Measuring the Balassa-Samuelson effect for the Countries of Central and Eastern Europe?

The "Balassa-Samuelson" effect designates the mechanism by which an appreciation of the real exchange rate occurs during the catching-up process, as a result of faster relative productivity gains in the tradable goods sector. The trend towards real exchange rate appreciation in Central and Eastern European countries (CEECs) over the past decade raises the question as to whether this effect is at work. Given that the first studies carried out have concluded that this is the case, some economists have regarded it as a possible obstacle to the nominal convergence of these countries in their process of integration into the euro area. Accordingly, if the appreciation of their real exchange rate were to continue, it would lead either to higher inflation than in the euro area, which would be prejudicial with respect to the Maastricht criterion on price stability; or to an appreciation of the nominal exchange rate, thus contravening the criterion on exchange rate stability. A large number of studies have recently been devoted to this issue. Although most of the papers estimate that the effect is small in size, its measurement is beset with uncertainty. This article provides a survey of the main results of the studies carried out so far and shows how measurement of the effect is sensitive to the formulations used and the implicit assumptions made.

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The different implications of the Balassa effect for the Central and Eastern European countries (CEECs) have given rise to numerous papers: Halpern and Wyplosz (1997), Krajnyak K. and Zettelmeyer (1997, 1998), Dietz (1999), De Broeck and Slok (2001), Backé and *al.* (2002), Kovacz (2002), Égert and *al.* (2003), *etc*. aimed at determining the existence and size of this effect. The Balassa effect is also taken into account in the calculation of equilibrium exchange rates for the European Union's acceding countries (ACs): Égert-Lahreche (2003), Alberola (2003), *etc*. The aim of the present article is to discuss different conceptions of the Balassa effect, the estimates that may be derived from it, before going on to provide some orders of magnitude for the effect. The first part sets out the main *formulae* used to calculate the Balassa effect and discusses the assumptions that underlie them. Two different definitions of the Balassa effect are given: a broad definition based on the rise in the relative prices of services; and a narrow definition, based on the differences in productivity between sectors. The second part deals with the specific origins of the Balassa effect in the ACs. The third part compares the findings of several estimates, published in different studies, which are based on direct measurement or econometric methods.

1. The Balassa-Samuelson effect: definition and consequences

The "Balassa-Samuelson" effect, formulated by Balassa (1964) and Samuelson (1964), describes the distortion in purchasing power parity (PPP) resulting from the international differences in relative productivity between the tradable goods sector (constituted more or less by manufacturing and agriculture) and the non-tradable goods sector (roughly speaking, services). This distortion can be assessed in level form or in evolution. The Balassa effect in level form predicts that countries that have relatively lower productivity in tradable goods than in non-tradable goods – as is the case in emerging or developing countries – have lower price levels than in other countries. In evolution terms, the Balassa effect designates the trend appreciation of the real exchange rate in countries undergoing a process of economic catching-up, resulting from the relative productivity gains in the tradable goods sector.

Accordingly, during the development process, productivity tends to increase more quickly in the tradable goods sector than in the services sector. Given that the prices of tradable goods are set by international competition, an increase in productivity in this sector leads to an increase in wages, which is not detrimental to competitiveness. Since this increase in wages spreads across the economy as a whole, there is a rise in relative prices in the non-tradable goods sector, where productivity has not grown at the same pace. Given that the price index is an average of these two sectors, there is an increase in the prices of domestic goods relative to those from abroad. This results in an appreciation of the real exchange rate.

1.1. The Balassa effect: the different definitions

There are different ways of viewing the Balassa effect. The first, simplified version involves solely the rise in the relative prices of services. This first conception may be regarded as a Balassa effect in the broad sense. Subsequently, the context in which relative price developments occur can be specified, taking account of productivity levels: this constitutes the Balassa effect as it is commonly understood.

1.1.1. Decomposition of the real exchange rate

To start with, we can give a simplified representation of the Balassa effect by taking the example of an open economy comprising two sectors, tradable goods and non-tradable goods. All we need to do is compare two definitions of the real exchange rate, obtained using two different deflators. To make it more concrete, let us take the example of an emerging economy, for example a CEEC, whose exchange rate is calculated compared with that of a more advanced foreign country, marked *, for instance the euro area.

On the one hand, the appreciation of the CEEC's real exchange rate compared with the euro area is equal to the appreciation of the nominal exchange rate plus the inflation differential (measured by the change in the final demand price) between the CEECs and the euro area, this being the commonly used definition:

(1) $\dot{q} = \dot{e} + \dot{p} - \dot{p}^*$

where $\dot{q}$ and $\dot{e}$ are the real and nominal exchange rate in growth terms respectively; $\dot{p}$ and $\dot{p}^*$ are the growth rate of final demand prices in the CEECs and the euro area respectively [1].

On the other hand, another real exchange rate can be defined solely for the tradable goods sector. In this case, the prices used for deflators are those of tradable goods, given as $\dot{p}_T$ and $\dot{p}_T^*$, where the index *T* stands for the tradable goods sector and the index *N*, used subsequently, the non-tradable goods sector;

(2) $\dot{q}_T = \dot{p}_T + \dot{e} - \dot{p}_T^*$

By subtracting the two equations (1) and (2), we can express the real exchange rate as the total of the real exchange rate for tradable goods $\dot{q}_T$ and the difference between the two countries of relative prices for goods across the board and the exposed sector *T*:

(3) $\dot{q} = \dot{q}_T + [(\dot{p} - \dot{p}_T) - (\dot{p}^* - \dot{p}_T^*)]$

We should note at this point that no particular assumption has yet been stated. Equation (3) is therefore valid whether a "Balassa effect" is corroborated or not. According to this *formula*, the real exchange rate may appreciate for two reasons:

[1] The lower-case variables marked with a dot indicate rates of growth (logarithmic derivatives). The nominal exchange rate is the number of foreign currency units per domestic currency unit.

