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Assessment of Balassa-Samuelson Effect in Croatia

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1. Introduction[1]

In most Central and East European countries over the past fifteen years, the transition process was characterized by periods of high inflation and real appreciation of domestic currency. It is often argued that one of the main sources of such trends was the Balassa-Samuelson effect, i.e. the difference in productivity growth between tradable and nontradable sectors within a given country compared to abroad. Namely, according to the Balassa-Samuelson effect, if the difference in productivity growth between tradable and nontradable sector is higher in a given transition country than in the Eurozone, the relative price of nontradables will grow faster. Under a fixed exchange rate regime this will be reflected in higher growth of overall prices, while under a floating exchange rate regime it will result in a combination of higher inflation and appreciation of the nominal exchange rate. In both cases, the real exchange rate will consequently appreciate.

After opening their borders at the beginning of the 1990s, transition countries experienced intense technological progress which resulted in faster productivity growth in comparison to the more developed Eurozone countries. The productivity growth achieved here was higher for tradables than for nontradables. However, productivity levels in transition countries are still considerably lower than those in developed countries, so it is reasonable to expect that the process of real convergence will continue. This is why there is a particularly great interest in studying the Balassa-Samuelson effect in the new European Union member states. Since they are obligated to introduce the euro as the national currency, the Balassa-Samuelson effect associated with real convergence could impede nominal convergence and fulfilment of the necessary Maastricht criteria.

Growth of relative productivity in Croatia from 1998 to 2006, as in other peer countries was higher than in the Eurozone. On the other hand, after implementing the Stabilization Programme in the first half of the 1990s, inflation was brought down and remained low and relatively stable, so the inflation differential with the Eurozone was considerably less pronounced than in other transition countries. The factors that largely contributed to low inflation were the stable nominal exchange rate, foreign trade liberalization, intense competition in retail trade after the entry of large retail chains on the domestic market at the beginning of the 2000s and moderate growth of nominal wages. Thanks to the relatively stable nominal exchange rate and the relatively small difference in inflation in comparison to the Eurozone, changes in the real exchange rate were not pronounced as in other Central and East European countries. Despite this, testing the Balassa-Samuelson effect in Croatia is important due to the European Union accession process and entry into the Eurozone. This is because one of the criteria for adopting the euro as the official currency is maintenance of low inflation as measured by the consumer price index. Croatia did not meet this criteria in neither 2005 nor 2006. The question arises as to how much the Balassa-Samuelson effect contributed to this and could it impede the process of adoption of the euro as Croatia's national currency.

Therefore, the main goal of this paper is to assess the importance of the Balassa-Samuelson effect in Croatia and quantify its influence on inflation and the real exchange rate. Section 2 covers the theoretical background of the Balassa-Samuelson effect based on which

[1] We would like to thank Evan Kraft, Ljubinko Jankov, Vedran Šošić and Maja Bukovšak for their helpfull comments.

a model is derived. A brief review of the results of empirical research on the Balassa-Samuelson effect in Central and East European countries is then presented. This is followed by a brief description of data relevant to testing the Balassa-Samuelson effect in Croatia and its econometric estimation. Concluding remarks are provided on this basis.

2. Theoretical Background

Balassa (1964) and Samuelson (1964) identified the shortcomings of absolute version of purchasing power parity (PPP) as a theory of exchange rate determination.[2] They identified productivity growth differentials between the internationally traded and internationally non-traded goods sectors as a factor introducing systematic biases into the relationship between relative prices and real exchanges rates. Thus the model, named Balassa-Samuelson after them, says that faster productivity growth in the tradables sector in relation to the nontradables sector in a given economy in comparison to foreign economies will lead to higher growth of domestic prices, which will result in real appreciation of that country's currency. Productivity growth in the tradable sector will increase wages in that sector and, due to labour mobility between sectors, wages in the nontradable sector will also rise. Producers of nontradables must raise the prices of their products to be able to pay higher wages, which in turn leads to an increase in the overall price level in the economy.

The Balassa-Samuelson effect is shown using a traditional model with two countries in which there are two sectors: the internationally traded goods sector (*T*) and the internationally non-traded goods sector (*NT*). The model is based on four assumptions: 1) absolute PPP holds only for tradable sector; 2) wages in the tradable sector are determined by labour productivity in that sector; 3) labour is perfectly mobile within a country, but not between countries, which leads to equalization of wages between sectors or to maintaining a constant wage ratio; and 4) capital is perfectly mobile, within a country and between countries.

To formalize the model, the general price level is expressed as a weighted average of the prices of tradables and nontradables:

$$P = P_T^{\alpha} P_{NT}^{1-\alpha} \tag{1}$$

$$P^* = P_T^{*\alpha^*} P_{NT}^{*1-\alpha^*} \tag{1a}$$

where P_T is the price level of tradables, P_{NT} is the price level of nontradables, and α is the share of tradables in the consumer basket at home[3] and abroad (*).

The real exchange rate can be expressed as the relative price of foreign goods in terms of domestic goods:

[2] According to the absolute purchasing power parity theory, the nominal exchange rate between two countries is computed as the ratio of prices in these countries, so the real exchange rate should be equal to 1 or have a tendency to quickly return to this level if fluctuations occur for any reason whatsoever.
[3] If prices are measured by implicit GDP deflators, α is the share of tradables in GDP.

$$Q = \frac{EP^*}{P} \tag{2}$$

where E is the nominal exchange rate defined as the number of domestic currency units per one unit of foreign currency. Increase in Q denotes real depreciation of domestic currency.

By expressing equations (1) and (1a) in logarithms and substituting them into the equation (2)[4] also expressed in logarithms, we get:

$$q = e + \alpha^* p^{*T} + (1-\alpha^*) p^{*NT} - \alpha p^T - (1-\alpha) p^{NT} \tag{3}$$

By differentiating equation (3), we get the following expression:

$$\Delta q = (\Delta e + \Delta p^{*T} - \Delta p^T) + (1-\alpha^*)[\Delta p^{*NT} - \Delta p^{*T}] - (1-\alpha)[\Delta p^{NT} - \Delta p^T] \tag{3a}$$

Assuming that PPP holds for tradable sector, or that:

$$\Delta p^T = \Delta e + \Delta p^{*T} \tag{4}$$

it follows that the first expression on the right hand side of equation (3a) is equal to zero, so the equation can be rewritten as:

$$\Delta q = (1-\alpha^*)[\Delta p^{*NT} - \Delta p^{*T}] - (1-\alpha)[\Delta p^{NT} - \Delta p^T] \tag{5}$$

Assuming that it refers to a small, open economy, production functions in both sectors can be expressed using the Cobb-Douglas function of the following form:

$$Y^T = A^T L_T^{\chi} K_T^{1-\chi} \tag{6}$$

$$Y^{NT} = A^{NT} L_{NT}^{\delta} K_{NT}^{1-\delta} \tag{7}$$

where Y denotes production, A technology, L labour, and K capital. Parameters χ and δ are positive and less than 1. Assuming perfect competition and perfect mobility of factors of production, profit maximization implies:

$$W = A^T \chi \left(\frac{K^T}{L^T} \right)^{1-\chi} \tag{8}$$

$$W = \left(\frac{P^{NT}}{P^T} \right) A^{NT} \delta \left(\frac{K^{NT}}{L^{NT}} \right)^{1-\delta} \tag{9}$$

[4] Lower-case letters indicate variables expressed in logarithms.

$$R = A^T(1-\chi)\left(\frac{K^T}{L^T}\right)^{-\chi} \tag{10}$$

$$R = \left(\frac{P^{NT}}{P^T}\right)A^{NT}(1-\delta)\left(\frac{K^{NT}}{L^{NT}}\right)^{-\delta} \tag{11}$$

where W is the wage rate (measured in terms of tradables), R is the rental rate of capital on world market, and P^{NT}/P^T is the relative price of nontradables to tradables. By log-differentiating and rearranging equations (8)-(11) we get the domestic version of the Balassa-Samuelson effect[5]:

$$\Delta p^{NT} - \Delta p^T = \left(\frac{\delta}{\chi}\right)\Delta a^T - \Delta a^{NT} \tag{12}$$

