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Kirsten Lommatzsch and Silke Tober



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Abstract

This paper argues that the Balassa-Samuelson effect is not of importance for the inflation target of the ECB. First, econometric tests of the Balassa-Samuelson effect suggest that its econometric significance is weak at best. Second, countries in the process of catching up require a real devaluation in the sector of tradable goods to maintain balance-of-payments equilibrium which counters the real appreciation resulting from a relative increase in service prices. It follows that whereas the Balassa-Samuelson effect could, at least in theory, be used to justify an inflation target well above zero, the difference in productivity growth and thus the difference in the size of the Balassa-Samuelson effect between countries as such cannot.

JEL-Classification: C32, E52, F41

Keywords: inflation target, Balassa-Samuelson effect, monetary policy

1. Introduction

The ECB has recently increased the precision of its “inflation target” by clarifying that it does not only have a medium-term upper limit of 2 % but is actually close to 2 % and by asserting that the prominent role of money growth applies to the medium term rather than the short-term analysis of the inflation outlook.¹ It is by now well understood that inflation targets should be relatively low because of the costs entailed by high anticipated and unanticipated inflation. High inflation increases uncertainty (about future inflation) because it makes it more difficult to distinguish between relative and absolute price changes thus giving rise to an option value of waiting which in turn reduces investment.² Furthermore divergent menu costs imply that high inflation causes relative price changes as well as incomplete indexation of the tax system can give rise to distortions.³ On the other hand, given that nominal interest rates cannot fall below zero, monetary policy is greatly restrained as inflation approaches zero – a fact that was recently stressed by the ECB’s chief economist Otmar Issing.⁴ Since the nominal interest rate is made up of the real interest rate and inflation expectations – the Fisher relation –, the real rate cannot be negative if the inflation target (and inflation expectations) are near zero. A very low inflation target thus reduces the central bank’s ability to affect aggregate spending and thus stabilise production in face of recessions or, worse still, if there is a danger of deflation.⁵ Another reason for an inflation target well above zero are problems in capturing quality improvements. So far, only few studies exist that calculate the bias in the inflation rate for the Euro Area or individual member countries. For Germany the bias is estimated at 0.5 – 1.5 percentage points; the only available estimate for the Euro Area suggests a bias of 0.4 percentage points.⁶

¹ Cf. The ECB's monetary policy strategy. ECB Press Release, 8 May 2003. The former ambiguity of the inflation target was criticized inter alia by the Bofinger (1999), Svensson (1999), German Council of Economic Experts (2002) and Svensson/Gerlach (2002); see also Schumacher/Tober (1999).

² Dixit/Pindyck (1994) show how a positive option value of waiting results in a high required rate of return on investment.

³ Cf. Feldstein (1999). A limited inflation tax may, however, be part of an optimal tax systems; cf. Phelps (1973).

⁴ See Issing (2002).

⁵ Deflation is caused by a drastic decline in aggregate spending and manifests itself not only in a general decline in prices but also recession, financial vulnerabilities and rising unemployment. Not only is investment deterred but the real burden of previously accumulated debt rises (debt deflation) which in turn gives rise to an increasing share of bad loans in the portfolio of banks. Deflations are “few and far between” (King 2002) but they do occur: in 1930-1933 the price level declined at a rate of 10 % per year thus giving rise to high real rates of interest (Bernanke 2002).

⁶ Estimates of these measurement problems are subject to high uncertainty and furthermore exist only for a few countries; cf. IMF (2002), Wynne/ Rodriguez-Palenzuela (2002) and Hoffman (1998).

An additional argument put forth in the literature for targeting a positive inflation rate is based on the empirical regularity that service prices have increased more than industrial goods prices during the past 50 years. This is often interpreted with reference to the Balassa-Samuelson model of differing productivity growth in industry and services. Due to the higher capital intensity, labour productivity growth in manufacturing exceeds that in services. As long as both sectors pay the same wages, the service sector will face wage increases above its productivity performance, that exert an upward pressure on prices. If industrial goods prices do not decline in response to productivity increases, the overall inflation rate in the economy will be both positive and higher than the inflation rate in industry. An inflation target that is lower than the productivity differential between the two sectors of the economy would imply falling prices of industrial goods. Although the Balassa-Samuelson effect should be especially pronounced in countries involved in the process of economic catch-up, such dual inflation may occur in any country that experiences higher productivity growth in manufacturing than in services.

Distinct from the question of divergent productivity developments in the services sector and the goods sector of the economy is the question of whether productivity differentials between the individual countries of the Euro Area justify a higher inflation target than the ECB's current implicit target of just under 2 %, i.e. whether a higher inflation target is needed to account for the differences in productivity and thus inflation rates between its member countries. We argue here that whereas the Balassa-Samuelson effect could, at least in theory, be used to justify an inflation target well above zero, the difference in productivity growth and thus the difference in the size of the Balassa-Samuelson effect between countries as such cannot. The effect is too weak to be used as justification of any inflation target of the ECB. Furthermore, countries in the process of catching up require a "real devaluation" in the sector of tradable goods to avoid balance-of-payments disequilibria given that relatively high GDP growth implies relatively high increases in imports.

The paper is structured as follows: Section 1 provides an overview of the Balassa-Samuelson effect and of studies quantifying its strength in the individual countries of the Euro Area. In sections 2 and 3 we present our own estimate of the Balassa-Samuelson effect, analyse why it is not as strong as theory (and some studies) would suggest and discuss the implication for the level of inflation in the individual countries of the Euro Area. Sections 4 and 5 assesses policy implications and concludes.

2. Earlier evidence of the Balassa-Samuelson effect in the Euro Area

Several studies have addressed the issue of dual inflation – higher inflation in services due to higher productivity growth in industry – and its impact on the overall inflation rate in the Euro Area. Assuming an overall inflation rate of 2 % in the Euro Area, Table 2 shows the calculated inflation divergences between the individual countries attributed to the Balassa-Samuelson effect under the (unrealistic) assumption that productivity differences fully translate into service inflation.

In their investigation of 1998, Alberola/Tyrväinen examined whether relative productivities can explain the development of relative prices in eight (future) member states of the Euro Area. They conducted cointegration tests for the basic relationship between relative productivities and relative prices and for an extended relationship that includes relative wages so as to account for heterogeneous wage developments. The sample period ranges from 1977-1995 and prices are measured as sectoral value-added deflators. The tests show that the basic relationship is found only in Belgium, in Germany and in Spain; whereas the extended model can explain the developments in relative prices in all countries except for the Netherlands.

In a panel estimate of differenced variables, de Grauwe and Skudelny test the effect for 13 of the 15 EU member countries for the time period 1971-1995 using five-year averages of the included variables. Prices are measured as CPI or GDP deflator in the case of non-tradables and PPI or export prices in the case of tradables. They estimate a fixed-effects model and find that differences in productivity growth translate into a change in CPI with a coefficient of 0.3. Using the relationships determined in the tests they find that on average the inflation differential between the sectors ranges between 0.07 and 0.6 %; with the maximum in individual years reaching 8 %. Canzoneri et al. (2001) also test the Balassa-Samuelson model within a panel framework. They conclude that while productivity differentials can explain part of the increase in the relative price of non-tradables, another important factor seems to be protection of the service sectors from competition.