– if the price of the CEECs' tradable goods rises compared to abroad (a rise of $\dot{q}_T$), this generally involves a loss of competitiveness, which makes it harder to export goods;

– if the relative price of non-tradable goods goes up more in the country concerned than in the euro area (increase in the term $[(\dot{p} - \dot{p}_T) - (\dot{p}^* - \dot{p}_T^*)]$). This second type of appreciation can occur without involving a loss of competitiveness in the tradable goods sector, *i.e.* with $\dot{q}_T$ constant. This constitutes a "Balassa" effect.

The rise in the relative price of non-tradable goods compared with that of tradable goods may stem from a variety of factors. For Balassa (1964), it results from larger productivity gains in manufacturing.

An equivalent expression can be obtained by taking the final demand price, given by the weighted average of prices in the two sectors:

(4) $\dot{p} = \gamma \dot{p}_T + (1-\gamma)\dot{p}_N$

where $\dot{p}_T$ and $\dot{p}_N$ are price variations in the tradable goods sector *T* and the non-tradable goods sector *N*, and γ is the share of tradable goods in final demand. This can also be written:

(5) $\dot{p} = \dot{p}_T + (1-\gamma)(\dot{p}_N - \dot{p}_T)$

This definition is also valid for the euro area:

(5') $\dot{p}^* = \dot{p}_T^* + (1-\gamma^*)(\dot{p}_N^* - \dot{p}_T^*)$

The real exchange rate against the euro set out in equation (1) can thus be written:

(6) $\dot{q} = \dot{q}_T + (1-\gamma)[(\dot{p}_N - \dot{p}_T) - (\dot{p}_N^* - \dot{p}_T^*)] - (\gamma - \gamma^*)(\dot{p}_N^* - \dot{p}_T^*)$

The first term of the right-hand expression of equation (6) designates the relative price of tradable goods. The second term represents the Balassa effect associated with the difference in relative prices between factors and countries. The last term on the right is negligible if the share accounted for by the two sectors is similar in the two countries. If the proportion of tradable goods is markedly greater in the emerging country (which appears to be the case in the CEECs), this term needs to be taken into account since it has a moderating effect on the appreciation of the real exchange rate.

Like equation (3), *formula* (6) is an arithmetic decomposition of the real exchange rate, obtained without any particular assumption. It is therefore valid in all circumstances. The Balassa effect is indicated by the appreciation of the real exchange rate, due to the increase in the second term, representing the difference between the countries of the relative prices of the two sectors.

The Balassa effect may stem from two different situations, depending on whether the appreciation of the real exchange rate results from inflation or from the nominal exchange rate. The most common scenario is that of higher inflation in the country

concerned than abroad. However, theoretically the Balassa effect may be present even with lower inflation, once the condition regarding relative prices is met (second term in square brackets in equation (6) positive). In this case, the appreciation of the real exchange rate occurs *via* a rise in the nominal exchange rate.

1.1.2. Productivity differentials between sectors

Next we need to explain the divergent development of relative prices between the sectors. This stems essentially from differences in productivity. In order to assess these, we start by determining the relative price of non-tradable goods compared with tradable goods in a single economy. This relative price is also called the "internal exchange rate", given that it compares the price of domestic goods with those exposed to international competition.

The change in the relative prices of non-tradable goods may be expressed as follows (see appendix):

$$(7) \qquad \dot{P}_N - \dot{P}_T = \frac{\alpha_N}{\alpha_T}\dot{\theta}_T - \dot{\theta}_N$$

where α_i designates the share of labour in the sector's value added $i=T, N$, and $\dot{\theta}_i$ the growth in the total productivity of factors in sector i.

Thus, the relative price of non-tradable goods, *i.e.* the "internal exchange rate", appreciates with productivity gains in the tradable goods sector. More specifically, it rises along with the total productivity of factors, corrected by the share of labour in the value added of the two sectors. Given that the tradable goods sector is generally more capital-intensive than the non-tradable goods sector, we have $\frac{\alpha_N}{\alpha_T} > 1$. Thus, even if productivity gains are the same in the two sectors, *formula* (7) shows that there is a drift in the prices of non-tradable goods or an appreciation of the real exchange rate. Generally, we also have: $\dot{\theta}_T > \dot{\theta}_N$, *i.e.* a relative increase in the productivity in tradable goods, which leads to an appreciation of the "internal exchange rate".

Coming back to the general formulation (6), and replacing relative prices by their value in (7) for the two countries, we obtain:

$$(8) \qquad \dot{q}=\dot{q}_T+(1-\gamma)\left(\left(\frac{\alpha_N}{\alpha_T}\dot{\theta}_T-\frac{\alpha^*_N}{\alpha^*_T}\dot{\theta}_T^*\right)-(\dot{\theta}_N-\dot{\theta}_N^*)\right)-(\gamma^*-\gamma)\left(\frac{\alpha^*_N}{\alpha^*_T}\dot{\theta}_T^*-\dot{\theta}_N^*\right)$$

This expression is often simplified by taking the parameters $\frac{\alpha_N}{\alpha_T}$ and γ to be equal for the two countries:

$$(9) \qquad \dot{q} = \dot{q}_T + (1-\gamma)\left(\left(\frac{\alpha_N}{\alpha_T}(\dot{\theta}_T - \dot{\theta}_T^*) - (\dot{\theta}_N - \dot{\theta}_N^*)\right)\right.$$

This *formula* can also be applied to the price differential between the countries, by subtracting the nominal exchange rate in both cases:

$$(10) \qquad \dot{p} - \dot{p}^* = (\dot{p}_T - \dot{p}^*_T) + (1-\gamma)\left(\left(\frac{\alpha_N}{\alpha_T}(\dot{\theta}_T - \dot{\theta}_T^*) - (\dot{\theta}_N - \dot{\theta}_N^*)\right)\right.$$

Lastly, we can also express an internal Balassa effect by means of the impact of productivity differences between sectors on the price index in a single country:

$$(11) \quad \dot{p} = \dot{p}_T + (1-\gamma)\left(\frac{\alpha_N}{\alpha_T}\,\dot{\theta}_T - \dot{\theta}_N\right)$$