It follows that prices of nontradables rise faster than prices of tradables if productivity growth in the tradables sector outpaces growth in the nontradables sector. This conclusion rests on the assumption of equal factor intensity of tradables and nontradables ($\delta = \gamma$). If, for example, $\delta > \gamma$, then even a small difference in productivity growth can lead to an increase in relative prices of nontradables. By substituting equation (12) into (5) and using equation (2), we get the international Balassa-Samuelson effect:

$$\Delta p - \Delta p^* = \Delta e + (1-\alpha)\left[\left(\frac{\delta}{\chi}\right)\Delta a^T - \Delta a^{NT}\right] - (1-\alpha^*)\left[\left(\frac{\delta^*}{\chi^*}\right)\Delta a^{*T} - \Delta a^{*NT}\right] \tag{13}$$

or

$$\Delta q = (1-\alpha^*)\left[\left(\frac{\delta^*}{\chi^*}\right)\Delta a^{*T} - \Delta a^{*NT}\right] - (1-\alpha)\left[\left(\frac{\delta}{\chi}\right)\Delta a^T - \Delta a^{NT}\right] \tag{14}$$

Assuming that factor intensity is equal in both sectors at home and abroad ($\delta = \gamma$) and that factor intensity ratios are equal at home and abroad ($\delta^*/\gamma^* = \delta/\gamma$), equations (13) and (14) can be simplified to:

$$\Delta p - \Delta p^* = \Delta e + (1-\alpha)(\Delta a^T - \Delta a^{NT}) - (1-\alpha^*)(\Delta a^{*T} - \Delta a^{*NT}) \tag{15}$$

and

$$\Delta q = (1-\alpha^*)(\Delta a^{*T} - \Delta a^{*NT}) - (1-\alpha)(\Delta a^T - \Delta a^{NT}) \tag{16}$$

Equations (15) and (16) show that faster growth of relative productivity in the tradables sector compared to the nontradables sector in the domestic economy as compared to

[5] This is actually the Baumol-Bowen effect. Baumol and Bowen (1966) argued that the growth of relative prices of services in comparison to goods (nontradables to tradables) in an economy is caused by faster productivity growth in the goods sector as compared to the services sector.

foreign economy will result in faster growth of domestic prices in relation to foreign prices and real appreciation of the domestic currency.

3. Review of the Empirical Literature

The Balassa-Samuelson effect has been empirically tested in numerous works, with the results largely confirming the theory. A brief overview of 58 research papers on this topic published from 1964 to 2004 can be found in Tica and Družić (2006), in which they show that empirical analysis has resulted in statistically insignificant coefficients and/or coefficients opposite to expectations in only six papers. In Central and East European countries assessments of the Balassa-Samuelson effect were spurred in particular by the process of joining the European Union and the question of meeting convergence criteria. The principle features of selected works for these countries are presented in Table 1.

Table 1. Review of Selected Studies on the Balassa-Samuelson effect in Central and Eastern Europe

Author	Country	Period	Results
Arratibel et al. (2002)	BG, CZ, EE, HU, LT, LV, PL, RO, SI, SK	1990-2001	BS effect not significant; principal source of difference in the prices of tradables and nontradables is the difference in market structure.
Cipriani (2001)	BG, CZ, EE, HU, LT, LV, PL, RO, SI, SK	1995-1999	Growth of relative labor productivity of 1% on average results in growth of relative prices of nontradables by 0.57%. Only 1% of inflation in the countries under observation can be explained by the
Coricelli and Jazbec (2001)	19 transition countries	1990-1998	Real exchange rate elasticity on productivity differential is 0.5.
Egert (2002)	CZ, HU, PL, SK, SI	1991-2001	According to the BS effect, equilibrium real appeciation was ca 0% for CZ, SI, SK, ca 1% for HU and ca 3% for PL.
Egert (2003)	EE	1993-2002	Average contribution of the BS effect to the general price level is between the 0.5 and 2 percentage points.
Egert et al. (2003)	CZ, EE, HR, HU, LT, LV, PL, SK, SI	1995-2000	BS effect does not significantly contribute to real exchange rate appreciation; other factors also important.
Egert (2005)	BG, HR, RO, RU, TR, UR	1991-2004	BS effect poorly determins the general level of inflation and real exchange rate, with the possible exception of HR; other factors more important.
Fischer (2002)	BG, CZ, EE, HU, LT, LV, PL, RO, SI, SK	1993-1999	Approximately half of change in equilibrium exchange rate can be explained by changes in productivity, approximately one fourth by changes in consumption, and approximately one fourth by changes in real interest rates.
Halpern and Wyplosz (2001)	CZ, EE, HU, LT, LV, PL, RO, RU, SI	1991-1998	Estimated annual appreciation due to BS effect is 3%.
Jazbec (2002)	SI	1993-2001	Growth in productivity differentials between tradables and nontradables by 1% spurs appreciation of real exchange rate by 1.5% and growth in the index of consumer prices by approximately 1.7%.
Loko and Tuladhar (2005)	MK	1995-2003	BS effect is not significant.
Lojschova (2003)	CZ, HU, PL, SK,	1995-2002	Average annual rate of real appreciation due to BS effect is 2.5% on average.
Mihaljek i Klau (2003.)	CZ, HR, HU, PL, SK, SI	1992-2001	Domestic BS effect runs between 0.3 and 1.6 percent; international between 0.1 and 1.8 percent.
Rother (2000)	SI	1993-1998	International BS effect runs between 1.5 and 2 percent.

Note: BG - Bulgaria, CZ - Czech Republic, EE - Estonia, HR - Croatia, HU - Hungary, LT - Lithuania, LV - Latvia, MK - Macedonia, PL - Poland, RO - Romania, RU - Russia, SI - Slovenia, SK - Slovakia, TR - Turkey, UR - Ukraine

Even though the authors use various econometric methods in their works to assess the Balassa-Samuelson effect and distinguish the tradable and nontradable sectors differently, their results most often confirm the presence of the Balassa-Samuelson effect in the observed countries. Here the contribution of the Balassa-Samuelson effect on inflation usually constitutes up to 3 percentage points. For example, Égert (2003) estimated that in Estonia the Balassa-Samuelson on average contributed to inflation from 0.5 to 2 percentage points. Lojschova (2003) showed that in Slovakia, the Czech Republic, Hungary and Poland the annual real appreciation rate due to the Balassa-Samuelson effect amounted to approximately 2.5% on average.

The existence of the Balassa-Samuelson effect in Slovenia is confirmed in papers by Rother (2000) and Jazbec (2002), who obtained similar results. Rother also argued that in the short term monetary and fiscal policy also significantly influenced the relative prices of nontradables, while over the long term their impact is difficult to assess due to discernible oscillations in the variables used.

Additionally, Égert (2002) showed that the difference in productivity growth between tradable and nontradable sectors is relatively low in the Czech Republic, Slovakia and Slovenia and, although considerably higher in Hungary and Poland, it does not entirely spill over into growth in the general price level due to the structure of the consumer price index. He also states that the real appreciation recorded in these countries that is higher than estimates of the Balassa-Samuelson effect can mostly be explained by changes in the structure of exports towards technologically more advanced products and demand factors prompted by GDP per capita growth.

According to Cipriani (2001) the Balassa-Samuelson effect is relatively weak because of relatively small share of nontradables in the consumer price index in the observed countries and the notable growth of productivity in both sectors, which was spurred by transition processes. He also states that a considerable portion of inflation in the observed countries is the result of other factors, such as growth in previously regulated prices which ensued after liberalization of individual sectors, and which spurred growth in nontradables prices that cannot be tied to changes in productivity.