Table 2

Hypothetical inflation divergence between the countries of the Euro Areacalculated on the basis of the Balassa-Samuelson effect¹

		Belgium	Germany	Greece	Spain	France	Ireland	Italy	Nether-lands	Austria	Portugal	Finland	Euro Area
Alberola-Tyrväinen (1998)	1975-1995	3.1	1.3	..	3.1	1.7	..	2.4	2.3	1.8	..	2.4	2.0
Canzoneri et al. (2001)	1973-1991	3.4	1.0	..	2.5	2.1	..	3.0	..	2.2	..	2.0	2.0
Sinn-Reutter (2001)	1987-1995	1.7	0.0	.	3.2	2.9	4.8	3.2	3.0	3.0	1.7	5.7	2.0
IMF (2002)	1995-2001	2.0	1.9	2.9	2.4	1.9	3.9	1.9	2.4	2.7	2.9	2.4	2.0
Lommatzsch-Tober (2003)	1992-2002	2.5	0.7	1.7	2.0	3.8	5.1	1.5	2.1	2.8	0.0	2.5	2.0

1 Adjusted for an average Euro-area inflation rate of 2.0 %. With the exception of Tober/Lommatzsch (see Table 3) calculated on the basis of the weighted average of the sectoral deflators, weights of the sectors in the production of income.

Sources: see references in the text.

Sinn/Reutter (2000) find that differences in productivity imply that inflation rates differ by up to 2.7 % among the countries of the Euro Area (adjusted for a Euro-Area average of 0.9 %). Their conclusion is based on a simple arithmetic exercise in which they calculate the inflation rates in the individual countries on the assumption that the Balassa-Samuelson model holds and that the relative price of non-tradables increases in accordance with the higher growth of productivity in the traded sector. For the calculation of the inflation rates they divide the price index of the respective country into prices of tradables and non-tradables, with the share of non-tradables equalling their share in value added.

In a somewhat different approach, the IMF (2002: 17) determines an HICP proxy based on the inflation differential between industrial goods (excluding energy) and services for the period 1995 to 2001. They assume that the average difference between goods and service price increases remains constant and on this basis find a maximum inflation differential between the individual countries of the Euro Area of 1.5 % (aligned to a euro area-wide inflation rate of 1.5 %). This calculation would imply an inflation rate of 1.4 % for Germany, France and Italy. Steady-state inflation rates extrapolated from past real exchange rate movements since 1985 yield a divergence in national inflation rates of 1.2 % and a rate of 1.1 % and 1.3 % for France and Germany respectively (IMF 2002: 19).

3. The Balassa-Samuelson model

The Balassa-Samuelson model is a supply-side explanation of the relative price of non-tradables based on the profit maximisation problem of firms. It is assumed that economies are characterised by two different production functions with constant returns to scale, one for the production of tradables, i.e. mainly industrial goods, and one for non-tradables, mainly services. A common variant of such production functions are Cobb-Douglas functions

$$Y_t = A_t \cdot L_t^b \cdot K_t^{(1-b)} \quad (1)$$

$$Y_{nt} = A_{nt} \cdot L_{nt}^c \cdot K_{nt}^{(1-c)} \quad (2)$$

where Y denotes output, A total factor productivity, L labour, K capital, t and nt the tradable and non-tradables goods sectors, respectively, and b and c the labour intensity in the two sectors.

The derivation of the Balassa-Samuelson effect is based on the following assumptions:

- labour is homogenous and wages are equal throughout the economy,
- the capital stock is fixed for one period ahead,
- interest rates are determined in the world market,
- traded goods prices are determined in the world market and therefore the same in all countries and
- capital intensity is higher in the traded goods sector (mainly industry) than in the non-traded goods sector.

The relative price of non-tradables is then determined by the profit maximum conditions (the first-order conditions):

$$A_t \cdot (1-b) \cdot \left(\frac{1}{K_t/L_t} \right)^b = \frac{i}{p_t} \quad (3)$$

$$A_t \cdot b \cdot \left(\frac{K_t}{L_t} \right)^{(1-b)} = \frac{W}{p_t} \quad (4)$$

$$A_{nt} \cdot c \cdot \left(\frac{K_{nt}}{L_{nt}} \right)^{(1-c)} = \frac{W}{p_{nt}} \quad (5)$$

$$A_{nt} \cdot (1-c) \cdot \left(\frac{1}{K_{nt}/L_{nt}} \right)^c = \frac{i}{p_{nt}} \quad (6)$$

where W denotes wages, i interest rates and p prices. Given that the capital stock, interest rates and prices in the traded goods sector are exogenous, the system of four equations explains four unknown variables. Equation 3 determines the capital labour ratio (and labour demand) in the traded goods sector, and Equation 4 the nominal wage in the industrial sector. Since the nominal wage set in the traded goods sector also holds in the non-traded goods sector, the non-traded goods sector adjusts the price of non-tradables and labour input. Therefore, the last two equations jointly determine labour input and the relative price of the non-traded goods. As long as the increase in the nominal wage exceeds productivity growth, the price of non-tradables will rise.

In the tests of the dual inflation model the case of changing tradables prices is often allowed for, and the tests focus on the price differential, i.e. the difference in the price level of the tradables and non-tradables prices. The basic testable equation can be derived from equating wages in the two first-order conditions of labour supply:

$$\frac{P_{nt}}{P_t} = \frac{\partial Y_t / \partial L_t}{\partial Y_{nt} / \partial L_{nt}} \quad (7)$$

If average productivity is used to approximate marginal productivity (which is easily permissible in the case of the Cobb-Douglas production functions), the tested relationship becomes:

$$\frac{P_{nt}}{P_t} = \frac{b}{c} \cdot \frac{Y_t / L_t}{Y_{nt} / L_{nt}} \quad (8)$$

This relationship shows that if wages equalise in the economy, higher increases in productivity in the traded goods sector relative to the non-traded goods sector will lead to an increase in the (relative) price of non-tradables. As the traded goods prices are assumed to be the same in all countries, in this model differences in the price level and in inflation rates between two countries can be traced back to different productivity levels in the traded goods sectors or to different growth rates thereof.

In the following we relax two assumptions of the basic model: that traded goods prices are the same in all countries and that wages equalise in the economy. Even if traded goods prices can deviate from world market prices, the Balassa-Samuelson model for dual inflation can still be applied to investigate the relative price of non-traded goods. However, in such a case the model cannot serve to fully explain the differences in inflation rates between countries, but only as a model that explains why service prices rise faster than industrial goods prices. The crucial pre-condition here is that the first-order conditions hold for the traded goods sector, i.e. that marginal productivity develops in line with the real wage.

Re-arranging equation (4), we can write:

$$b \cdot \frac{Y_t}{L_t} = \frac{W_t}{P_t} \quad (9)$$

or

$$P_t = \frac{W_t}{b \cdot (Y_t/L_t)} \quad (10)$$

which is the same as

$$P_t = \frac{1}{b} \cdot ULC_t \quad (11)$$

with *ULC* denoting unit labour costs.

With this modification it is sufficient that traded goods prices evolve in a predictable relationship with productivity developments. Because the real wage changes in line with productivity, any increase in the nominal wage above productivity growth will show up in prices. This predictable relationship continues to make it possible to determine the increase in the relative price of non-tradables that is caused by higher productivity growth in industry than in services.