1.2. How valid is this effect?

1.2.1. The underlying assumptions

One of the central assumptions is that the economy can be broken down into two sectors, one producing tradable goods, exposed to international competition, the other "non-tradable" goods, where external trade is too limited to influence price formation. Given the growing openness of economies, we may wonder about the validity of this assumption. In fact, in spite of the development of international trade in services, services as a whole remain much less "tradable" than goods, as has been shown by De Gregorio and *alii* (1994). Their "tradability criterion" consists in regarding as "tradable" a sector in which exports account for more than 10% of domestic production. Their calculations, which relate to 14 countries of the Organisation for Co-operation and Economic Development (OECD) for the 1970-1985 period, show that 45% of manufactured goods are exported, this figure standing at 24% for agricultural products and 31% for minerals. Only 4% of services are exported at the end of the period under review, and this share falls to 2% if transport is excluded. These figures confirm the existence of a "non-tradable" goods sector, including services except for transport. The tradable goods sector includes not only manufacturing but also agriculture, minerals and transport, even if most existing studies restrict it to manufactured products alone, as is observed by Egert and *al.* (2003).

Originally, the Balassa effect was demonstrated on the basis of a single price for tradable goods, in the context of a small open economy that has no trade barriers. In reality, the law of single price is obviously not borne out, in particular given the diversity of products, transport costs and pricing policies of companies, which tend to align themselves with local prices ("price to market") rather than applying their own prices converted using current exchange rates. However, this assumption proves to be unnecessary, since the Balassa effect can persist in its absence. This can be observed if we look at *formula* (8). The appreciation of the real exchange rate is decomposed into two parts, one reflecting the change in the real exchange rate for tradable goods – which can be different from zero in the absence of a single price for these goods – and the other the rise in relative prices of non-tradable goods, which constitutes the Balassa effect.

Larger productivity gains are observed in the tradable goods sector than in the non-tradable goods sector. This assumption seems to hold true for individual countries, and also at the international level when we look at the difference in relative productivity gains in the tradable sector between an emerging country and an advanced economy. In other words, the productivity gains made during a country's catching-up process are seen above all in the tradable goods sector.

Another category of assumptions linked to this model concerns the perfect mobility of factors of production. Internal labour mobility tends to equalise wages between the different sectors, which, according to the statistics provided by Mihaljek and Klau (2003), appears to be true for the CEECs. The assumptions of the perfect international mobility of capital and the absence of investor risk aversion are more debatable. These latter two assumptions are necessary for the equalisation of real interest rates (deflated by the price of tradable goods) between countries (see appendix). Thus, relative prices between countries and sectors depend solely on the cost of labour and demand does not contribute to price formation. In reality, there are risk premia on the currencies of emerging countries, which prevent the equalisation of returns on capital. As a result, demand has an influence on prices.

1.2.2. Other possible explanations for the appreciation of the real exchange rate

The Balassa effect is not the only factor that can explain the appreciation of currencies as development levels rise. The Balassa effect is purely a "supply side effect"; demand does not play any part in the formation of relative prices (as can be seen from the model given in the appendix). However, relative prices can also increase as a result of the pressure of demand. If we put aside the Balassa-Samuelson model's assumption of perfect capital mobility, we can evidence a demand effect on the relative prices of the different sectors known as the "Baumol-Bowen" effect (1966). The Baumol-Bowen effect also provides an explanation for the rise in relative prices of non-tradable goods by introducing the factor of consumer demand: given that the income elasticity of the demand for services is greater than that of demand for goods, the share of services in demand increases during the process of development. The relative price of services also tends to increase to rebalance the supply and demand of non-tradable goods. This results in an appreciation of both the internal and external real exchange rates. In actual fact, it appears that the rise in the relative prices of services derives not only from lower productivity in the sector, as the Balassa effect predicts, but also from growing demand during the development process (De Gregorio and *alii*, 1994). The trend increase in relative services prices predicted by the Balassa-Samuelson effect is substantiated in the majority of advanced and emerging countries, but it is also accompanied by another major trend which is the growth in the share of services in GDP. This phenomenon is however not anticipated by the Balassa effect. A consumer demand effect needs to be introduced to take account of it. However, most studies confuse the Balassa and Baumol-Bowen effects, since both effects have a similar impact on real exchange rates, which appreciate during the development process. The Balassa effect, which is better-known, is the one that is most often adduced to explain the two phenomena.

The impact of variations in productivity on exchange rates is also often wholly – and wrongly – attributed to the Balassa effect. But productivity shocks can also affect the real exchange rate *via* other channels, for example through investment demand. Thus, an increase in productivity can bring about investment growth and therefore a rise in the real interest rate in order to attract the necessary capital to fund it, thus leading to an appreciation of the real exchange rate. There can also be sectoral components to this investment demand, as is shown by Fischer (2002).

1.2.3. Empirical tests

A large number of empirical tests of this effect have been conducted. In the first instance, Balassa's original article of 1964 pertained to OECD member countries. However, the many subsequent studies have shown that the effect was valid for a broad range of countries with different levels of development. In their survey of the literature, Edwards and Savastano (1999) report some 15 studies that test the Balassa effect on samples of data drawn from a large number of countries; most find a significant effect. Montiel's review of the literature (1999) arrives at similar conclusions. In general, the tests are not based on productivity differences between sectors, for which data are not always available for emerging countries, but on *per capita* GDP, used as a measure of levels of development. In this type of test, it is therefore not possible to distinguish the supply from the demand effect.