In contrast to the aforementioned studies that confirm the existence of the Balassa-Samuelson effect in Central and East European countries, Arratibel et al. (2002), by separately testing the determinants of prices of tradables and nontradables, concluded that faster growth of prices of internationally traded goods sector than in the non-traded goods sector is mostly caused by differences in the market structure of these sectors, i.e. the degree of competition. They additionally stress the considerable impact of nominal wage growth, the features of fiscal policy and liberalization of the market on price changes. Similarly, Loko and Tuladhar (2005) cite the long-term transition process and the associated, and relatively low, technological growth and declining quality of internationally traded goods in comparison with trade partners as the predominant factors in real exchange rate trends in Macedonia. When contemplating inflation differentials in transition and developed countries, Egert (2005) believes that other factors must also be considered, and among the latter he stresses the impact of changes in export and total prices which are caused by depreciation or appreciation of the domestic exchange rate (exchange rate pass-through). He then cites the impact of oil shocks, cyclical factors, inflation inertia, adjustments of tradables prices and regulated prices and credibility of economic policy after bouts of hyperinflation.

An estimate of the Balassa-Samuelson effect in Croatia can be found in works by Mihaljek and Klau (2003) and Egert (2005), while in a work by Nestić (2004) Croatia is encompassed in a sampling of 27 European countries for which dependency of the price level on relative labour productivity is estimated. Mihaljek and Klau (2003) used data for the period from the first quarter of 1995 to the third quarter of 2001, in which the tradable sector included manufacturing, mining, hotels and restaurants and transport and communications, while the nontradables sector included the remaining activities, except agriculture, public administration, defence and compulsory social security. Using the ordinary least squares (OLS) method, they showed that productivity differential between tradable and nontradable sectors contributed to price differential between nontradables and tradables by 2.2 percentage points, and consumer price inflation (domestic Balassa-Samuelson effect) by 1.26 percentage points. This relatively powerful Balassa-Samuelson effect may be partially explained by the high share of nontradables in the consumer basket (as much as 58%) that is used by Mihaljek and Klau in their computations. At the same time, the assessment of the international Balassa-Samuelson effect was not statistically significant.

Based on data series for the 1991-2004 period[6] and use of the dynamic ordinary least squares (DOLS) method and the autoregressive distributed lag (ARDL) model, Egert (2005) also econometrically tested the assumption upon which the Balassa-Samuelson model is based and then estimated the Balassa-Samuelson effect. He concludes that, in contrast to the other countries under observation, the Balassa-Samuelson effect in Croatia could be important for an explanation of the general price level and the real exchange rate. If the entire period from 1991 to 2002 is considered, the estimated contribution of the Balassa-Samuelson effect to average annual consumer price inflation in Croatia largely differs depending on whether it is based on productivity data from national accounts or on industrial production data (from -0.06 to 0.63 percentage points). In contrast, the estimated contribution during the 1996 to 2002 period ran from 0.60 to 0.82 percentage points. It is worthwhile mentioning that this estimate was obtained with a considerably smaller share of nontradables in the consumer basket in relation to Mihaljek and Klau (2003), which is here 20%.

Nestić (2004) analyzed the dependency of price levels on relative labour productivity based on 1999 data for a group of countries. Even though the Balassa-Samuelson effect for Croatia is not directly evaluated, he concludes that the higher price level in Croatia compared to other transition countries can be partially explained by labour productivity differentials in the tradables and nontradables sectors. He also argues that, given the higher price level in Croatia in comparison to other transition countries and a structure of prices relatively similar to that of the EU, the convergence of the price level and inflation rate in Croatia could be relatively painless.

4. Data

Productivity and price series for Croatia and the Eurozone for the period from the first quarter of 1998 to the third quarter of 2006 are constructed below, as well as the real HRK/EUR exchange rate series. The selection of the period is constrained by the availability of officially published data. The consumer price index series begins with 1998, while for earlier periods it would be necessary to use data on retail prices, which would constitute a

[6] Certain assumptions are tested for briefer periods depending on the availability of data.

break in the price series, and every effort was made to avoid this. In addition, the value-added tax was introduced in Croatia in 1998, so a one-off influence of the tax system on prices was avoided in this fashion.[7] The series were constructed as base indices with 1998 as the base year and seasonally adjusted using the X-12 ARIMA method.

4.1. Productivity Series

Since data on the quantity of capital for Croatia (as in most other Central European countries) are not available, average labour productivity is used as an approximation for total factor productivity (Mihaljek and Klau, 2003). Average labour productivity was computed as the ratio between gross value added (constant 1997 prices) and number of employed in individual branches of the National Classification of Activities[8] (NCA), which encompassed those employed in legal entities and those employed in crafts and trades and the free lances..[9]

The existing literature does not offer a single unified method for classifying activities in the tradables and nontradables sectors, although the share of exports in total production in a given activity (often 10% is taken as a borderline value) and exposure to international competition and the possibility of trade arbitrage that enables PPP are often cited as possible criteria. These criteria are often difficult to apply to available data, so the classification largely depends on the subjective views of the author. Nonetheless, as Table 2 shows, the tradables sector regularly includes industry, while the nontradable sector most often consists of services. Agriculture is generally excluded from the analysis due to high dependency on government subsidies and intervention.

[7] Introduction of the value-added tax generally led to an increase in the prices of services due to a VAT rate that is higher than the sales tax rate, while the prices of certain goods decreased.

[8] A, B – agriculture, hunting, forestry and fishing; C, D, E – mining, quarrying, manufacturing, electricity, gas and water supply; F – construction; G – wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods; H – hotels and restaurants; I – transport, storage and communications; J, K – financial intermediation, real estate, renting and business services; L, M, N, O, P – public administration and defence, compulsory social security, education, health and social work, other community, social and personal services and activities of households.

[9] The number of employed does not include individual farmers. The share of employed individual farmers in the total employment figures fell from an average of 9.4% in 1997 to 3.2% in the first nine months of 2006. Exclusion of individual farmers is also consistent with the division of gross value added to the tradable and nontradable sector, wherein agriculture is excluded.

Table 2. Review of Methods for Classifying Activities in Tradable and Nontradable Sectors

Author	Tradable sector	Nontradable sector
Arratibel et al. (2002)	Manufacturing	-
Cipriani (2001)	Differs from country to country	Differs from country to country
Coricell and Jazbec (2001)	Manufacturing, extraction, electricity, gas and water supply, construction	Other
Egert (2002)	Industry	Services
Egert (2003)	Agriculture, hunting, forestry, fishing, manufacturing (incl. and excl. construction)	Wholesale and retail trade; hotels and restaurants; financial intermediation; real estate, renting and business activities (incl. and excl. construction); transportation, storage and communications; mining and extraction; electricity, gas and water supply; public administration and defence; education;
Egert et al. (2003)	Two combinations: industry and agriculture; industry	Other (excl. agriculture)
Egert (2005)	Several combinations: industry; industry and agriculture; industry, agriculture, transport and telecommunications; industry, transport, agriculture, telecommunications, hotels and restaurants; industry, transport, telecommunications, hotels and restaurants	Several combinations: other; other and real estate; other, real estate and agriculture; education, healthcare, public administration and other utilities; education, healthcare, public administration, other utilities and agriculture
Fischer (2002)	Industry	Services (excl. agriculture)
Halpern and Wyplosz (2001)	Industry	Services
Jazbec (2002)	Industry	Services
Loko and Tuladhar (2005)	Agriculture, manufacturing, extraction, trade	Other
Lojschova (2003)	Manufacturing	Services and construction
Mihaljek and Klau (2003)	Manufacturing, extraction, hotels, transport and communications	Other (excl. agriculture and public administration, defense, compulsory social security)
Nestić (2004)	Industry, incl. mining and extraction, electricity, gas and water supply	Construction, wholesale and retail trade and repair services, hotels and restaurants, transport, storage and communications, financial intermediation, real estate, renting and business services
Rother (2000)	Manufacturing	Other (excl. agriculture)

In this analysis, two sets of productivity data were constructed for Croatia. In the first set, the tradables sector encompasses industry, mining and quarrying and electricity, gas and water supply (*LPT1*), while in the second hotels and restaurants (*LPT2*) are added due to the high share of travel services (tourism) in the overall export of goods and services in Croatia.[10] The nontradables sector constitutes a residual, wherein the activities of agriculture, hunting, forestry and fishing were excluded from the analysis due to reasons mentioned earlier. Given that there is disaggregation into 6 branches of the NACE[11] in the Eurozone, one set was

[10] Some authors (Egert, 2005) contend that hotels and restaurants, despite the high share in exports, should not be classified in the tradables sector because their prices are primarily determined by domestic factors.