It might furthermore be the case that the wages in the non-traded goods sector do not fully correspond to the wages in the traded goods sector, i.e. wage increases are either higher or lower than in the traded goods sector⁷. In this case, the basic relationship between relative prices and relative productivity might still exist, albeit altered by the wage ratio:

Relating prices of (4) and (5) leads to

$$\frac{P_{nt}}{P_t} = \frac{\frac{W_{nt}}{c \cdot (Y_{nt}/L_{nt})}}{\frac{W_t}{b \cdot (Y_t/W_t)}} \quad (12)$$

which can be re-arranged as:

$$\frac{P_{nt}}{P_t} = \frac{W_{nt}}{W_t} \cdot \frac{b}{c} \cdot \frac{Y_t/L_t}{Y_{nt}/L_{nt}} \quad (13)$$

If wages in the non-traded goods sector increase by less than in the traded goods sector, the price ratio will increase by less than suggested by the development in relative productivity. Provided that this difference is stable over time, the relationship between relative prices

⁷ This extension is similar to the extended model of Alberola/Tyrväinen (1998).

and relative productivity still exists, albeit with a coefficient of $(W_{nt}/W_t) * (b/c)$ instead of (b/c) .

In the case of a changing wage ratio, where nonetheless the profit maximum conditions hold for both sectors, the relationship between unit labour costs and relative prices might still be intact, and could be investigated instead of the relationship between productivity and relative prices:

$$\frac{P_{nt}}{P_t} = \frac{b}{c} \cdot \frac{ULC_{nt}}{ULC_t} \quad (14)$$

Such a relationship allows for the case that wages in the non-traded goods sector increase by more than productivity in this sector but by less than implied by the difference in productivity growth. The basic idea of the Balassa-Samuelson model is retained: higher productivity advances in the traded goods sector can lead to higher relative prices of non-tradables. However, the relationship between the relative prices and unit labour costs is based on less strict assumptions than the original model with regard to both the prices in the tradable sector and the wage mechanism, as it includes the case of an incomplete and changing pass-through of wage increases from the traded to the non-traded goods sector. This modification is all the more appropriate as using average labour productivity might distort the relationship between relative prices and relative productivity if one sector shows a stronger tendency towards part-time employment than the other. In the unit labour cost measures this effect would cancel out, because wage costs and value added are divided by the same measure of labour input.

4. Basic evidence from the Euro-Area countries

In this section, we take a first look at the differences in productivity, unit labour costs and price developments and their consequences for overall inflation and discuss the data used in the investigation.

Before calculating the sectoral developments, the crucial issue of how to separate the economy into a traded and a non-traded goods sector has to be addressed. The main problem in this respect is that the distinction between traded and non-traded goods differs between economies, depending on the openness to trade and competitive pressures from the world market. Furthermore, as all production involves some non-tradable goods such as public infrastructure, it is questionable whether a separation into tradables or non-tradables goods is viable at all.

In order to get a close approximation of the traded and non-traded goods, de Gregorio et al. (1994) classified as tradable goods those produced in sectors which export more than 10 %

of the production value; all other goods are classified as non-tradable. They find that the output of agriculture, mining, manufacturing and transport should be treated as tradables. Other tests use a less sophisticated classification in defining which sectors produce tradable and non-tradable goods. In most cases either manufacturing or manufacturing and agriculture are interpreted as the traded goods sector; all other sectors produce non-traded goods. Alberola/Tyrväinen (1998) chose to classify manufacturing and transport as tradables, market services as non-tradables and excluded agriculture as well as the public sector. De Grauwe/Skudelny (2002) equate the traded goods sector with manufacturing; the non-traded goods sector is calculated as the entire economy minus manufacturing, agriculture and mining. Sinn/Reutter (2000) define the tradable sector as agriculture and manufacturing, and the non-tradable sector as the remainder.

We decided to classify industry as the traded goods sector and market services (comprised of construction, trade, finance; i.e. groups F – K in the ESA95 classification of sectors) as the non-traded goods sector. This has a number of reasons. First, we excluded agriculture because price developments in this sectors are heavily influenced by the EU's Common Agricultural Policy. Second, the exclusion of the public sector is motivated by the fact that its prices are overwhelmingly neither market-determined nor driven by wage pressure. Third, the rather rough classification into industry and market services is due to availability of comparable data. Even so, lack of data made econometric tests possible for only eight of the twelve countries of the Euro Area.

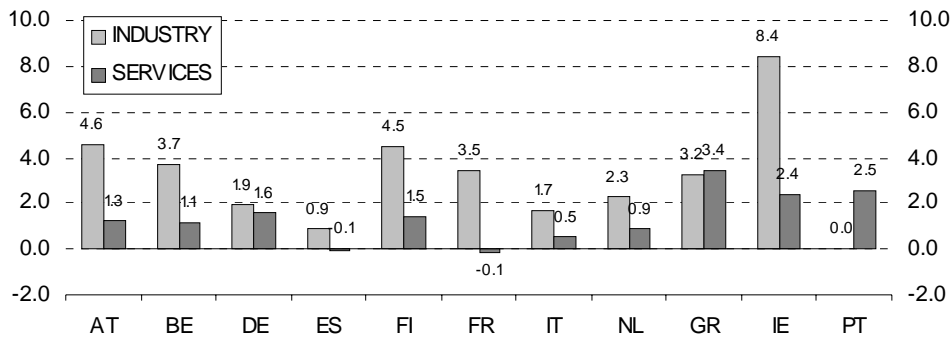
Our data set consists of data on productivity, unit labour costs and deflators in industry and market services, as well as prices of industrial goods and services within the HICP. Table 5 in the annex contains detailed information about the data and its sources. Productivity is measured as value added divided by total employment in the two sectors. This measure may be a biased, given the shift to more part-time employment. As already mentioned, however, this bias disappears when unit labour costs are used. Unit labour costs are defined as compensation of employees per employee divided by productivity (value added / total employment). Value added deflators relate nominal value added to real value added in each sector. The industrial goods prices in the HICP are provided by Eurostat as “industrial goods excluding energy”, services are “services (overall index excluding goods)”. For Germany domestic CPI and its components are used since the HICP series start only in 1995. Data of higher than annual frequency are seasonally adjusted, either as provided by Eurostat or on the basis of X-12 ARIMA.

Graphs 1 to 4 contain information about average annual growth in productivity, unit labour costs and prices in the two sectors for the period 1995-2001. Due to the unavailability of data on compensation of employees, unit labour costs were calculated only for Austria,

Belgium, Finland, France, Germany, Italy, the Netherlands and Spain. Furthermore, productivity data is available for Greece only on an annual basis and for the period 1995-2001; for Ireland quarterly data are available for 1997-2001. Portuguese data were calculated using a different classification, in that industry and construction are defined as tradables and services including the public sector as non-tradables. The productivity increases in the service sector may therefore be understated.