2. The origins of the Balassa effect in the CEECs

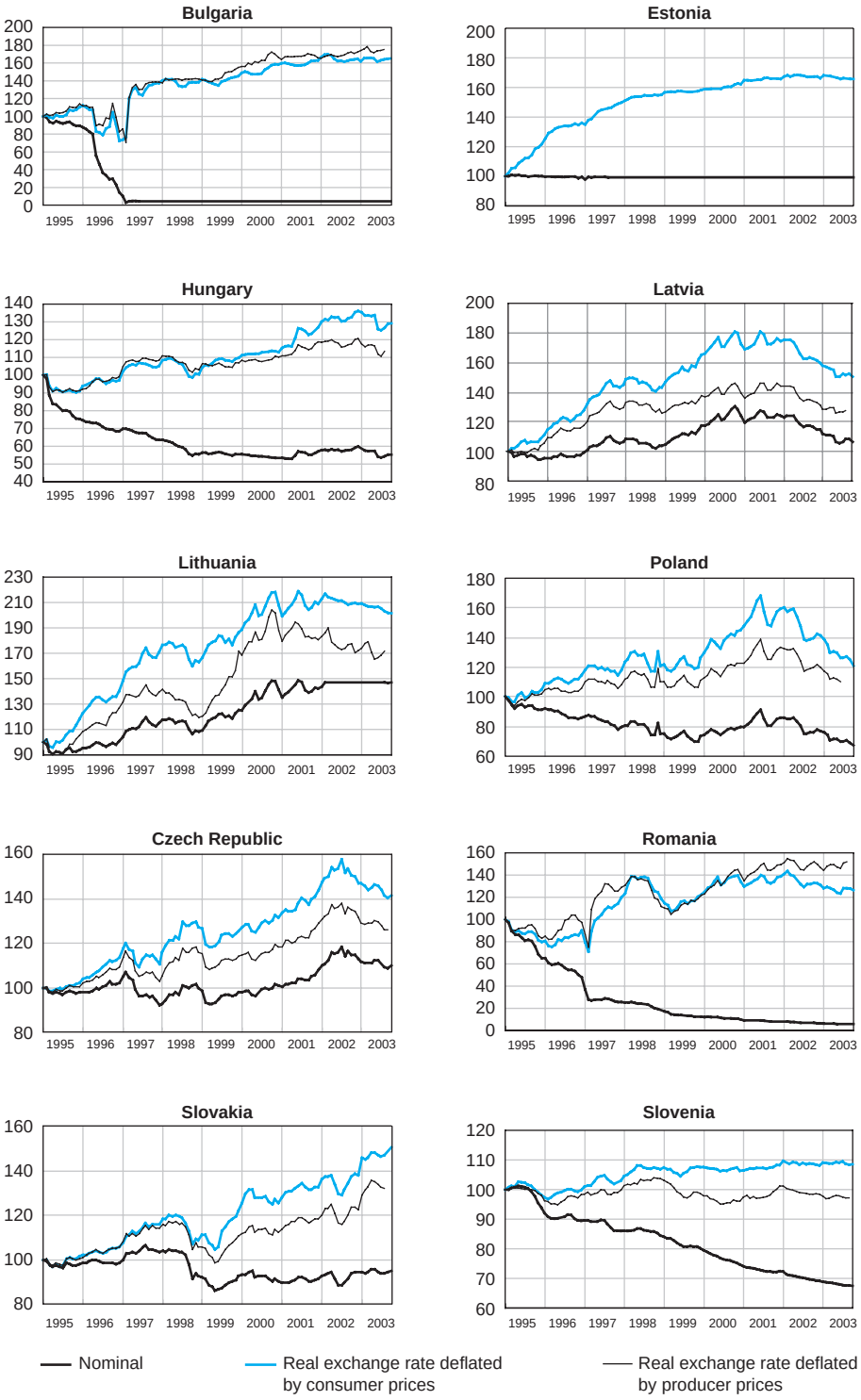
Overall, the real exchange rates of the CEECs have appreciated strongly over the last decade. This appreciation may stem from different factors, including a catching-up after the initial undervaluation at the time of these countries' transition to a market economy (Halpern and Wyplosz, 1997). However, the fact that this appreciation concerned above all prices of final demand rather than the price of tradable goods is an indicator of the Balassa effect at work in these countries (see Chart 1).

Two specific reasons can explain the rise in relative services prices in the CEECs. Firstly, the productivity gains in the tradable goods sector have been particularly rapid since the start of the transition, as a result of the wholesale restructuring of existing companies and foreign direct investment. Secondly, the prices of services, which were kept extremely low during the Socialist period, have only been deregulated gradually, giving rise to a "cost recovery effect", highlighted by Krajnyak and Zettelmeyer (1997). After the transition, administrated prices have been adjusted gradually, whereas prices of tradable goods have converged more rapidly. This process is still not yet complete since the share of regulated prices remains substantial, at between 13% to 24% of the price index in the CEECs in 2000, according to Backé and *alii* (2002). There is still therefore "contained" inflation that may appear in the future, even if its magnitude should theoretically diminish.

MacDonald and Wojcik's study (2002) raises questions about the nature of the real appreciation observed in the CEECs. Their econometric tests seek to explain two dependent variables: the "internal exchange rate" (reconstructed using a data base giving prices by product) and the real exchange rate deflated by consumer prices. The main explanatory variable is the relative productivity of the two sectors, (the productivity of each of the sectors is taken to be labour productivity calculated by dividing value added by employment). The results show that the real exchange rate is linked to the productivity of the tradable goods sector rather than to the difference between the sectors, which runs counter to what is predicted by the Balassa effect.

Chart 1
CEEC real and nominal exchange rates against the euro

(Bilateral exchange rate against euro, february 1995 = 100)



Sources: IFS, ECB, Banque de France calculations.

Paradoxically, the usual demand effects are negative for the CEECs. Thus, according to these findings, an increase in overall demand has not led to a rise in relative demand in services like in other countries. A possible explanation of this paradox is that, having been deprived of tradable goods during the previous decades, CEEC consumers are purchasing more and more of these goods as their income increases. Another finding of this study is to demonstrate the importance of administrated prices in the evolution of inflation and the real exchange rate in the CEECs. Introducing administrated prices into the equations tends to reduce the size of the Balassa effect, the rise in administrated prices taking the place of rising services prices.