[11] Available NACE classification corresponds to classification according to the NCA with the exception being the aggregation of branches G, H and I.

constructed in which the tradable sector includes branches C, D, and E, while the residual, except agriculture, encompasses the nontradable sector.

Table 3. Productivity Series for Croatia and the Eurozone

Average labour productivity in the tradable sector	Activities in the tradable sector	Average labour productivity in the nontradable sector	Activities in the nontradable sector
CROATIA			
LPT1	C, D, E	LPNT1	F, G, H, I, J, K, L, M, N, O, P
LPT2	C, D, E, H	LPNT2	F, G, I, J, K, L, M, N, O, P
EUROZONE			
LPT_EU	C, D, E	LPNT_EU	F, G, H, I, J, K, L, M, N, O, P

4.2. Price Series

When constructing the series for the prices of tradables and nontradables in Croatia, data from the Central Bureau of Statistics (CBS) on the consumer price index and implicit deflators of individual GVA categories[12] were used. In this regard, when assessing the domestic Balassa-Samuelson effect, two data sets are distinguished. The first set includes prices of tradables expressed by the goods prices index (*CPI_G*) and prices of nontradables by the services prices index (*CPI_S*) of the consumer price index. For the second set, implicit deflators were used, so the prices of tradables (*DEFT*) are expressed by weighted implicit deflator index of branches C, D, E and H based on the NCA, where shares of gross value added of each of these categories in overall value-added activities classified in the tradable sector were used as weights. The prices of nontradables (*DEFNT*) are expressed by the weighted implicit deflator index of branches F, G, I, J, K, L, M, N, O and P according to the NCA, and the weights are computed in the same manner as those for tradables.

The consumer price index for Croatia and the harmonized consumer price index for the Eurozone (*HICP_EA*) are used to test the international version of the Balassa-Samuelson effect. Here it should be stressed that the consumer price index constitutes a comparable measure of inflation at the international level, and when developing it the CBS largely adhered to Eurostat's methodology for compiling a harmonized consumer price index. The domestic consumer price index differs from the harmonized index in several segments that should not influence the results of this analysis.[13] The implicit GDP deflator is used as the second measure of aggregate price levels.

[12] Various price index measures are used in works on assessment of the Balassa-Samuelson effect (consumer price index, GDP deflators, producer price index). The advantage of consumer price index is its comparability between countries, even though its internationally tradable and nontradable components are not clearly demarcated. Additionally, it is subject to the influence of indirect taxes, subsidies and price controls. Even though the producer price index better follows price changes in tradables, its construction is not uniform among different countries, which hinders international comparisons, and it often has poorer statistical qualities than the consumer price index (Turner and Van't dack, 1993).

[13] The consumer price index methodology in Croatia does not include the Eurostat guideline whereby the extent of the index necessarily encompasses foreign consumption in the domestic territory if it is significant and consumption of institutional households (e.g. retirement homes).

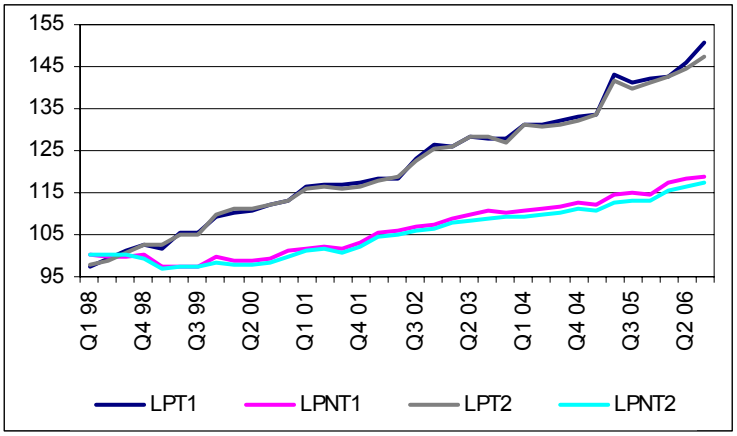
4.3. Real Exchange Rate Series

The real exchange rate of the Croatian kuna against the euro is computed by using the average quarterly nominal HRK/EUR exchange rate and the ratio of foreign and domestic prices. In the first case (*RER1*), the ratio between the harmonized consumer price index for the Eurozone and the consumer price index for Croatia was used, while in the second case (*RER2*) the ratio between implicit GDP deflators was used, and in the third case (*RER3*) the ratio between producer price indices was used.

5. Descriptive Analysis of Data and Testing of Model Hypotheses

Average labour productivity in Croatia from 1998 to 2006 increased by one fourth. Even though growth occurred in both sectors, Chart 1 shows that productivity growth in the tradables sector (*LPT1* and *LPT2*) was considerably more intense in relation to the nontradables sector (*LPNT1* and *LPNT2*). This is backed by data on average annual productivity growth, which was twice as high in the tradables sector than in the nontradables sector.

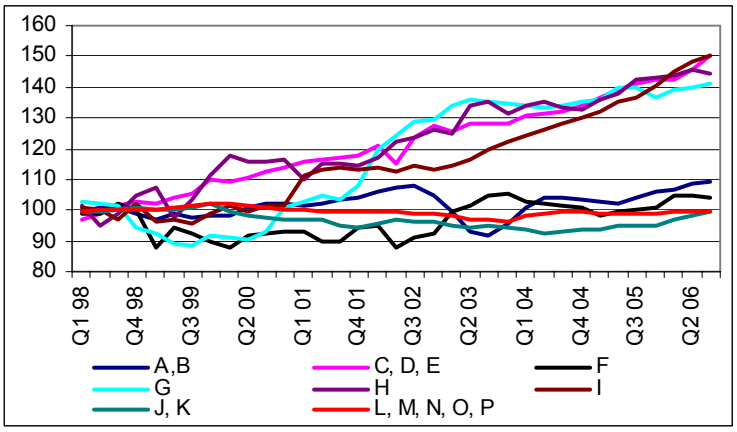
Figure 1. Labour Productivity in Croatia, 1998=100



Source: CBS

When observed in terms of NCA branches, the greatest increase in labour productivity was achieved in industry (branches C, D and E according to the NCA), which reflects the permanent growth of gross value added, and also the reduction of the number of employed, especially in manufacturing. High productivity growth was also achieved in transport and communications, followed by hotels and restaurants, and trade. One should keep in mind that the most intense labour productivity growth in trade, recorded in 2002, was the result of the entry of foreign retail chains on the domestic market, which was a one-time effect. Further intensification of competition also had a positive impact on productivity, but to a considerably lesser degree. On the other hand, labour productivity in financial intermediation and real estate and in public administration, defence, healthcare, education, etc. did not change significantly, which is a result of proportional growth of value added and the number of employed (Figure 2).