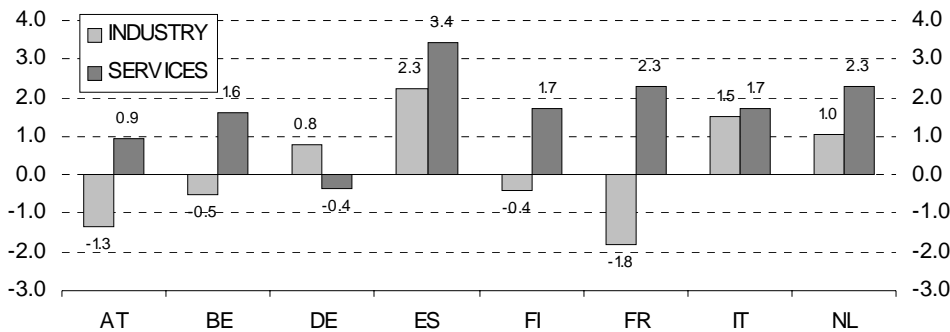
As the model suggests, productivity increases in industry were higher than in services in almost all countries, the exceptions being Greece and Portugal (Graph 1). The difference between the annual growth rates in productivity between the two sectors reaches values as high as 6 per cent. It is noteworthy that high productivity growth in industry is not experienced primarily by countries that could be considered as catching up economically. Besides Ireland it is Austria, Finland and France that exhibit above-average performance. In contrast, Spain records below-average productivity growth in both sectors.

Graph 1: Average annual productivity growth in industry and services, 1995-2001



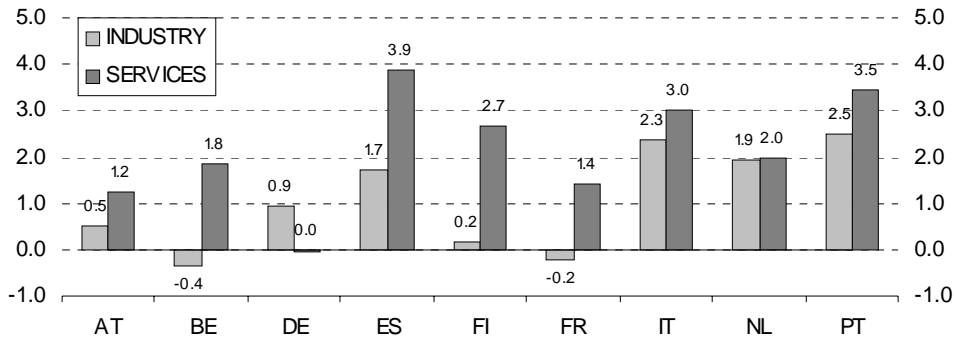
Source: Eurostat.

Graph 2: Annual average growth in unit labour costs in industry and services, 1995-2001



Source: Eurostat.

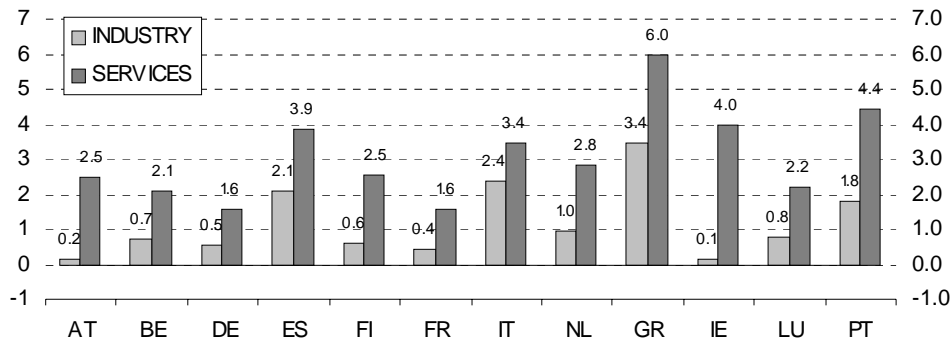
Graph 3: Annual average growth in sectoral deflators; industry and services 1995-2001



Note: Industry defined as C-E, Services as F-K (i.e. excluding public sector) in the ESA 95, with the exception of Portugal where industry includes construction and services the public sector.

Sources: Eurostat, OECD.

Graph 4: Annual average growth of components of the HICP: industrial goods excluding energy and services



Source: Eurostat.

The development of unit labour costs supports the idea that wage pressures are higher in the service sector (cf. Graph 2). A notable exception is Germany, where unit labour cost increases in industry exceeded those in services in the period 1995 to 2001. The graphs show that unit labour cost increases may differ from productivity growth, so that unit labour costs are a more appropriate measure of the actual cost pressure. In all countries except France and Spain, the differences in unit labour costs are lower than those in productivity. Four countries recorded declining unit labour costs in industry. If the relationship between unit labour costs and prices were stable, this would imply declining

prices in industry. A change in the relative prices would therefore not necessarily imply overall inflation – a proposition supported by the deflator series, according to which the value added deflator in industry declined in both France and Belgium. At the same time, in Germany the service deflator remained virtually unchanged, in line with the unit labour costs. All in all, however, the price series show the development as suggested by the original Balassa-Samuelson model: service prices have indeed risen more than prices of industrial goods. But the development of the value added deflators and the prices as measured in the HICP can differ markedly (Graphs 3 and 4). In almost all countries service prices in the HICP increased more rapidly than the service deflators. The differences are most pronounced in Germany where services in the HICP increased on average by 1,6 % per year whereas the service deflator remained unchanged. This difference between the value added deflator and the service measure in the HICP should stem mainly from indirect taxes and publicly provided goods such as health, indicating mechanisms other than the Balassa-Samuelson effect are also a source of high service inflation.

The data do not support the view that service prices have increased most in countries with a particularly large productivity differential. As regards productivity advances in industry and different sectoral productivity growth Finland and France are examples of countries that range among the highest during the period 1995-2002, they do not, however, have above-average increases in the relative price of non-tradables (Graph 4). In contrast, Greece, Portugal and Spain have at most slightly higher productivity growth in industry than in services, but their differences in the development of industrial goods and service prices are at least as high as the Euro-Area average.

To get a first impression of the impact of dual productivity growth on inflation in the Euro Area, we calculated a Euro Area-wide inflation rate (HICP) based on the assumption that the Balassa-Samuelson model holds. The annual increase in food, energy and industrial goods prices was set at 1 %, ⁸ and the price increases in services exceed those in industrial goods by the amount of the productivity differential (i.e. differences in productivity growth are translated in exactly this extent into an increase of the relative price of services). The weights for the individual categories are the weights used for the calculation of the Euro-Area HICP by Eurostat for the year 2002. ⁹ The productivity differential is the average difference in productivity growth in 1995-2001, exceptions being Portugal (1996-2001), Ireland (1997-2001) and Luxembourg (no productivity data available).

⁸ Although the choice of 1 % is somewhat arbitrary, it allows for positive inflation in these sectors even after accounting for the upward bias due to quality measurement problems.

⁹ The source is Eurostat New Cronos. The differences in weights between 1995 and 2002 are not very large; services gained in weight: in 1995 the weight was 34 % in 2002 39 %. This implies that using the weights of 2002 might slightly overstate the Balassa-Samuelson effect.

The results of this calculation are summarised in Table 3. The overall inflation rate in the Euro Area would amount to 1.6 %, with the service component reaching 2.5 %. The maximum deviation of inflation rates is 3.6 %, which is almost as the 4.6 % determined by Sinn and Reutter (here adjusted to our Euro-Area average of 1.6 %). However, it is quite surprising which countries would be characterised by high and low inflation rates if the model were a correct description of the driving forces of relative prices in the Euro Area. France and Austria become high inflation countries with inflation rates of 2.5 %, and service inflation of 4.3 % and 4.6 % respectively. In actual fact, however, Austrian and French service inflation amounted to only 3.3 % and 2.2 % respectively (not adjusted to a 1 % inflation in industrial goods the figures are 2.5 % for Austria and 1.6 % for France). At the same time, Greece and Portugal should have below-average overall inflation and their service inflation should come to 0.8 % and -1.5 % rather than the recorded 2.6 % in both countries (not adjusted to the 1 % in industrial goods the figures are 6 % for Greece and 4.4 % for Portugal).