3. Estimating the Balassa effect in the CEECs

Various problems are inherent in estimating the Balassa effect. All of these problems and the different methods used to overcome them mean that estimates vary greatly from one study to another. The definition of the non-tradable goods sector differs from one author to another. Most of them take tradable goods to mean goods from the manufacturing industry; others also include agricultural goods. However, although the latter are tradable, the existence of the common agricultural policy certainly contributes to blurring the relationship between productivity and prices, thereby distorting estimates of the Balassa effect.

The formulations also vary, as is shown in the first part of this paper. Thus, we can see that *formula* (8) may give rise to several different formulations depending on whether or not one regards the parameters α_T, α_N and γ, γ^* respectively as being equal in the two sectors and in both countries. According to Égert and *al.* (2002), the weighting of services in the price index, represented by the coefficient $(1-\gamma)$, is very different in the CEECs than in the euro area. The figures stand at 28% for Hungary and 32% for Poland, as against 45% for Germany.

Mihaljek and Klau (2002) point out two other common flaws in these estimates. Firstly, the variables used to represent productivity are approximate. Theoretically, the "total productivity of factors" should be considered, *i.e.* reflecting both payrolls and the stock of capital. In reality, given the lack of relevant data, most estimates use labour productivity. Secondly, most authors use a formulation concerning the relative prices of the two sectors in a single country (as in *formulae* (7) and (11)) without comparing it with changes in the same variables abroad. It is thus only the "internal real exchange rate" that is considered and not the usual real exchange rate. Finally, there are considerable problems concerning data for CEECs; labour productivity gains in industry vary considerably from one paper to another, depending on the sources used, making it difficult to compare estimates.

3.1. Direct measurement by decomposition of the real exchange rate

Direct measurement consists in decomposing changes in the real exchange rate into one part relating to tradable goods and the other representing developments in relative prices in the two sectors, as in the *formulae* (3), (6) and (8). However,

these methods are inappropriate, since the Balassa effect is supposed to be a long-term phenomenon and therefore is not verifiable over a specific period. This justifies the use of econometrics. Nonetheless, direct measurement has the advantage of simplicity, making possible an initial rapid check.

3.1.1. A preliminary approximation

Formula (3), $\dot{q} = \dot{q}_T + [(\dot{p} - \dot{p}_T) - (\dot{p}^* - \dot{p}_T^*)]$, which ascribes the Balassa effect to the difference between the two zones of relative inflation between goods taken as a whole and tradable goods is the simplest to use, since unlike the usual formulations, it does not require knowing the weighting between the sectors. However, a major problem remains the measurement of prices of tradable goods. As a preliminary approximation, wholesale (or producer) prices are sometimes used. It is judged that, by virtue of their intangible nature, services are by definition more difficult to stock and sell "wholesale" than goods, hence a composition of this index that gives more weight to tradable goods than the consumer price index.

Using this indicator, a faster increase in relative prices of demand as a whole compared to tradable goods can be clearly observed in the CEECs than in the euro area, as is shown by Table 1. The average annual difference is 1.9% for the period 1995-2002 for the 10 CEECs taken as a whole. However, a slight fall is recorded for the recent period, since it was only 1.4% between 1999 and 2002. This figure allows us to give a preliminary approximation of the term representing the Balassa effect in equation (3). This trend is corroborated by Chart 1, which shows that the real trend appreciation of the CEEC currencies is much greater when one considers the consumer price index than that obtained taking tradable goods prices alone, thereby pointing to a Balassa effect. However, this effect explains the appreciation only partially, since most currencies continue to appreciate even when their exchange rate is deflated by the price of tradable goods. Massive capital inflows, attracted by high yields in the region may explain this phenomenon.

Table 1
Differences in relative prices in the two sectors between the CEECs and the euro area

	1999	2000	2001	2002	Annual average 1999-2002	Annual average 1995-2002
Bulgaria	1.0	-3.2	0.7	3.8	0.5	0.8
Czech Republic	2.6	1.9	-0.9	1.6	1.3	2.0
Estonia	6.2	2.1	-1.4	2.5	2.3	2.7
Hungary	6.4	1.2	1.4	7.1	4.0	1.8
Latvia	8.3	5.0	-2.0	0.3	2.8	4.0
Lithuania	0.8	-11.5	2.4	3.3	-1.4	3.0
Poland	3.2	5.2	0.9	0.1	2.3	2.7
Romania	2.4	-2.3	-7.2	-2.3	-2.4	-0.8
Slovenia	5.6	4.0	-3.2	1.6	1.9	1.3
Slovakia	8.1	5.0	-2.1	0.6	2.8	–
CEEC-10 average	4.5	0.7	-1.1	1.8	1.4	1.9

NB: Data represent $(\dot{p} - \dot{p}_T) - (\dot{p}^* - \dot{p}_T^*)$, *where* $\dot{p}_T$ *is approximated by producer prices.*
Sources: IMF (International Financial Statistics), ECB.

3.1.2. Measurement using the productivity differential

Backé and *alii* (2002) estimate a Balassa-Samuelson effect for the internal exchange rate, using *formula*:

$$(11) \quad \dot{p} = \dot{p}_T + (1-\gamma)\left(\frac{\alpha_N}{\alpha_T}\,\dot{\theta}_T - \dot{\theta}_N\right),$$

where the last term represents the contribution to inflation of the differences in productivity between sectors. The tradable goods sector is taken to mean manufacturing, prices are the implied deflators of value added, and productivity is calculated in relation to labour.

Their results, given in Table 2, show that the Balassa effect, brought about by the productivity differential is estimated to have been very large notably in Poland (9.8% between 1995 and 2000). This theoretical effect exceeded the rise observed in the relative prices of services (5.3%), which points to a narrowing of the margins of companies producing non-tradable goods over the period, thus precluding the usual parallel evolution in prices and productivity.

