21] See Kovács (1998).

Table 4
Components of the non-traded-traded price ratio in two sub-periods

	Prices (CPI)	Productivity	Wages	Markups	Other	Period covered
Czech Republic*	5.8	6.8	4.7	-5.0	-0.3	1994-1997
Hungary**	5.3	6.6	-0.1	-0.1	-1.0	1992-1995
Slovenia*	12.6	1.2	0.2	3.2	7.7	1992-1995
	Prices (CPI)	Productivity	Wages	Markups	Other	Period covered
Czech Republic*	5.8	-2.5	2.1	-0.2	6.5	1998-2001
Hungary**	5.1	5.8	0.1	-0.2	0.1	1996-2001
Slovenia*	2.4	6.5	-1.4	-2.2	-0.3	1996-2001

* CPI excluding regulated prices
** CPI excluding food+ regulated prices

Splitting the *Czech* sample reveals that, while the growth rate of non-traded-traded relative prices was nearly/completely the same in the early and late transition periods, the underlying determinants were dramatically different. After a period of rapid improvement, relative tradable productivity turned negative, which questions the relevance of the BS effect. Nevertheless, care must be taken when drawing conclusions on the basis of 3 years' data.

The dramatic change in the productivity pattern was offset by a counter-change in the pattern of other factors, which, as mentioned earlier, represented the effect of modifications to VAT since 1997. The growth rate of relative wages declined in the late transition period, which again supports our former view, namely, that some kind of adverse BS story may be behind the figures. While relative mark-ups changed dramatically in the early transition period, their effect practically disappeared after 1997. This may be attributable to the fact that market structure changed more dramatically in the first part of the period.

In *Hungary,* both relative prices and the underlying fundamentals behaved very similarly during the two periods – improved productivity accounted for the majority of the relative price changes, while relative wages and mark-ups practically remained stable. It was only the other effects that differed slightly between the two periods. A decrease in the other effects in the early transition period can be explained by changes to the tax regime.

Relative prices and their underlying determinants were the least stable in *Slovenia*. A two-digit change in non-tradable-tradable relative prices in the early period decreased to 2.4% in the late period. While in the early transition period the change in the other effects and mark-ups was the primary cause of the relative price changes, the pace of change in relative prices decreased dramatically once these effects had faded away. It is, however, important to note that at the same time the productivity differential

increased markedly, which, if proves to be permanent, may indicate future potential acceleration of the BS effect.

5.1. Calculation of the BS effect on CPI

Once the various underlying determinants of relative price changes are identified, the BS effect on CPI can be calculated on the following assumptions:

First, we assume that the external real appreciation is zero, ignoring deviations from relative PPP for traded prices. Second, we assume that the change in relative wages, mark-ups and other effects is zero. Third, we assume that improved productivity affects relative prices by a unit coefficient in the long run. This assumption is consistent with a relatively large class of production functions.[22] Finally, we use the non-traded share in CPI (market + administered), which is approximately 40% in the majority of the countries involved.

Table 5 summarises the results of the project.[23] As can be seen in each country presenting the calculation, the BS effect seems to have been under an annual rate of 2% over the past years.

Table 5

The Balassa-Samuelson effect in CEC5 countries

Annual change (%)	Actual	BS	Period Covered
Czech Republic*	4.4	1.6	1994-2001
Hungary**	2.3	1.9	1992-2001
Poland	5.3	na	1995-2001
Slovakia***	4.3	1.0-2.0	1995-2001
Slovenia*	1.9	0.7	1992-2001

* CPI excluding regulated prices

** CPI excluding food+ regulated prices

*** Value added deflator

The results having been outlined, a few additional remarks may be worth making.