Table 3

Arithmetic Balassa-Samuelson Effect

	country weight in the HICP of the Euro Area 2002	weight of industrial goods in the national HICP 2002	weight of services in the national HICP 2002	Average differ- ence in produc- tivity growth between the two sectors ¹	hypothetical inflation rate in services ²	hypothetical inflation rate in each country ³
Austria	3.2	31.1	45.1	3.3	4.3	2.5
Belgium	3.4	32.4	37.4	2.6	3.6	2.0
Germany	30.6	31.4	39.1	0.3	1.3	1.1
Spain	10.3	31.3	35.3	1.0	2.0	1.4
Finland	1.6	31.0	39.9	3.0	4.0	2.2
France	20.4	30.6	40.4	3.6	4.6	2.5
Italy	19.3	36.3	37.9	1.2	2.2	1.5
Netherlands	5.2	30.6	39.7	1.4	2.4	1.6
Greece	2.5	32.1	38.1	-0.2	0.8	0.9
Ireland	1.2	25.1	44.0	6.0	7.0	3.6
Portugal	2.1	30.8	36.9	-2.5	-1.5	0.0
Luxembourg	0.3	31.5	31.2	3.0	4.0	1.9
Euro Area	100.0	32.1	38.9	..	2.5	1.6

¹ Sector of tradable goods: Industry; sector of non-tradable goods: Services excluding public sector (C-E and F-K in the classification of the European System of National Accounts 1995)

Portugal: non-tradable goods sector comprises industry and construction; sector of non-tradables includes public sector
Ireland: 1998-2001; Luxembourg: estimate

² Differences in productivity growth are fully translated into change in the relative prices of services.

³ For the categories industrial goods, food and energy an annual inflation rate of 1 % is assumed, inflation in the service sector exceeds this rate by the hypothetical Balassa-Samuelson effect.

Sources: Eurostat; OECD; calculations of the authors.

In a second step we calculated the inflation rate using differences in unit labour costs instead of productivity differences (cf. Table 6). For the four countries, for which we do not have the required data, we assumed that the differences in unit labour cost equal the

differences in productivity.¹⁰ Because the differences in unit labour costs are on average smaller than the differences in productivity, overall Euro-Area inflation now declines to 1.4 % (services 1.9 %). According to this calculation, France contributes even more to the inflation rate, as its calculated overall inflation now reaches 2.7 %. For Germany declining prices in services are found and an overall inflation rate of only 0.5 %.

A comparison of the actual price developments (Graph 4) with these rudimentary calculations in which increases in either productivity or unit labour costs are fully translated into increases in the relative price of non-tradables makes it difficult to accept the hypothesis that the Balassa-Samuelson effect is the driving force behind price developments in the Euro Area. The suggested inflation rates differ greatly from the actual figures over the past decade. In the following, we test the effect econometrically in order to better assess whether there exists a relationship between relative prices and relative productivity.

5. Econometric tests

5.1 Tested relationships

In the following we explore econometrically whether two relationships related to the Balassa-Samuelson effect hold. Firstly, we test whether real wages in the traded goods sector develop in line with productivity, i.e. whether traded goods prices and unit labour costs in this sector are in a stable relationship. If this is the case, we can investigate secondly whether the Balassa-Samuelson model explains the development of the relative price of non-tradables by testing for a long-term relationship between relative prices and either relative productivity or relative unit labour costs. If wages develop similarly in the entire economy, both relationships should be found in the data; if the transmission of higher wages in the traded goods sector to the non-traded goods sector varies over time but nonetheless exists, only the second relationship can be determined.

The tests were performed for both price measures: the relative prices measured by the components of the HICP and the sectoral deflators. Of the 12 countries of the Euro Area, we could consider only Austria, Belgium, Finland, France, Germany, Italy, the Netherlands and Spain. Due to lack of data (in particular on compensation of employees) we could not analyse developments in Greece, Ireland or Portugal, although they would have been good examples for inflation developments during catch-up growth, and are of particular interest due to the observed price and productivity developments mentioned above. However, the higher service than goods inflation is a phenomenon found in all countries of the Euro

¹⁰ This assumption should generate an upward bias.

Area, and due to their relatively low weight in the overall HICP these countries are not the prime source of the overall tendency of service prices to rise faster.

The sample ranges from the first quarter 1991 to the second quarter of 2002. This choice is motivated mainly by the fact that we were interested in the recent developments, and that the series on the HICP start in 1991 for most of the member states. All series are normalised to 1 in the first included quarter and in natural logarithms. The tests were carried out for three time periods: 1q1991-2q2002, 1q1994-2q2002, 1q1995-2q2002. The choice of the first period was motivated by that the time series for Germany and the HICP series start only in 1991. The two shorter time periods were chosen to examine economies whose structures are as comparable to the current ones as possible. For example, more intense competition within the single market and the lack of exchange rate movements may have increased the ability of employers to keep wage increases below productivity growth and promoted social pacts aimed at wage moderation. If wages are determined in centralised or cross-firm bargaining processes, the targeted wage rise can be orientated with the aim of securing or improving the country's competitiveness within the monetary union.¹¹

5.2 Econometric method

In the econometric investigation we tested for cointegration. This is due to the non-stationary nature of the data which is to be expected already on theoretical grounds since the differences between sectoral productivity and prices are assumed to be growing over time. Cointegration was tested for with the Johansen procedure (Johansen 1995, Hamilton 1994). The advantage of the Johansen test is that its VAR framework allows for possible endogeneity of the variables. The testing procedure consists of the following steps:

- 1) Determination of the order of integration of the time series. Unless the series are of the same order of integration, cointegration relationships cannot exist. We tested for unit root test with Augmented-Dickey Fuller tests.
- 2) Determination of the lags to include in the VAR. Information criteria such as the Akaike, Hannan-Quinn and Schwarz criteria can be used to weigh parsimonious parametrisation against remaining auto-correlation of the residuals. We first looked at the Schwarz criterion, which lays more emphasis on parsimonious parametrisation. The Johansen cointegration test is carried out with this lag length if the residuals of the unrestricted VAR are not autocorrelated. This is tested for with the correlogram and

¹¹ Unlike de Grauwe/Skudelny (2000), whose time series span the period 1970-1995, we view the closeness of the period examined to the present as being more important than the length of the time series given structural breaks and the limited comparability of data as one goes back further in time.

the LM autocorrelation test. If there is autocorrelation in the residuals, we increased the number of included lags by one and tested again for autocorrelation.

- 3) The Johansen cointegration test was carried out with the smallest lag length that was found to be accompanied by unautocorrelated residuals.

In the Tables containing the results we report the lag length determined by the Schwarz, Hannan-Quinn and Akaike criteria, and the residuals characteristics for the chosen Johansen tests lag length.