This effect is probably overestimated for two reasons. Firstly, to obtain the impact on the real exchange rate, on this domestic effect, we need to subtract the same effect in the euro area, even if this is slight, estimated at approximately 1% per annum (Rother, 2000) or at 0.4% to 0.6% for Germany for the period 1995-2000, as is shown by Table 3. Secondly, labour productivity is used here. As the stock of capital was also renewed during this period, probably above all in the manufacturing sector, it is likely that the differences are smaller if total productivity is considered. But this bias is common to most studies, which nonetheless obtain lower estimates.

Notwithstanding, the Balassa effect appears here to be particularly strong in Poland. A figure of the same order (9.4%) is also cited by Kovacs (2002) for the1992-1998 period in his survey of all of the available studies on the Balassa effect in Poland.

Table 2
Inflation differential between sectors and contribution of productivity differential between sectors

(annual average as a %)

	Poland		Hungary		Czech Republic	
	1992-2000	1995-2000	1992-2000	1995-2000	1992-2000	1995-2000
Inflation differential between sectors, value added deflator	5.6	5.3	3.3	2.7	1.2	0.4
Contribution of productivity differential between sectors – second term, equation (11) –	9.4	9.8	5.6	3.8	0.8	0.4

Source: Backé and *alii* (2002).

3.1.3. Another measurement using the productivity differential

Égert and *alii* (2003) obtain a much lower estimate for the same period (see Table 3). According to these results, even in countries where the increase in relative productivity in tradable goods has been very sharp, such as in Poland (5.5% to 9% depending on the definition of non-tradable goods used), the impact on relative prices compared to Germany (and therefore on the real exchange rate) remains moderate, between 1.2% and 2.4% *per annum*.

Several factors explain why this estimate is much lower than the previous one. Firstly, as it is an estimate of the Balassa effect on the external real exchange rate, and not on domestic inflation, we need to subtract the same effect for the euro area from the domestic Balassa effect of the CEECs. Égert and *al.* (2002) take Germany as the reference, where this effect is estimated to be between 0.4% and 0.5% annually over the period under review, *i.e.* 1995-2000. However, this factor only explains a small part of the de*via*tion observed between the two estimates.

Secondly, the authors judge that prices depend solely on labour productivity, which leads them to use the following formulation: $\dot{p} = \dot{p}_T + (1-\gamma)(prod_T - prod_N)$, which is analogous to equation (11), but where the share of labour is the same in the two sectors $(\alpha_N = \alpha_T)$ and where labour productivity replaces total productivity. This formulation can lead to the estimation of a lower effect than the usual *formula* in which the share of labour, which is greater in the services sector, increases the impact of the productivity differential.

Thirdly, the authors' approach involves considering the effects on the consumer price index, unlike previous authors, who used the prices of value added. However, the share of non-tradable goods in the price index, shown in Table 3, is very small for the CEECs, at around 22% to 32% for those that appear in Table 3. This amounts to one-half less than their share of value added, which is more than 60%. Thus, only 20% to 30% of the productivity differentials between sectors is passed on to consumer prices. However, using the same services-based weighting, whether or not agriculture is included in tradable goods with respect to productivity gains, can interfere with the interpretation of the results. More fundamentally, taking a long-term perspective, we may expect the share of services in the price index to increase, catching up with that of euro area countries, which would automatically amplify the Balassa effect.

Table 3
Productivity differentials between sectors and impact on relative prices in CEECs compared to Germany
Period 1995-2000

(annual average, growth rate as %)

	Productivity differential between sectors		Weighting of services in the consumer price index	Impact on relative prices compared with Germany		
	Definition 1	Definition 2		Definition 1	Definition 2	
					Assumption 1	Assumption 2
Czech Republic	2.5	1.4	32.7	0.2	*-0.1*	0.0
Estonia	3.9	4.1	22.7	0.3	*0.4*	0.5
Hungary	5.1	5.7	28.0	0.8	*1.1*	0.8
Poland	5.5	9.0	31.9	1.2	*2.4*	1.7
Slovakia	6.2	5.2	33.1	1.4	*1.2*	0.9
Germany	*1.4*	*1.1*	*45.2*	*0 (0.6*)*	*0 (0.5*)*	*0 (0.4*)*

NB: The first two columns give the productivity differentials between the tradable good and non-tradable goods sectors. In Definition 1, the tradable goods sector corresponds to industry (excluding construction) and agriculture. In Definition 2, agriculture is taken out of tradable goods.
Assumptions 1 and 2 in the last two columns are as follows:
Assumption 1: variations in productivity are passed on 100% to the price of non-tradable goods.
Assumption 2: only 70% of these variations are passed on (this assumption derives from an econometric estimate when agriculture is included in non-tradable goods).
** Estimate of the impact on German domestic prices.*

Source: Égert and *alii*, 2003.

3.2. Econometric methods

3.2.1. International comparison of price levels

A number of studies seek to explain differences in price levels between countries by the Balassa effect (see for example Edwards and Savastano's survey of 1999). The Balassa effect can also be used to explain the lower price levels in emerging countries. All we need to do is to take the mechanism described above in level form, since real exchange rates in level form are by definition equal to relative prices between countries. In emerging countries, productivity in the tradable goods sector is low compared with advanced economies. The fact that prices in this sector are assumed to be subject to competition from international trade explains the lower wages (measured in international currency) found in less developed countries. Given that these low wages prevail in the economy as a whole, the comparatively stronger productivity of the non-tradable goods sector leads to a lower price level than abroad. As a result, the price level across the economy as a whole, which is the weighted average of the two sectors, is lower in less developed countries. Consequently, their real exchange rate is systematically undervalued compared with the PPP exchange rate (*i.e.* the exchange rate that equates the price of a basket of goods between countries).