Figure 2. Labour Productivity in Croatia Based on NCA Branches, 1998=100



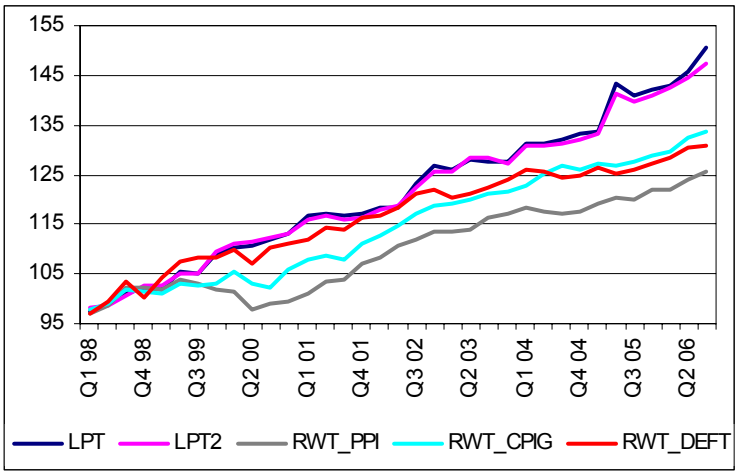
Source: CBS

In compliance with the theoretical assumptions of the Balassa-Samuelson effect, real wages in the tradable sector are determined by productivity in that sector, while labour mobility between sectors should result in equalization of nominal wages in the tradable and nontradable sector. In this manner, a transmission mechanism works, whereby differential in labour productivity between sectors influences price differential between tradables and nontradables. Thus, it will be necessary to more closely observe wage trends in Croatia hereinafter.

To compute real wages[14] (*RW*) in Croatia, three different tradables price indices were used: the price index for goods (*CPIG*), the producer price index (*PPI*) and the implicit deflator in the tradables sector (*DEFT*). Even though real wages in the tradables sector in Croatia increased by almost a third during the relevant period (Chart 3), their growth lagged behind productivity growth. This may be reflected in the weaker influence of relative productivity of tradables on relative prices of nontradables. These real wage trends in the tradables sector can be partially explained by the currently high unemployment and relatively high unit labour cost. However, in the long run, growth of wages cannot be expected to lag behind productivity growth, so the aforementioned transmission mechanism should gradually strengthen.

[14] Real wages are computed as the ratio of nominal wages and selected price index.

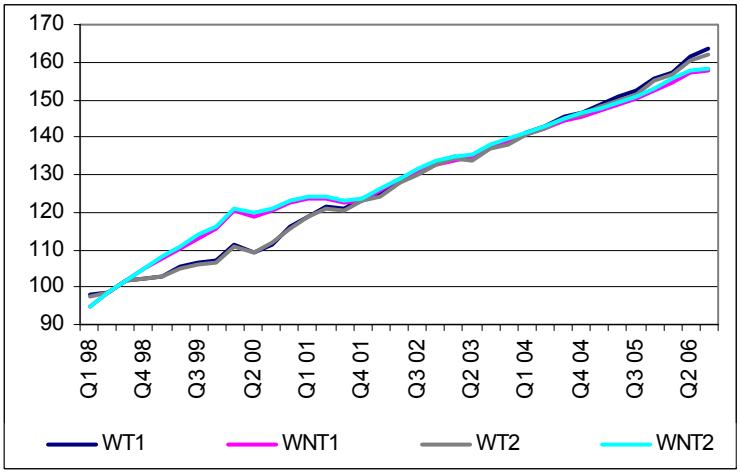
Figure 3. Labour Productivity and Real Wages in the Tradable Sector in Croatia, 1998=100



Source: CBS

On the other hand, Figure 4 shows how the assumption of the equalization of the nominal wages between the tradable (*WT*)[15] and nontradable sector (*WNT*), or the equalization of their growth if using the dynamic model, is met.[16] Furthermore, actual wage growth in the nontradable sector, which surpassed productivity growth in this sector, was possible only by raising prices. Figure 5 confirms that the prices of nontradables (*CPI_S* and *DEFNT*) grew faster than prices of tradables (*CPI_G* and *DEFT*).

Figure 4. Nominal Wages in Croatia, 1998=100

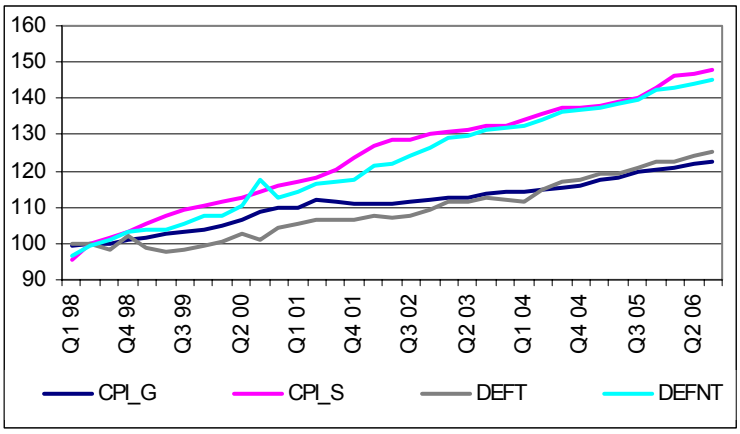


Source: CBS

[15] Depending on the method for classifying activities in the tradables and nontradables sectors, two data sets were constructed for wages in each sector.

[16] The occasional incongruities in wage levels recorded from the first quarter of 1999 to the first quarter of 2001 are the result of increased salaries in public administration, defence and healthcare.

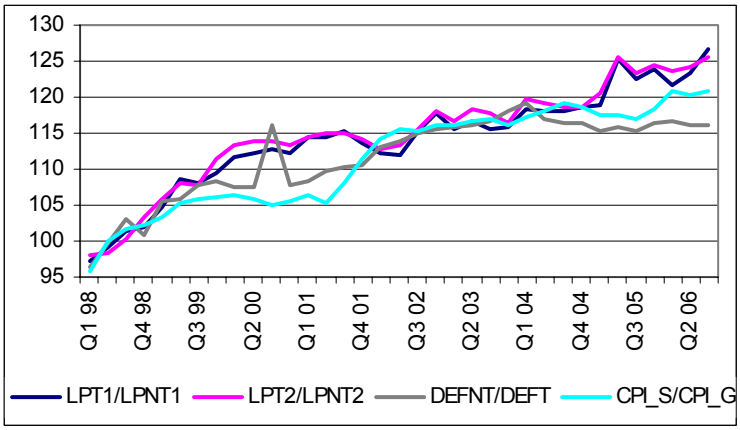
Figure 5. Prices of Tradables and Nontradables in Croatia, 1998=100



Source: CBS

Finally, Figure 6 shows how, pursuant to the theoretical model, relative prices of nontradables kept pace with relative productivity growth in the tradables sector, which backs the domestic version of the Balassa-Samuelson effect.

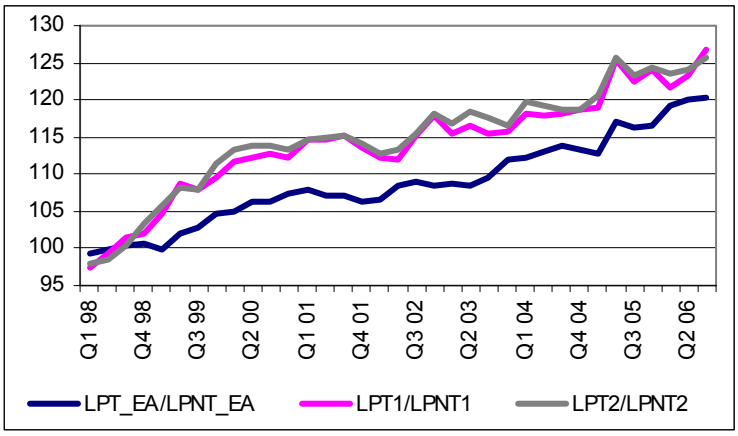
Figure 6. Relative Prices and Relative Productivity in Croatia, 1998=100



Source: CBS

On the other hand, if the difference in productivity growth between the tradables and nontradables sectors is higher in Croatia than in the Eurozone, the international Balassa-Samuelson effect comes into play. This means that prices in Croatia will grow faster than in the Eurozone, which should also result in appreciation of the real HRK/EUR exchange rate. Figures 7-9 show relative productivity trends in the tradable sector (in relation to nontradable) and general price levels in Croatia and the Eurozone from 1998 to 2006, as well as the real exchange rate during that same period.