5.3 Results

Table 4 provides an overview of the test results. Detailed test results and graphs of the tested series are in the annex. Relationship 1 refers to the first-order condition for labour demand in the traded goods sector, estimated in logarithms:

$$\ln P_t = \ln b + \beta * \ln ULC_t + \varepsilon_t$$

Relationship 2 refers to the Equations (8) and (14), where price differentials are connected to productivity or unit labour cost differentials:

$$\ln (P_{nt} / P_t) = \ln (b/c) + \alpha * \ln (Y_t / L_t / Y_{nt} / L_{nt}) + \varepsilon_2$$

or

$$\ln (P_{nt} / P_t) = \ln (b/c) + \chi * \ln (ULC_{nt} / ULC_t) + \varepsilon_3$$

where the coefficients α , β and χ are expected to be positive and equal to 1.

The unit root tests confirmed that most of the investigated series are integrated of order 1. In the case of industrial goods prices in the HICP we found that the series are I(2) with the exception of Belgium and France. Provided that the unit root test results are reliable, this means that it is not possible to find cointegration with the unit labour cost series integrated of order 1.

Table 4: Test results

	Relationship 1		Relationship 2	
	Sectoral deflators	HICP components	Productivity	Unit labour cost
Austria	No
Belgium	Yes	No	No	Yes (cointegration vector 1; -0.91)
Finland	Yes	...	No	No
France	Yes	No	No	Yes (cointegration vector 1; -0.44)
Germany	No
Italy	No
Netherlands	Yes	...	No	Yes (cointegration vector 1; -0.31)
Spain	Yes	...	Yes (cointegration vector 1; -2.47)	Yes (cointegration vector 1; -2.46)

Notes: We reject the hypothesis of no cointegration if the Johansen test finds cointegration for at least one of the time periods studied. No tests were carried out for the relationship ‘industrial goods prices in the HICP – unit labour costs in industry’ for Austria, Finland, Germany, Italy, the Netherlands and Spain, because of the I(2) nature of the series determined in the unit root tests.

As the results for relationship 1 show, we could establish cointegration between deflators and unit labour costs in industry in five of the eight countries. However, not in all cases was it possible to determine the relationships for all time periods studied.

In three cases (Austria, Germany and Italy), it turned out that productivity developments are not predictably reflected in the real wage. We had to exclude these countries from further tests for the reasons mentioned above: as prices in the traded goods sector cannot be related to the nominal wage and productivity development, the relative price cannot be explained with wage growth spilling over to the non-traded goods sector.

The determined cointegration relationships between unit labour costs and the industrial goods price series in the HICP for Belgium and France carry the wrong sign: declining unit labour costs are connected with rising prices. Such a relationship is not in line with the Balassa-Samuelson model, therefore we did not include the relative prices calculated on the basis of the HICP components in the tests for relative prices and relative productivity. However, this once again shows that further factors have to be considered when the development of the HICP components is to be explained.

The second test is for cointegration between relative prices and relative productivity or relative unit labour costs. If relative prices are related to relative productivities, this means that the wage pass-through is stable which should imply that there also exists a stable

relationship between relative prices and relative unit labour costs. The results summarised in Table 4 show that for four of the five countries for which we determined a stable relationship between the sectoral deflator and unit labour costs in the traded goods sector (Belgium, France, Netherlands, Spain), we were also able to find a long-term relationship between the relative deflator and relative unit labour costs. The coefficient of translation from unit labour cost differences to relative prices is close to 1 in Belgium, below 0.5 in France and in the Netherlands, and 2.6 in the case of Spain. Differences in the growth rates of unit labour costs between the two sectors may hence be related to lower or higher differences of growth rates in the relative price of non-tradables. However, it should be noted that as the model is estimated in logarithms, the implied coefficient is 1 in all cases. The fact that the coefficients can differ that much between the countries calls for further explanations, and these will lie outside the model. The relatively low coefficient determined for France implies that despite the rather high inflation calculated on the basis of productivity and unit labour cost differentials, France's hypothetical inflation would be much lower if the coefficients determined in the econometric test are used (cf. Table 7). At the same time, Spanish inflation now belongs to the highest. Including these four countries with their respective coefficients in the calculation of the Euro Area-wide inflation rate, yields an inflation rate in the service component of 1.5 % and an overall inflation rate of 1.2 %.

Only for Spain could we determine both the relationship between relative productivity and relative prices and between unit labour costs and relative prices. The similar coefficient suggests that in Spain wage increases do equalise between the sectors.

6. Rapid growth and balance of payments equilibrium: The case for a relative decline in the prices of tradables

In the previous section empirical evidence for the Balassa-Samuelson effect was analysed. It was found to be a relationship that is difficult to establish and even when established, the data in most cases suggest a less than proportional change in relative prices given a differential in unit labour costs between the sector of tradable and non-tradable goods. What follows from this for the inflation target of the European Central Bank? Our assertion is: Very little. This conclusion does not rest only on the size of the Balassa-Samuelson effect actually found but also on a broader macroeconomic look at fast-growing economies in which the Balassa-Samuelson effect is expected to be most pronounced.

Other studies that investigate and quantify the Balassa-Samuelson effect for the Euro Area draw a rather simple conclusion for the inflation target. The argument usually goes something like this: Economies in the process of catching up experience above-average

overall inflation as a result of above-average inflation in the service sector due to high economy-wide wage increases in response to above-average productivity growth in the tradable goods sector. So as to avoid very low inflation rates in the more developed, slower-growing economies – the argument continues – the inflation target of the ECB has to be set high enough to permit an adequate positive inflation rate in all countries despite the “inflationary” effects of the Balassa-Samuelson effect experienced by some. The higher inflation due to the Balassa-Samuelson effect is thus viewed as an equilibrium phenomenon.

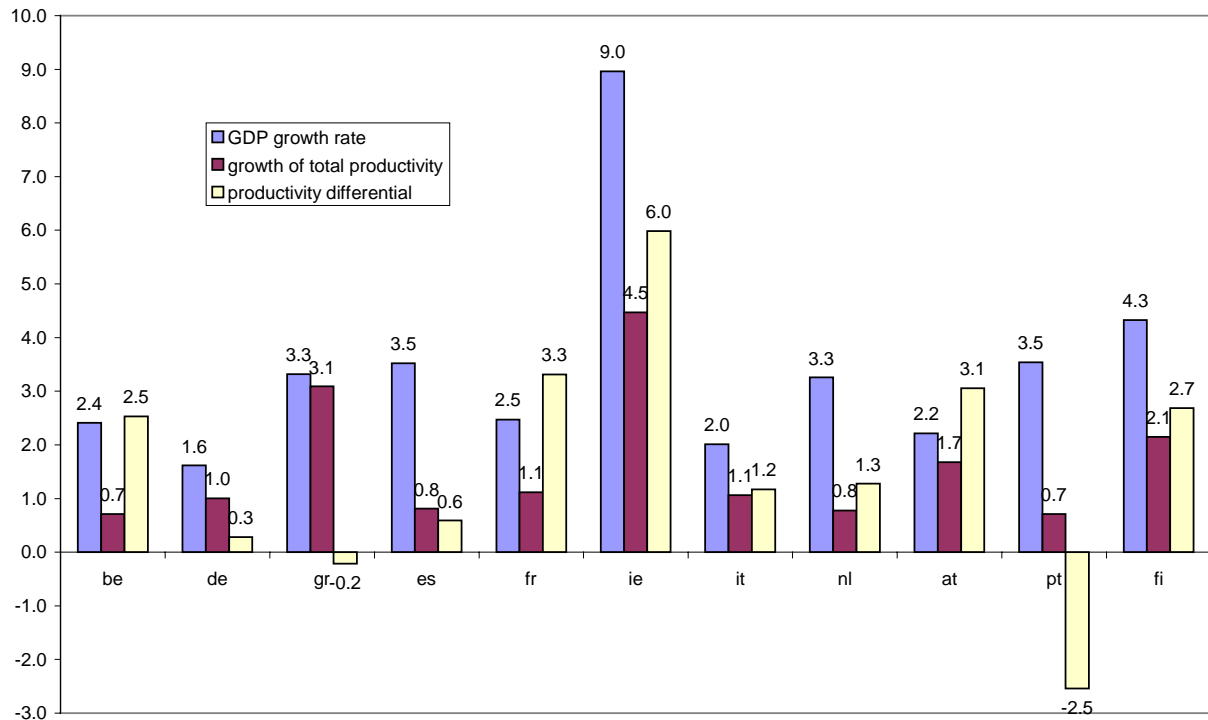
We reject this notion of a higher equilibrium inflation rate for faster growing countries because a broader macroeconomic perspective leads us to conclude that faster-growing countries will require below-average inflation rates in the sector of tradable goods to avoid balance of payments problems. If viewed from the perspective of macroeconomic models of open economies, above-average economic growth implies above-average import growth which will only be accompanied by above-average export growth if the international competitiveness of the respective country increases. This leads us to conclude that countries that experience above-average growth due to pronounced higher productivity growth in industry will require relatively declining prices in their tradable sector. Furthermore, divergent demand elasticities of imports and exports may require real exchange rate adjustments. Admittedly, a change in relative international prices assumes that goods produced in different countries are not perfect substitutes and PPP does not hold.¹² This is in contrast with the basic Balassa-Samuelson model as industrial prices are assumed to be the same across the countries. It can, however, be reconciled with the unit labour cost interpretation of the model, because this shows how the relative price of non-tradables is determined irrespective of whether PPP holds.