We only have to transpose equation (10) into level form for this to be apparent. This we do by using, to keep it simple, the same capital intensity in the two sectors based on the assumption of a single price for tradable goods (which makes the first term disappear):

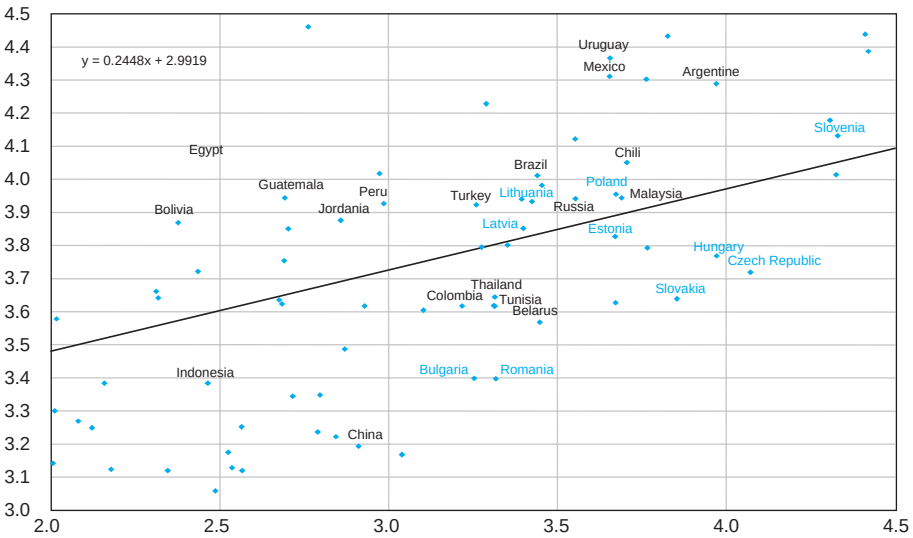
$$(10') \quad P - P^* = (1-\gamma)\left(\left(\frac{\alpha_N}{\alpha_T}\right)(\theta_T - \theta_T^*) - (\theta_N - \theta_N^*)\right) \approx (1-\gamma)\left((\theta_T - \theta_N) - (\theta_T^* - \theta_N^*)\right)$$

The level of relative productivity in tradable goods, which is lower in emerging countries, $(\theta_T - \theta_N) < (\theta_T^* - \theta_N^*)$, means that average prices are lower in these countries, $P < P^*$. In other words, the real exchange rate of these countries is undervalued compared with the purchasing power parity (PPP).

In order to test this effect, relative price levels of a group of countries can be regressed on PPP GDP *per capita*, and can be used to approximate the relative productivity differentials between sectors (see for example Rogoff, 1996, De Broeck and Slok, 2001). An example of this type of regression is shown in Chart 2. It is taken from the study by Coudert and Couharde (2002), which considers a sample of 120 emerging countries for a given year (in this case, 2000). The slope indicates the average appreciation of the real exchange rate to be expected from a 1% increase in relative GDP per capita: this ranges between 0.25% and 0.5%, depending on the sample used for the estimates, which may or may not include advanced economies. Thus, based on this types of estimate, and factoring in an annual catching-up of 2% in GDP *per capita* terms for the CEECs, the appreciation of their real exchange rates due to the Balassa effect would be small, at around 0.5% to 1% *per annum*.

Chart 2
Relative price levels and GDP *per capita* compared with the European Union

(in log form)



Horizontal axis: relative GDP per capita
Vertical axis: relative price levels

NB: Regression line: $Log\,(P - P^*) = \underset{(6.2)}{0.245}\,Log\,(GDP_i\ per\ capita) + \underset{(27.3)}{2.9919}$

Source: Coudert and Couharde (2002).

3.2.2. Regressions using panel data

Most of the estimates concerning the CEECs use pooled time series for several countries, as the series are too short for reliable econometric calculations for a single country. For example, De Broek and Slok (2001) regress the real exchange rate on the productivity differential between sectors for a range of CEECs; depending on the specifications used, the elasticities obtained vary between 0.2 and 0.6, which is close to the results obtained by means of the estimates cited above, which use a cross-section approach. Using a similar regression based on panel data, Coricelli and Jazbec (2001) obtain an elasticity of roughly 0.5.

Given the large number of papers on the subject, it is impossible to address all of them in this article. It is also extremely problematic to summarise their findings. Breuss (2003) and Mihaljek and Klau (2003) attempted this by recapitulating the recent main estimates in a table. Their work is partially reproduced in Table 4. The average econometric estimates fall within a bracket of 0.4% to 3.8% *per annum*. However, the Table also shows that, while they refer to the same documents, the two surveys sometimes provide differing estimates.

Table 4
Econometric estimates of the Balassa effect, as a % *per annum*

Study	Sample used		Size of the Balassa effect estimated in the study	
	Countries	Period	According to Breuss' summary (2003)	According to Mihaljek and Klau's summary (2003)
Pelksman and *alii* (2000)	10 CEECs	1997-1999	3.8	–
De Broek and Slok (2001)	10 CEECs	1993-1999	1.4-2.0	0.2-0.6%
Halpern and Wyplosz (2001)	8 countries	1991-1999	2.0-2.2	3%
Coricelli and Jazbec (2001)	19 transition countries	1990-1998	0.7-1.2%	0.9-1.2%
Fischer (2002)	10 CEECs	1990-1998	1.9-2.6	0.7-2.2%
Égert (2002)	5 CEECs	1991-2001	0.5-1.8	–
Arratibel, Rodriguez-Palenzuela, Thimann (2002)	10 CEECs	1995-2001	"insignificant"	"insignificant"
Begg and *alii* (2003)	9 countries	1991-1998	0.4-1.4	–

Sources: Breuss (2003), Mihaljek and Klau (2003)

The results of these surveys are difficult to use. Indeed, there is no consensus about the method to be employed to estimate the size of the Balassa effect. Once the coefficient of the Balassa effect has been estimated in the regression, it must be multiplied by the relative productivity differential between sectors and countries (or the variable that approximates it). This is where the different approaches diverge. Roughly speaking, three methods are used implicitly: the average productivity differential observed over the estimation period (*e.g.* Mihaljek and Klau, 2003); for the latest year (*e.g.* De Broek and Slok, 2001), or else a forecast is used (as Coricelli and Jazbec, 2001, do very inaccurately). These three methods produce very different results. The discrepancies in the surveys probably derive from this stage of the process. A further difficulty resides in the fact that the data used vary considerably from one study to another. Thus, it is impossible to apply a single set of data as these are not necessarily the same as those used in the estimate.