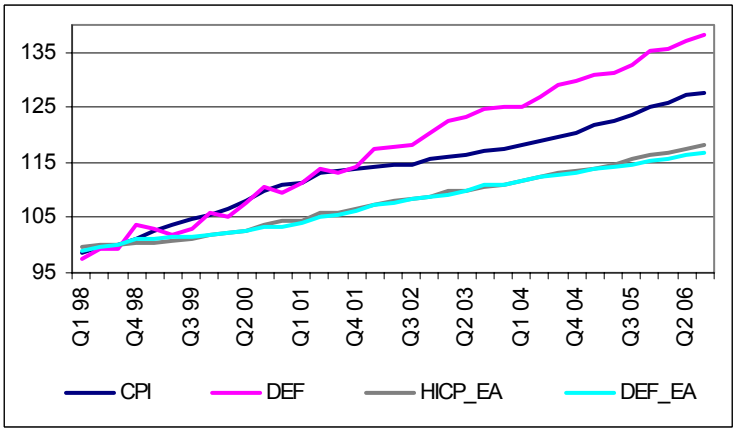
Figure 7. Relative Productivity in Croatia and the Eurozone, 1998=100



Sources: CBS; Eurostat

During the period under observation, growth of relative productivity in Croatia was somewhat faster than in the Eurozone, but the inflation differential between Croatia and the Eurozone was even more striking. This indicates the possible presence of the Balassa-Samuelson effect, even though the contribution of other factors was probably greater. Also notable is the fact that inflation between Croatia and the Eurozone is twice as low if consumer prices are compared to implicit deflators. This can be partially explained by the favourable effect of trade liberalization and lowering of imported goods prices, which contributed to maintenance of low and stable consumer price inflation in Croatia, which did not simultaneously affect implicit deflators. Maintenance of nominal exchange rate stability between the Croatian kuna and euro also greatly contributed to price stability.

Figure 8. Prices in Croatia and the Eurozone, 1998=100



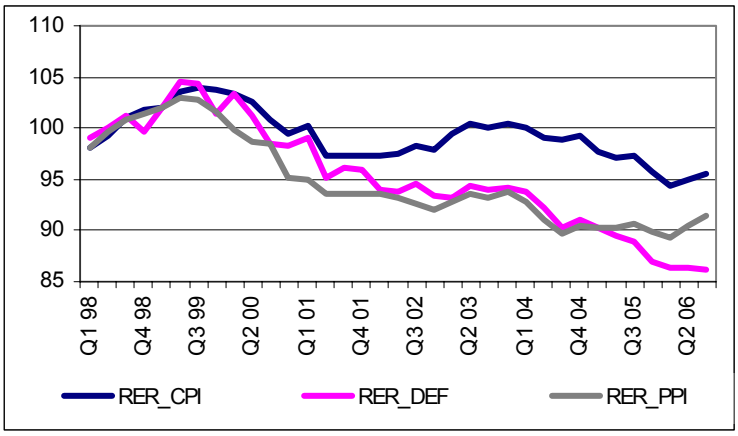
Sources: CBS; Eurostat

The nominal exchange rate between the Croatian kuna and the euro from 1998 to 2006 oscillated over a relatively narrow range of +/- 7% around the average exchange rate during this period. At the beginning of the observed period, exchange rate trends were predominantly influenced by depreciation pressures. These were prompted by increased demand for foreign exchange on the domestic market due to limited access to foreign capital markets by domestic firms and commercial banks, and by enhanced imports, foreign liabilities servicing and growth of uncertainty after a banking crisis. Over the past several years, appreciation pressures have been more marked, and these are the result of a significant inflow of foreign

direct investment (including privatization revenues), tourism revenues, appreciation expectations, etc.

Thanks to the relatively stable nominal exchange rate between the Croatian kuna and euro and the relatively small inflation differential in comparison to the Eurozone, changes in the real exchange rate in Croatia were not very remarkable. From 1998 to 2006 the real exchange rate deflated by consumer price index moved within a range of +/- 5%. The average annual real appreciation rate was only 0.6%,[17] which is considerably less than in many counties from the two preceding waves of European Union enlargement.

Figure 9. Real HRK/EUR Exchange Rate, 1998=100[18]



Sources: CBS; Eurostat; CNB; authors' computation

Since it operates via nontradables prices, the international Balassa-Samuelson effect can only explain appreciation of the real exchange rate computed using the consumer price index and implicit GDP deflators, but not the producer price index, which shows price trends for tradables. In other words, for the Balassa-Samuelson effect to explain real exchange rate appreciation, the PPP would have to hold for tradables, meaning the real exchange rate series deflated by tradables prices (PPI) would have to be stationary (Égert, 2003). Given that Figure 9 clearly shows that during the observed period the real HRK/EUR exchange rate deflated by producer price index paralleled the real exchange rate deflated by consumer price index (meaning that it declined over time), the recorded real appreciation most likely cannot be explained by the Balassa-Samuelson effect.

5.1. Simple Accounting Framework

During the period from 1998 to 2006, the average annual inflation rate for consumer prices in Croatia was approximately 3%, and nontradables (services) prices grew twice as fast (5%) as tradables (goods; 2.5%) prices. How much of the inflation differential between nontradables and tradables can be ascribed to the domestic Balassa-Samuelson effect (BS^d) and the extent of the Balassa-Samuelson effect on inflation (*Inflation BS*) prior to econometric analysis can be estimated with the help of the following equations (Égert, 2005):

[17] The average annual appreciation rate of the real HRK/EUR exchange rate index deflated by consumer price index was 0.3%, the real effective exchange rate index deflated by consumer price index was 0.7%, and deflated by producer price index 0.3%.
[18] A decline of the index indicates real exchange rate appreciation.

$$BS^d = \beta_1\left(\Delta PROD^T - \Delta PROD^{NT}\right) \quad (17)$$

$$InflationBS = (1-\alpha)\beta_1\left(\Delta PROD^T - \Delta PROD^{NT}\right) \quad (18)$$

where β_1 is the coefficient that connects relative prices of nontradables and relative productivity, $\Delta PROD$ is the annual growth of average labour productivity in the tradable (T) and nontradable (NT) sectors, while (1-α) is the share of nontradables in the consumer basket. An attempt shall be made to econometrically assess the value of β_1 in the continuation of this paper, but in compliance with the theoretical model, we can assume that it moves within a range from 0 to 1.

Table 4. Domestic Balassa-Samuelson effect – Simple Accounting Framework, Annual Growth Rates in Percentage

	CPI inflation	CPI^{NT}	CPI^{T}	CPI_DIFF**	$PROD^{T}$	$PROD^{NT}$	BS effect** (β_1=0,2)	BS effect** (β_1=0,4)	BS effect** (β_1=0,6)	BS effect** (β_1=0,8)	BS effect** (β_1=1)	Contribution of BS effect to inflation** (β_1=1)
1999	4,02	8,14	2,88	5,25	5,47	-2,09	1,51	3,03	4,54	6,05	7,57	1,74
2000	4,62	5,12	4,48	0,63	5,77	1,56	0,84	1,69	2,53	3,37	4,22	0,97
2001	3,73	5,36	3,35	2,01	4,81	2,70	0,42	0,85	1,27	1,69	2,12	0,49
2002	1,70	7,27	0,30	6,98	4,07	4,22	-0,03	-0,06	-0,09	-0,12	-0,15	-0,03
2003	1,75	2,57	1,56	1,01	4,67	3,27	0,28	0,56	0,84	1,12	1,40	0,32
2004	2,06	3,27	1,68	1,59	3,63	1,55	0,42	0,83	1,25	1,66	2,08	0,48
2005	3,34	2,89	3,44	-0,55	6,05	2,20	0,77	1,54	2,31	3,08	3,85	0,88
2006	3,02	5,09	2,41	2,68	4,65	3,60	0,21	0,42	0,63	0,84	1,04	0,24
Average	**3,03**	**4,96**	**2,51**	**2,45**	**4,89**	**2,13**	**0,55**	**1,11**	**1,66**	**2,21**	**2,77**	**0,64**