First, as these results apply to the past, i.e. the period in which the growth differential was very large in the tradable sector in the majority of the countries involved, we may allowably assume that productivity differentials, i.e. the BS effect, are likely to be even smaller in the future. Second, as Table 4 reveals, it is very controversial to project any pattern for relative wages, mark-ups and other factors from the past. In the Czech Republic, it was only relative wages and other effects that contributed

[22] See Canzoneri et al. (1998)

[23] Unfortunately, our Polish colleagues did not provide a numerical estimate for the effect.

positively to the increase in non-tradable tradable prices in the late transition period. Even in this case, the contribution of relative wages declined markedly, and that of other effects was connected with a discretionary increase in indirect taxes. On the contrary, both relative wages and mark-ups contributed negatively to the observed increase in non-tradable relative prices in Slovenia in the second period. While in Hungary no clear trend of other relative price determinants but productivity might have been observed. Taking into account these considerations, it is tempting to argue, that by assuming productivity differentials to remain the most important determinants of relative price changes after EMU accession, we do not loose too much information.

5.2. Some policy consequences

After EMU accession, once the nominal exchange rate becomes irrevocably fixed, traded prices are expected to converge to the aggregate European level. This result has already been supported by recent research conducted in the current EMU member states[24] and by several earlier papers for cities in the US.[25] Nevertheless, even in this case marginal excess inflation in the tradable sectors is imaginable, mainly on account of the increasing demand for the products of catching-up countries, although it is much harder to quantify. Eliminating the traded component of the real exchange rate, in the BS framework it is only non-tradable relative prices that matter from the point of view of long-term inflation differentials.

Given that we are unable to project any stable and systematic behaviour of relative wages, mark-ups and other effects, it is the amount of the BS effect that seems to matter in the long run. This indicates that an equilibrium inflation differential of less than two percent is expected in the case of these countries after EMU accession. Are these numbers in line with other estimates of the BS effect?

Part of the papers mentioned in section 3, gave numerical estimates on the BS effect using the estimated sectoral regressions. Table 6 summarises a few results. We found two papers presenting comparable estimates of the BS effect in EU periphery countries prior to EMU accession. It is interesting to compare our and other authors' results for accession countries with these numbers, in order to obtain a picture of the difference between the current enlargement of the EMU and the first wave in 1999, at

[24] See Pinelopi and Verboven (2001).
[25] See Engel and Rogers (1996), and Parsley and Wei (1996).

least from the point of view of inflation differentials. Hence the papers by Canzoneri et al. (1998) and Alberola et al. (1998) may be considered as benchmarks.

For the sake of comparability, we have collected a few of those studies that gave elasticity for sectoral productivity in accession countries.[26] In most cases, the studies are not easily methodologically comparable, as the countries considered are different, and one needs assumptions to derive comparable results.

Where it was possible, we used Hungary for the calculations, not only because of the best availability of data, but also because Hungary is usually considered as having the highest BS effect among the accession countries.[27] In the case of the Coricelly-Jazbec (2001) and Halpern-Wyplosz (2001) papers, we applied the non-traded weights in the Hungarian consumer price index and used available German data on the non-tradable-tradable inflation results to achieve comparability. In the case of the other studies, this calculation was not possible to perform, so I simply presented the authors' results.

Table 6

Estimated BS inflation differentials in different studies

	Country	%	Period	Weighting
Alberola et. al. (1998)	*Spain vs Germany*	*1.9*	*1970-1995*	*CPI*
Canzoneri et al. (1998)	*EU perihepry vs Germany*	*2-2.5*	*1973-1991*	*GDP deflator*
Cipriani (2000)	Hungary	0.8	19951999	CPI
Dubravko (2002)	Hungary vs EMU	0.6	1996-2002	Estimated
Égert (2001)	Hungary vs. Germany	2.5-2.9	1991-2000	Estimated
Égert (2002a)	Hungary vs Germany	1.3-1.7	1993-2000	CPI
Coricelly-Jazbec (2001)	Hungary vs Germany	1.6	1990-1998	CPI
Halpern-Wyplosz (2000)	Six Country Average vs. Germany	1.0	1992-1998	CPI
Kovács-Simon (1998)	Hungary vs. effective	1.6	1992-1996	CPI
Sinn-Reuter (2001)	Hungary vs Germany	6.9	1994-1997	GDP deflator