A closer look at GDP growth, total productivity growth and the productivity differential in the Euro Area (Graph 5) reveals that the high productivity differential in Austria, Belgium, Finland, France and Ireland has indeed been accompanied by rather high growth, albeit close to the Euro-Area’s average of 2.4 %, except for Finland and Ireland which experienced above-average growth. Greece, Portugal and Spain also recorded above-average growth but not high productivity differentials so that the roots of growth seems to have been either higher employment or high productivity growth in both sectors of the economy. Macroeconomic reasoning would hence suggest that the latter countries have to experience relatively declining industrial goods prices and at the same time nearly no

¹² Cf. Krugman/Obstfeld (1994) and Macdonald/Ricci (2002).

adjustment in the relative prices.¹³ This differs greatly from the development actually observed.

Graph 5: Growth rates in GDP, total productivity and the productivity differential; annual averages 1996-2001



Source: Eurostat, OECD.

In contrast, the five countries with high productivity differentials all recorded below-average increases in industrial goods prices, so that the substantial adjustment in relative prices occurred with rather low overall inflation.

In calculations for France (cf. Table 8) we found that the GDP elasticity of imports is 2.1. The export elasticity to foreign GDP is 1.8 and to the real exchange rate -0.9.¹⁴ In the case of no growth differential towards the Euro Area, industrial goods prices decline by 0.3 %; if growth were higher in France by 1 percentage point than in the Euro Area, industrial goods would have to decline by 2.6 %. In the latter case overall inflation in France would amount to 0.1 % with service prices rising at a rate of 1 % (the productivity differential

¹³ This conclusion on nearly no adjustment in the relative price might seem to contrast with the high coefficient between relative productivity and relative prices for Spain. However, as was already stressed, a coefficient different from 1 cannot be explained by the Balassa-Samuelson model.

¹⁴ Real exchange rate towards the other Euro-Area countries measured with the industrial goods prices in the HICP (cf. annex for the results of the test).

being 3.6 %) and given price increases in food and energy by 1 %.¹⁵ In the case of equal growth, inflation would amount to 1.5%.

The industrial goods prices in Greece, Spain and Portugal range from 1.8 % to 2.2 % in the period 1999 – 2002 (i.e. after the disinflation phase in the run-up to EMU), which is significantly above the Euro-Area average of 1 % in that period. This indicates either that these countries will run into serious problems of low competitiveness within the Euro Area, or that a further explanation is needed that explains the development of both tradables and non-tradables prices as an equilibrium phenomenon outside standard models of inflation during growth periods (macroeconomic open-economy models and the Balassa-Samuelson model). A similar observation has been made for EU candidate economies, where the trend increase in industrial goods prices is a major source of higher overall inflation and real exchange rate appreciation (Lommatzsch/Tober 2002), and can be related to other aspects of catch-up growth than divergent productivity growth between industry and services.

7. Conclusions

In our investigation we addressed the question of how high the inflation target of the ECB should be in view of possible structural inflation in countries with high industrial productivity growth. Concerning the Balassa-Samulson effect we found that if productivity differentials translated fully into service price inflation, service inflation would add 0.6 % to an assumed 1 % inflation rate for the rest of the economy as reflected in the HICP. Regarding the empirical tests of the Balassa-Samuelson effect, we conclude that it is rather difficult to establish the link between relative productivity and relative prices. The most reliable relationship can be found between the development of the relative prices calculated as deflators and unit labour costs (i.e. when actual wage growth in the non-traded goods sector is explicitly included). If the scarce evidence found were used to draw a general conclusion, it would be that differences in unit labour costs do not fully translate into differences in relative prices. However, the greatest difficulties in relating the Balassa-Samuelson effect to the inflation target of the ECB stem from the fact that the link could not be found for the HICP, on which the ECB focuses.

Irrespective of the size of the actual Balassa-Samuelson effect found we argue that above-average productivity growth coupled with above-average growth need not give rise to an above-average *equilibrium* inflation rate if one takes into account higher imports in the faster growing countries and the resulting necessity of below-average inflation in the sector

¹⁵ This factor may have to be adjusted to account for different volumes of exports and imports respectively.

of tradable goods to maintain balance of payments equilibrium. The Balassa-Samuelson effect could therefore only justify a higher inflation target if it is argued that industrial prices should not fall below a certain level – say 1 % – in any country. In this case it is the industrial goods prices in the fastest growing country that would serve as an argument for a higher inflation target, not the price developments in countries with slow growth.

Five arguments are presented of why the inflation target of the ECB should be well above zero and why in our opinion it should be set at 2 %.¹⁶ First, the inflation target should be well above zero because zero is the lower bound for nominal interest rates and the closer the inflation target is to this lower bound, the more restricted is the scope of monetary policy – especially when faced with the infrequent but serious danger of deflation. Second, measurement problems related to quality improvement imply a positive inflation target. The Balassa-Samuelson effect figures in the third argument, albeit not to justify different overall inflation rates in individual countries, but rather to suggest that the inflation target to be aimed at in all countries lies around 1 to 2 % if the increase in the price of tradables is not to fall below 1 % in any country. The fourth argument is very similar but related to the increase in regulated prices. The fifth and final argument to support our preferred target of 2 % is that it would be in line with the inflation targets of other major currency areas and thus reduce the occurrence of exchange rate changes due to inflation differentials.