**In percentage points

Table 4 shows that during the observed period the difference in the average annual growth of prices of tradables and nontradables in Croatia was 2.45 percentage points. An assessment of the domestic Balassa-Samuelson effect depends on the assumed value of the coefficient β_1. If the productivity growth differential between tradables and nontradables does not influence the relative price of nontradables, the coefficient β_1 is equal to zero. On the other hand, if the β_1 is assumed to be equal to 1, the Balassa-Samuelson effect would be 2.77 percentage points. This means that when the productivity growth differential between tradables and nontradables completely flows into the inflation differential between nontradables and tradables and when it is the only factor affecting this differential, then it would be 2.77 percentage points. During the observed period, however, this was not the case, so the existence of barriers in the previously described transmission mechanism and/or the impact of some other factors is evident.

To assess the impact of the Balassa-Samuelson effect on general price level inflation, it is worthwhile to consider the share of services (nontradables) in the consumer basket in Croatia. This share was 23 percent, so it follows that during the observed period the contribution of the Balassa-Samuelson effect to average annual inflation, assuming that β_1 is equal to 1, was 0.64 percentage points on average,[19] which is almost identical to the result

[19] The average annual inflation rate measured by the implicit GVA deflator was 4.1%, which is 1 percentage point more than average annual consumer price inflation (CPI). Even though nontradables prices measured by implicit deflator grew slower than services prices in the consumer basket, the estimated impact of the Balassa-

obtained for the 1996-2002 period by Égert (2005). Nevertheless, it should be kept in mind that the assumption of the value of coefficient β_1 is probably overestimates the impact of the Balassa-Samuelson effect on domestic inflation. Namely, based on the results of econometric estimates of coefficient β_1 in the selected works, it is reasonable to expect that its value runs between 0 and 0.5.

The international Balassa-Samuelson (BS^m) effect was estimated on the basis of the following equation:

$$BS^m = \Delta p - \Delta p^* = \beta_2 \left[(1-\alpha)(\Delta PROD^T - \Delta PRODa^{NT}) - (1-\alpha^*)(\Delta PROD^{*T} - \Delta PROD^{*NT}) \right] \quad (19)$$

where $\Delta p - \Delta p^*$ is the inflation differential between Croatia and the Eurozone and β_2 is the coefficient that relates the relative productivity differential between Croatia and the Eurozone to the inflation differential. As in the case of the domestic version of the Balassa-Samuelson effect, an attempt will be made subsequently to econometrically estimate the value of coefficient β_2, but for now we shall assume that it is between 0 and 1.

Even though the productivity differential between tradables and nontradables during the observed period was higher in Croatia than in the Eurozone, the higher share of nontradables in the Eurozone consumer basket (41% as compared to 23%) resulted in a negative Balassa-Samuelson effect. This would mean that if only productivity differentials influence prices in Croatia and the Eurozone, Croatia's inflation would be lower, which was not the case in the observed period. It follows that some other factors exerted a greater impact on inflation differentials between Croatia and the Eurozone.

Table 5. International Balassa-Samuelson Effect – Simple Accounting Framework, Annual Growth Rates in Percentage

	CPI	CPI_EA	CPI_DIFF**	(1-α)*PROD_DIFF**	(1-α*)*PROD_EA_DIFF**	BS effect** (β_2=0,2)	BS effect** (β_2=1)
1999	4,02	1,14	2,88	1,74	0,94	0,16	0,80
2000	4,62	2,12	2,50	0,97	1,58	-0,12	-0,61
2001	3,73	2,36	1,38	0,49	0,34	0,03	0,15
2002	1,70	2,27	-0,56	-0,03	0,39	-0,08	-0,42
2003	1,75	2,07	-0,32	0,32	0,59	-0,05	-0,26
2004	2,06	2,14	-0,08	0,48	1,31	-0,17	-0,83
2005	3,34	2,17	1,16	0,88	0,91	0,00	-0,02
2006	3,02	2,00	1,03	0,24	1,51	-0,25	-1,27
Average	**3,03**	**2,03**	**1,00**	**0,64**	**0,95**	**-0,06**	**-0,31**

**In percentage points

Samuelson effect on inflation measured using the implicit GDP deflator was considerably higher, because the share of nontradables in GDP is triple its share in the consumer basket.

6. Econometric Analysis

What follows is an econometric analysis of the domestic and international Balassa-Samuelson effect in Croatia. For the needs of econometric analysis, the series described in the preceding two sections were transformed into logarithms. Such data only facilitates testing of the relative version of the Balassa-Samuelson effect rather than the absolute version (Égert, 2005). Prior to the actual estimate of the Balassa-Samuelson effect, the stationarity of all observed variables was tested using Augmented Dicky-Fuller (ADF) and Phillips-Perron tests; the results are shown in Appendix 1. Since all of the time series proved stationary after first differenting them, this makes it possible to use the ordinary least squares (OLS) method to estimate regression equations.

6.1. Domestic Version of the Balassa-Samuelson Effect

An estimate of the domestic version of the Balassa-Samuelson effect begins with the following equation:

$$\Delta \log(\frac{CPI^{NT}}{CPI^{T}})_t = c + \beta_0 \Delta \log(\frac{LP^{T}}{LP^{NT}})_t + \varepsilon_i \qquad (20)$$

where CPI^{NT} is the nontradables (service) price index, CPI^{T} is the tradables (goods) price index, LP^{T} is labour productivity in the tradables sector, and LP^{NT} is labour productivity in the nontradables sector. However, while testing model robustness it was established that the Breusch-Godfrey test indicates the existence of the serial correlation of residuals and therefore equation (20) was expanded by the lagged value of the relative nontradables price index logarithm as an additional independent variable:

$$\Delta \log(\frac{CPI^{NT}}{CPI^{T}})_t = c + + \beta_0 \Delta \log(\frac{LP^{T}}{LP^{NT}})_t + \beta_1 \Delta \log(\frac{CPI^{NT}}{CPI^{T}})_{t-1} + \varepsilon_i \qquad (21)$$

After expansion of the equation, based on the Breusch-Godfrey test the null hypothesis of the non-existence of serial correlation cannot be rejected. The results of the estimated equations indicate a very low level of significance of the coefficients, which pertains in particular to coefficient β_0 which plays a key role in the assessment of the domestic version of the Balassa-Samuelson effect. Even though the signs of estimated coefficients are positive as expected, the poor characteristics of the model (small R^2) and insignificance of the estimated coefficients indicate that by using the least squares method on the tested sampling change in domestic nontradables and tradables price differential cannot be explained by the change in differential between productivity in the tradables and nontradables sectors. Coefficient β_1 in equation (21) proved somewhat more significant.

Table 6. Overview of Estimated Coefficients and Accompanying t-statistics for Domestic Balassa-Samuelson Effect

	Dependent var.: $\Delta \log(\frac{CPI^{NT}}{CPI^{T}})_t$	
Independent variables	Equation (20)	Equation (21)
C	***0.0067 (2.9579)	0.0036 (1.6406)
$\Delta \log(\frac{LP^{T}}{LP^{NT}})_t$	0.0081 (0.0652)	0.0065 (0.0615)
$\Delta \log(\frac{CPI^{NT}}{CPI^{T}})_{t-1}$	-	*0.2964 (1.9945)
N	34	33
R^2	0.0001	0.1208

Note: ***, **, * indicates rejection of the null hypothesis at significance levels of 1%, 5% and 10%.