Looking at **Table 6**, the following conclusion can be made:

First, in most of the studies it was found that BS inflation was less than 2% vis-à-vis Germany. This number is of the same magnitude as that found by Alberola et al. (1998) for Spain before EMU entry, and slightly smaller than in the paper by Canzoneri et al. (1998). Second, there are two outlier results. Égert (2001a) estimated the effect to be slightly higher, between 2%–3%, while Sinn-Reuter gave an extreme value of 6.9% for Hungary.

Second, *weighting* is very important for the comparability of the calculations. The Canzoneri paper may give slightly higher estimates than the Alberola one, as the

[26] As we already mentioned, the BS effect has implications for a sectoral story, which does not necessary mean an aggregate story. Therefore, we neglected studies from the analyses that estimated aggregate productivity elasticities.

[27] Looking at Table 2 it becomes clear that the productivity differential was the highest in Hungary among the CEC5.

former is based on GDP weights, which has higher shares of non-tradables than in the CPI. This problem is even more severe in the case of accession countries, where the non-traded share in CPI is even smaller than in more developed economies.[28] This fact also partially explain the sizeable figures obtained by Sinn and Reuter (2001). Also, the higher figures of Égert (2001) may be partially explained by the estimated weights used in the calculation.

Third, not only the weights, but also *other data concepts* are important. The Sinn-Reuter (2001) paper used gross output for the traded sector, which was growing at a substantially higher pace than value added figures. This again caused an upward bias in their BS number.

Examining the studies using the 'correct' weights and data (i.e. CPI and value added figures), all the numbers presented in the table are similar in magnitude. This magnitude of 1%–2% on annual CPI inflation, however, also indicates that the CEC5 countries are no more exposed to excess inflation than were non-core EU countries prior to their EMU entry.

6. Conclusion

In this paper, we presented a simple accounting framework that can be used to assess the empirical validity of the assumptions of the BS model. Then the framework was applied to CEC5 data, so as to obtain a correct measure of the BS effect in these countries. Other empirical studies were also reviewed, in order to ensure broad comparability of our results with other papers in this topic.

The analyses provide clear evidence that the BS effect on CPI inflation in these countries has not exceeded 2% per annum vis-à-vis Germany over the past few years. The numbers obtained are somewhat different from the actual change in the real exchange rate, due to several reasons. First, the traded real exchange rate had appreciated substantially, violating PPP for this price category. Second, other factors, such as changes in sectoral wage rates, pricing behaviour and intermediate product prices, have also contributed in the past to the development in the non-tradable-tradable price ratio. As these estimates are based on the data of a period in which the productivity differentials were higher than the current figures, it is very likely that, as

[28] The smaller nontraded share in accession country CPI might be explained by the smaller share of services compared to developed economies. As the income elasticity of services is larger than that of industrial goods, catching-up will also mean a closing gap in the structure of consumption.

the catching-up proceeds, the BS effect will continue to decrease in magnitude. Also, even at this level these numbers are broadly comparable with those obtained by other authors for non-core EU countries prior to EMU accession. This would suggest that the CEC5 countries are no more exposed to dual inflation due to real convergence, than were quite a few EMU countries prior to EMU accession.

7. References

Alberola, I. and Tyrvainen, T. (1998) "Is There a Scope for Inflation Differentials in EMU" Bank of Spain Working Papers No. 9823

Asea, P. K. and Mendoza E. G. (1994) "The Balassa-Samuelson Model: A General-Equilibrium Appraisal" Review of International Economics 2(3) 244-267.

Balassa, B. (1964) " The Purchasing Power Parity Doctrine: A Reappraisal" Journal of Political Economy 72.

Balassa, B. (1973) " Just How Misleading are Official Exchange Rate Conversions: A Comment" Economic Journal 83.