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¹⁶ De Grauwe (2002: 702) also argues for an inflation target of 2 %, surrounded by a corridor of 3 percentage points. The majority of a committee called ECB Shadow Committee that comprises 18 members and includes De Grauwe also favours a point target of 2 %, albeit with a corridor of 1 % to 3 %. Charles Wyplosz is in favour of an inflation band of 1.5 % to 2.5 %, Patrick Artus of one that spans 1 % to 3 or 3.5 % and Svensson (2002a) stresses the importance of an *explicit* target which could be set either at 1.5 %, 2 % or 2.5 %. Cf. also Handelsblatt (2002, 2003).

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Portugal

Annual 1995-2002

	Included series	source
Productivity	GDP and value added in the sectors at 1995 prices in the A6 classification	Eurostat
	Employment, total and in industry including construction and services including public sector	OECD
Deflators	GDP and value added in sectors in 1995 prices as stated	
	GDP and value added in sectors at current prices	Eurostat
HICP	Components and weights	Eurostat

Table 6

Arithmetic Balassa-Samuelson Effect, based on unit labour cost differentials

	country weight in the HICP of the Euro Area 2002	weight of industrial goods in the national HICP 2002	weight of services in the national HICP 2002	Average differ- ence in unit labour cost growth between the two sectors ¹	hypothetical inflation rate in services ²	hypothetical inflation rate in each country ³
Austria	3.2	31.1	45.1	2.3	3.3	2.0
Belgium	3.4	32.4	37.4	2.2	3.2	1.8
Germany	30.6	31.4	39.1	-1.2	-0.2	0.5
Spain	10.3	31.3	35.3	1.2	2.2	1.4
Finland	1.6	31.0	39.9	2.1	3.1	1.8
France	20.4	30.6	40.4	4.1	5.1	2.7
Italy	19.3	36.3	37.9	0.2	1.2	1.1
Netherlands	5.2	30.6	39.7	1.3	2.3	1.5
Greece	2.5	32.1	38.1	0.0	1.0	1.0
Ireland	1.2	25.1	44.0	6.0	7.0	3.6
Portugal	2.1	30.8	36.9	-2.5	-1.5	0.0
Luxembourg	0.3	31.5	31.2	3.0	4.0	1.9
Euro Area	100.0	32.1	38.9	..	1.9	1.4

1 Sector of tradable goods: Industry; sector of non-tradable goods: Services excluding public sector (C-E and F-K in the classification of the European System of National Accounts 1995)

Portugal: non-tradable goods sector comprises industry and construction; sector of non-tradables includes public sector
Ireland, Greece, Portugal and Luxembourg as in the Table 3 as no unit labour costs in sectoral classification are available

2 Differences in unit labour costs growth are fully translated into change in the relative prices of services.

3 For the categories industrial goods, food and energy an annual inflation rate of 1 % is assumed, inflation in the service sector exceeds this rate by the hypothetical Balassa-Samuelson effect.

Sources: Eurostat; OECD; calculations of the authors.

Table 7

The Inflation Target of the ECB: Does the Balassa-Samuelson Effect Matter?

Arithmetic Balassa-Samuelson Effect, based on unit labour cost differentials and econometric estimates

	country weight in the HICP of the Euro Area 2002	weight of industrial goods in the national HICP 2002	weight of services in the national HICP 2002	Average differ- ence in unit labour cost growth between the two sectors ¹	hypothetical inflation rate in services ²	hypothetical inflation rate in each country ³	adjusted to 2% in the Euro Area
Austria	3.2	31.1	45.1	2.3	3.3	2.0	3.3
Belgium	3.4	32.4	37.4	2.2	2.9	1.7	2.8
Germany	30.6	31.4	39.1	-1.2	-0.2	0.5	0.8
Spain	10.3	31.3	35.3	1.2	3.9	2.0	3.3
Finland	1.6	31.0	39.9	2.1	3.1	1.8	3.0
France	20.4	30.6	40.4	4.1	2.8	1.7	2.8
Italy	19.3	36.3	37.9	0.2	1.2	1.1	1.8
Netherlands	5.2	30.6	39.7	1.3	1.4	1.2	2.0
Greece	2.5	32.1	38.1	0.0	1.0	1.0	1.7
Ireland	1.2	25.1	44.0	6.0	7.0	3.6	6.0
Portugal	2.1	30.8	36.9	-2.5	-1.5	0.0	0.0
Luxembourg	0.3	31.5	31.2	3.0	4.0	1.9	3.2
Euro Area	100.0	32.1	38.9	..	1.5	1.2	2.0

¹ Sector of tradable goods: Industry; sector of non-tradable goods: Services excluding public sector (C-E and F-K in the classification of the European System of National Accounts 1995)

Portugal: non-tradable goods sector comprises industry and construction; sector of non-tradables includes public sector Ireland, Greece, Portugal and Luxembourg as in the Table 3 as no unit labour costs in sectoral classification are available

² Differences in unit labour costs growth translated into change in the relative prices of services with the coefficient determined in the econometric tests (i.e. for the deflators)

if no relationship was found, the differences in unit labour costs are fully translated into the relative price of services

³ For the categories industrial goods, food and energy an annual inflation rate of 1 % is assumed, inflation in the service sector exceeds this rate by the hypothetical Balassa-Samuelson effect.

Sources: Eurostat; OECD; calculations of the authors.

Table 8

France: Foreign trade relationships

	Imports from Euro Area; volume	GDP in 1995 prices	Exports to Euro Area; volume	GDP of Euro Area excluding France, 1995 prices	Real exchange rate of FRF to the synthetic Euro; deflated with industrial goods prices in the HICP
Source	Eurostat	Eurostat	Eurostat	Eurostat, own calculations	IFS; Eurostat; own calculations
Unit root tests	t-statistic	t-statistic	t-statistic	t-statistic	t-statistic
Levels; all tests include trend and constant	-2.0668 (lag 1)	-2.5376 (lags 1-4)	-1.9621 (lag 1)	-2.1955 (lag 1)	-2.0593 (lags 1,2)
Differences; all tests include constant	-3.8603**	-2.9903* (lags 1-3)	-3.9856** (lag 1)	-3.8394** (lag 1)	-3.9180** (lag 1)

		Imports - GDP		Exports – Euro Area GDP excluding France and real exchange rate of the FRF to synthetic Euro deflated with industrial goods prices in the HICP		
Lag length of VAR determined by information criteria		SC=1	Lags 1-3	SC=1	HQ = AIC =2	Lags 1-5
LM test of autocorrelation for VAR residuals	Lag 1	0.50	0.54	0.03	0.59	0.50
	Lag 2	0.06	0.45	0.70	0.53	0.81
	Lag 3	0.12	0.48	0.35	0.54	0.51
	Lag 4	0.53	0.82	0.00	0.08	0.37
	Lag 5	0.68	0.25	0.31	0.09	0.59
	Lag 6	0.16	0.52	0.23	0.52	0.40
	Lag 7	0.18	0.37	0.93	0.81	0.66
	Lag 8	0.06	0.42	0.46	0.74	0.69
Trace statistic	CI = 0	5.48	21.04**	13.85	13.47	43.95**
	CI = 1	0.23	3.37	6.01	5.85	8.73
	CI = 2			1.21	0.12	0.63
Cointegration relationship			1; -2.09			1; -1.83; 0.90

Due to difficulties in the adjustment of a VAR without autocorrelation for the import equation, the determined relationships refer to different time periods: the import equation was determined for 1q1995-2q2002; the export equation for 1q1991-2q2002.

* denotes significance at 5%, ** at 1%.

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