The coefficients in the model in which hotels and restaurants are added to the tradable sector, with prices shown by implicit deflators, have proven equally insignificant.

6.2. International Version of the Balassa-Samuelson effect

In line with the theoretical model, when assessing the international Balassa-Samuelson effect the real exchange rate or the difference between domestic and international prices can be used as a dependent variable, or changes of these variables if it is a dynamic model. In this paper several equations are therefore specified to obtain the highest-quality information on the impact of the Balassa-Samuelson effect on prices and the real exchange rate.

The first specification is based on theoretical equation (16):

$$\Delta \log RER_t = c + \beta_0 \Delta prod\_dif_t + \varepsilon_i \qquad (22)$$

where *RER* is the real Croatian kuna exchange rate deflated by consumer price index, while *prod_dif* is the productivity differential in the tradables and nontradables sector between the Eurozone and Croatia, weighted by shares of nontradables in consumer baskets

$$prod\_dif = (1-\alpha^*)\log(\frac{LP^{T\_EA}}{LP^{NT\_EA}}) - (1-\alpha)\log(\frac{LP^{T}}{LP^{NT}}).$$

The other two specifications of the model used to assess the international Balassa-Samuelson effect are based on theoretical equation (15). The dependent variable is the relative price differential between Croatia and the Eurozone. The independent variables are the nominal HRK/EUR exchange rate and the productivity differential in the tradable and nontradable sectors in Croatia and the Eurozone weighted by shares of nontradables in consumer baskets

$$(prod\_dif = (1-\alpha)\log(\frac{LP^{T}}{LP^{NT}}) - (1-\alpha^*)\log(\frac{LP^{T\_EA}}{LP^{NT\_EA}})):$$

$$\Delta \log(\frac{CPI}{CPI^{EA}})_t = c + \beta_0 \Delta prod\_dif_t + \beta_1 \Delta \log E_t + \varepsilon_i \quad (23)$$

Due to the problem of serial correlation, and to improve the model's features, in equation (23) the lagged value of the relative price differential between Croatia and the Eurozone was added as a dependent variable:

$$\Delta \log(\frac{CPI}{CPI^{EA}})_t = c + \beta_0 \Delta prod\_dif_t + \beta_1 \Delta \log E_t + \beta_2 \Delta \log(\frac{CPI}{CPI^{EA}})_{t-1} + \varepsilon_i \quad (24)$$

Even though R^2 increased with this expansion, it is still relatively low. As with the domestic version of the Balassa-Samuelson effect, the results of the estimated equations in the international version also indicate a statistical insignificance of the relative productivity differential to explain the change in the real exchange rate and the relative price differentials between Croatia and the Eurozone.

Table 7. Overview of Estimated Coefficients and Accompanying t-statistics for the International Balassa-Samuelson Effect

	Dependent variable: $\Delta \log RER_t$	Dependent variable: $\Delta \log(\frac{CPI}{CPI^{EA}})_t$	
Independent variables	Equation (22)	Equation (23)	Equation (24)
C	-0.006 (-0.3396)	***0.0026 (3.4549)	*0.0014 (1.7714)
$\Delta prod\_dif$	-0.2232 (-0.5801)	0.1744 (1.10425)	0.2048 (2.6998)
$\Delta \log E_t$	-	0.0280 (0.3572)	-0.0572 (-0.7497)
$\Delta \log(\frac{CPI}{CPI^{EA}})_{t-1}$	-	-	**0.4378 (2.6998)
N	34	34	33
R^2	0.0104	0.0476	0.2298

Note: ***, **, * indicates rejection of the null hypothesis at significance levels of 1%, 5% and 10%.

The described results comply with the research by Mihaljek and Klau (2003), who also obtained an insignificant coefficient with an independent variable of the relative productivity differential for Croatia in their analysis of the international Balassa-Samuelson effect in Central European countries. Even though their estimate encompassed data for a different period (1996-2002) than this paper, a confirmation of the results indicates that other factors exert a stronger impact on the relative price differentials in Croatia and the Eurozone, meaning that the impact of the Balassa-Samuelson effect in Croatia is considerably less marked in Croatia than in other countries with comparable features.

7. Conclusion

As in other Central and East European countries, testing of the Balassa-Samuelson effect in Croatia is particularly interesting given the prospects of its accession to the European Union and the subsequent introduction of the euro as the national currency. It is believed that its strong impact may hinder the fulfilment of convergence criteria as these pertain to inflation and the exchange rate.

However, the Balassa-Samuelson model is based on relatively rigid assumptions that are only partially met in Croatia. Despite this, by using simple accounting framework it was estimated that during the observed period the average contribution of the Balassa-Samuelson effect to annual inflation was a maximum of 0.64 percentage points. On the other hand, the international Balassa-Samuelson effect provided no theoretically acceptable results, with considerably lower share of nontradables in Croatia's consumer basket as compared to the Eurozone contributing to this. To more precisely assess whether there is a Balassa-Samuelson effect in Croatia and to what extent it operates, an econometric analysis was conducted, which showed the statistical insignificance of the coefficients that explain the Balassa-Samuelson effect (domestic and international).

The impossibility of confirming a link between relative productivity and relative prices, i.e. the low significance of the Balassa-Samuelson effect, can be explained by several factors. Thus it is possible that labour market rigidity and high unemployment in Croatia weakened the mechanism whereby productivity growth should spur higher wages. On the other hand, tradables prices are greatly influenced by market liberalization and reduction of tariff and non-tariff barriers on foreign trade, which contributed to more intense competition on the domestic market, that in turn limited higher price growth. Growth of tradables prices, however, was probably greatly influenced by the process of deregulation of earlier administratively regulated prices.

Ultimately we can conclude that the presence of the Balassa-Samuelson effect in Croatia is obviously less marked than in similar countries, so its influence on inflation and real exchange rates should not constitute a barrier to meeting convergence criteria, rather attention should be dedicated to other factors that lead to price increases in Croatia. Finally, further testing and estimates of the Balassa-Samuelson effect in Croatia are vital to a better understanding of this economic phenomenon.

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Appendix 1. Results of Augmented Dicky-Fuller (ADF) and Phillips-Perron (PP) Tests for Stationarity of Variables

Variables	ADF		PP	
	t-value		t-value	
	Constant	Constant and trend	Constant	Constant and trend
cpi_nt_t	-2,6067	-2,0422	-2,3633	-2,8326
Δ cpi_nt_t	-4,9444***	-4,7804***	-4,9367***	-4,7825***
lp_nt_t	-1,9138	-3,1928	-2,2021	-3,2074*
Δ lp_nt_t	-3,4557**	-3,4760*	-6,7111***	-6,7666***
rer	-0,8021	-5,2624***	-1,3844	-2,7445
Δ rer	-4,7641***	-4,7670***	-4,8371***	-4,8826***
cpi_dif	-2,5303	-4,1895**	-3,3395**	-2,4452
Δ cpi_dif	-3,8052***	-4,0796**	-3,7670***	-4,1349**
prod_dif	-0,8857	-3,3231*	-0,8857	-3,1783
Δ prod_dif	-6,1367***	-5,4444***	-6,7730***	-8,5485***
e	-3,9826***	-4,1802**	-3,5144**	-3,7464**
Δ e	-3,9021***	-4,0950**	-3,8936***	-4,1835**

Note: ***, **, * indicates that the non-stationarity assumption can be rejected at levels of significance of 1%, 5%, 10%.

Description of variables:

$$cpi\_nt\_t = \log(\frac{CPI^{NT}}{CPI^{T}})$$

$$lp\_nt\_t = \log(\frac{LP^{T}}{LP^{NT}})$$

$$rer = \log(RER)$$

$$cpi\_dif = \log(\frac{CPI}{CPI^{EU}})$$

$$prod\_dif = (1-\alpha)\log(\frac{LP^{T}}{LP^{NT}}) - (1-\alpha^{*})\log(\frac{LP^{T\_EU}}{LP^{NT\_EU}})$$