Balvers, R. J. and Bergstrand, J. H. (1997) "Equilibrium Real Exchange Rates: Closed Form theoretical Solutions and Some Empirical Evidence" Journal of International Money and Finance Vol. 16. No. 3. Pp. 345-366

Buiter, W. H. (2000) " Exchange Rate Regimes for Accession Countries" Lecture given at a luncheon hosted by Deutsche Bank and the EBRD Annual General Meeting in Riga, Latvia on 21 of may 2000.

Buiter, W. H. and Grafe, C. (2002) "Anchor, Float or Abandon Ship: Exchange Rate Regimes for Accession Countries" EBRD, mimeo

Canzoneri, M. Cumby, R. Diba, B: and Eudey, G. (1998) "Trends in European Productivity and Implications for Real Exchange Rates" Mimeo, March

Cipriani, M: (2000) "The Balassa-Samuelson Effect in Transition Economies" Unpublished IMF Working Paper

Chinn, D. M: (1998) "The Usual Suspects? Productivity and Demand Shocks and Asia-Pacific Real Exchange Rates" CEPR conference, Vienna, April 3-4

Coricelli, F. Jazbec, B. (2001) "Real Exchange Rate Dynamics in Transition Economies" CEPR Discussion Paper Series No. 2869.

Darvas, Zs. (2001) "Exchange Rate Pass Through and Real Exchange Rate in the EU Candidate Countries" Discussion Paper 10/01. of the Economic Research Centre of the Deutsche Bundesbank

De Broeck, M. Slock, T. (2001) "Interpreting Real Exchange Rate Movements in Transition Economies" IMF Working Paper 01/56

Dobrinsky, R. (2001) "Convergence in Per Capita Income Levels, Productivity Dynamics and Real Exchange Rates in the Candidate Countries on the Way to EU

Accession" International Institute for Applied Systems Analysis, Interim Report no. 038 2001.

Égert, B (2001) "Estimating the Impact of the Balassa-Samuelson Effect on Inflation During the Transition: Does it Matter in the Run-UP to EMU?" East European Transition and EU Enlargement: a Quantitative approach Gdansk, 15-201 June, 2001

Égert, B. Drine, I. Lommatzsch, K. and Rault, Ch. (2002) "The Balassa-Samuelson effect in Central and Eastern Europe: Myth or Reality" William Davidson Institute Working Paper No. 483

Égert, B. (2002a) "Estimating the Impact of the Balassa-Samuelson Effect on Inflation and the Real Exchange Rate During the Transition" Economic Systems 36 1-16

Égert, B. (2002b) "Investigating the Balassa-Samuelson Hypothesis in Transition: Do we understand What we see?" BOFIT Discussion Papers No. 6.

Égert, B. (2002c) "Nominal and Real Convergence in Estonia: The Balassa-Samuelson (dis)connection, Does disaggregation provides a better understanding?" Bank of Estonia, mimeo

Froot, A. K: and Rogoff, K: (1995) "Perspectives on PPP and long-run Real Exchange Rates" *In: Grossmann, G. and Rogoff, K: Handbook of International Economics, Ch.. 32*

Gali and Monacelli (2002) "Monetary Policy and Exchange Rate Volatility in a Small Open Economy" CEPR Discussion Paper Series, No. 3346

Grafe, C. and Wyplosz, Ch. (1997) "The Real Exchange Rate in Transition Economies" CEPR Discussion Paper Series No. 1773.

Halpern, L. and Wyplosz, Ch. (1997) "Equilibrium Exchange Rates in Transition Economies" IMF Staff Papers 44/4.