The majority of the studies produced on the subject, accept the existence of a Balassa effect in the broad sense in the CEECs. Indeed, the usual indicators of the Balassa effect can be observed. Over the last decade, in most of these countries the following simultaneous developments can be noted: a rise in the relative prices of services, an increase in relative productivity in the tradable goods sector and a trend appreciation of the real exchange rate. Opinions differ, however, on the nature of this effect, which may also have other causes than those proposed by Balassa, such as the increase in consumer demand, in line with the Baumol-Bow effect, or the gradual dismantling of systems of administrated prices. Opinions also vary as to the magnitude of the effect. In recent econometric studies, this is often deemed to be modest on average across the CEECs as a whole. Estimates range, however, between 0.4% and 3.8% depending on the methods and the sample used. Some direct measurement that use a decomposition of the relative prices of sectors by country arrive at much higher estimates, particularly for countries such as Poland where productivity growth has been very strong in tradable goods.

The trend appreciation in real exchange rates observed in the CEECs over the past few years stems in part from a Balassa effect to be expected in a catching-up country. This component of real appreciation has occurred without loss of competitiveness and has therefore been without risk for external accounts. However, while the estimated Balassa effect goes some way towards explaining this real appreciation, other factors are also at work, notably capital inflows, that are fuelled by positive interest rate differentials with the euro area and are liable to exert upward pressures both on the nominal exchange rate and domestic inflation.

Another question relates to the persistence of the Balassa effect in the future. In principle, we should expect the Balassa effect to persist for the whole of the catching-up period – which should continue for at least the coming decade, before and after adoption of the euro. Obviously, the rise in relative prices in the CEECs compared with the euro area, *via* which the inevitable catching-up in price levels takes place, should, even after the adoption of the euro, be followed by an increase in inflation in these countries. The size of the effect will depend on the speed of the catching-up process. It will be unchanged if the productivity gains observed in the tradable goods sector continue at the same pace. This is dependent on continued inflows of direct investment.

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Appendix

Determination of the Balassa effect

We assume that the production functions in the two sectors are of the Cobb-Douglas type, as used, for example, by De Gregorio and *al.* (1994) and Obstfeld and Rogoff, (1996):

(A1) $Y_T = \theta_T L^{\alpha T} K^{1} - {}^{\alpha T}$

(A2) $Y_N = \theta_N L^{\alpha N} K^{1} - {}^{\alpha N}$

where Y designates output, L labour and K capital. The parameters a represent the share of labour in the sectors' value added. θ represents the total productivity of factors.

Under conditions of perfect competition, prices are set at marginal cost, the marginal rate of substitution between factors being equal to W/r.

(A3) $P_T = \theta_T^{-1} W^{\alpha T} r^{1-\alpha T} \alpha_T^{-\alpha T} (1-\alpha_T)^{-(1-\alpha T)}$

(A4) $P_N = \theta_N^{-1} W^{\alpha N} r^{1-\alpha N} \alpha_N^{-\alpha N} (1-\alpha_N)^{-(1-\alpha N)}$

where W is the wage rate, r the rate of return on capital, the two being common to the two sectors. We assume that there is perfect international mobility of capital ($i = i^* + \dot{E}^a$) and that there is purchasing power parity for the tradable goods sector $P_T / E = P_T^*$ or in evolution, $\dot{E} = \dot{P}_T - \dot{P}^*_T$, , so that real returns equalise between countries: $r = i - \dot{P}_T = r^* = i^* - \dot{P}_T^*$. Thus, the rate of return on capital r is exogenous and set by external factors. By differentiating equations (A3) and (A4) in log form, we obtain:

(A5) $\dot{P}_T = -\dot{\theta}_T + \alpha_T \dot{W}$

(A6) $\dot{P}_N = -\dot{\theta}_N + \alpha_N \dot{W}$

where $\dot{\theta}_i$ stands for growth of the total productivity of factors; and $\dot{W}$ the growth rate of wages. By taking the price of tradable goods as currency, $P_T = 1$, equation (A5) makes it possible to determine the wage rate W or its evolution.

(A7) $\dot{W} = \dfrac{\dot{\theta}_T}{\alpha_T}$

The growth rate of the relative price of non-tradable goods, marked $\dot{P}_r$, is obtained by subtracting (A6) from (A5) and taking account of (A7):

(A8) $\dot{P}_r = \dfrac{\alpha_N}{\alpha_T} \dot{\theta}_T - \dot{\theta}_N$

The general price index, P, obtained by taking tradable goods as currency, is given by $P = (1)^{\gamma} P_r^{\,1-\gamma}$

(A9) $\dot{P} = (1-\gamma)\dot{P}_r = (1-\gamma)\left(\dfrac{\alpha_N}{\alpha_T}\ \dot{\theta}_T - \dot{\theta}_N\right)$

Assuming now that all these relationships hold for the foreign country, we can also express the foreign price level P* in terms of tradable goods, and therefore in a common unit, since the tradable good has the same price in the two countries: $\dot{P}^* = (1)^{\gamma} P^{*1-\gamma}$, (assuming for the sake of simplicity that the share of tradable goods sector in demand, γ, is the same in the two countries). From this the change in the real exchange rate between the two countries can be deduced, which is the ratio of domestic prices to foreign prices:

$$\text{(A10)} \qquad \dot{P} - \dot{P}^* = (1-\gamma)\left(\frac{\alpha_N}{\alpha_T}(\dot{\theta}_T - \dot{\theta}_{T^*}) - (\dot{\theta}_N - \dot{\theta}_{N^*})\right)$$

Thus, the change in the real exchange rate depends on the relative productivity differentials of tradable and non-tradable goods between the two countries. Where the domestic economy is in the process of catching up and the foreign country a developed country, there should be a larger gain in relative productivity in the tradable goods sector, and therefore an appreciation of the real exchange rate.