Halpern, L. and Wyplosz, Ch. (1999) "Equilibrium Exchange Rates" In. Ambrus-Lakatos, L: Schaffer, M. E. eds.: Monetary and Exchange Rate Policies, EMU and Central and Eastern Europe, Forum Report of the Economic Policy Initiative No. 5

Halpern, L. and Wyplosz, Ch. (2001) "Economic Transformation and Real Exchange Rates in the 2000s: The Balassa-Samuelson Connection" Chapter 6 in Economic Survey of Europe 2001/No. 1, Economic Commission of Europe, Geneva, United Nations, 2001

Hobza, A (2002) "CEE countries on the Way to Euro Zone" CEPS Working Paper, June

Hsieh, D. (1982) "The Determination of Real Exchange Rates: The Productivity Approach" Journal of International Economics 12

Isard, P. and Symansky, S. (1996) "Long-Run Movements in Real Exchange Rates" In: Takatoshi Ito, Peter Isard, Steven Symansky and Tamim Bayoumi: Exchange Rate Movements and Their Impact on Trade and Investment in the APEC Region IMF Occasional Paper 145 IMF Working Paper 97/1

Jakab, M. Z. Kovács, M. A. (1999) "Determinants of Real Exchange Fluctuations in Hungary" MNB Working Papers Series 1999/6

Jazbec, B. (2001) "Balassa-Samuelson Effect in Transition Economies: The Case of Slovenia" William Davidson Institute Working Paper No. 507

Kovács, M. A. Simon A. (1998) "Components of the Real Exchange Rate in Hungary" MNB Working Paper Series 1998/3

Kovács, M. A. (1998) "Mit mutatnak? A különféle reálárfolyam-mutatók áttekintése és a magyar gazdaság ár és költség-versenyképességének értékelése (The Information Content of Various Real Exchange Rate Indicators" MNB Working Papers 1998/8 in Hungarian

Kovács, M. A. (2001) "The Equilibrium Real Exchange Rate in Hungary" MNB Background Studies 2001/3.

Kovács, M. A. et al. (2002) "On the Estimated Size of the Balassa-Samuelson Effect in CEC5 countries" Prepared by experts from the CEC5 Central Banks, edited by Kovács, M. A:

Krajnyák, K. and Zettelmeyer, J. (1997) "Competitiveness in Transition Economies: What Scope for Real Appreciation?" IMF Working Paper 97/1

Krugman, P. (1987) " Pricing to Market When the Nominal Exchange Rate Changes" NBER Working Paper No. 1926

MacDonald, R. and Ricci, L (2001) "PPP and the Balassa-Samuelson Effect: The Role of the Distribution Sector " IMF Working Paper 01/38

Marston, R (1987) "Real Exchange Rates and the Productivity Growth in the United States and Japan" In.: Arndt, S. and Richardson, J.D. eds., Real-Financial Linkages among Open Economies. (MIT press)

Officer, L. (1976) "The Productivity Bias in Purchasing Power Parity: An Econometric Investigation" IMF Staff Papers10.

Rogoff, K. (1996) "The Purchasing Power Parity Puzzle" Journal of Economic Literature Vol. XXXIV: June.

Sinn, H. W. Reutter, M (2001) "The Minimum Inflation Rate For the Euroland" NBER Working Paper, No. 8085

Smets, F. and Wouters, R. (2002) "Openness, Imperfect Exchange Rate Pass-Through and Monetary Policy" Journal of Monetary Economics 49.

Szapáry, Gy. (2000) "Maastricht and the Choice of Exchange Rate Regime in Transition During the Run-Up to EMU" MNB Working Paper 2000/7

Takatoshi, I. Isard, P. Symasky, S and Tamim, B. (1996) "Exchange Rate Movements and Their Impact on Trade and Investment in the APEC Region" IMF Occasional Paper145

Varian, H. (1992) "Microeconomic Analyses" Third Edition, W. W: Norton and Company

Williamson, J. (1994) "Estimating Equilibrium Exchange Rates" Institute for International Economies, Washington DC:

Wu, Hsiu-Ling (1996) "Testing for Fundamental Determinants of the Long Run Real Exchange Rate: The Case of Taiwan" NBER Working Paper Series No. 5787.

Zumer, T. (2002) "The Balassa-Samuelson Effect In Slovenia" BSI