ASSESSMENT OF THE BALASSA-SAMUELSON EFFECT IN CROATIA[1]

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Abstract

The main objective of this paper is to assess the importance of the Balassa-Samuelson effect in Croatia and to quantify its influence on inflation and the real exchange rate. The productivity growth differential between tradable and nontradable sectors within a given country compared to abroad has recently often been used to explain the real appreciation of Central and East European (CEE) transition countries' currencies against euro, and also to explain the inflation differential between the aforementioned countries and the euro area. Since all new EU member states 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. The main conclusion of this paper is that in the period from 1998:Q1 to 2006:Q3 the Balassa-Samuelson effect in Croatia was not statistically significant, so it should not constitute a barrier to meeting convergence criteria.

Key words: Balassa-Samuelson effect, tradables and nontradables, relative prices, productivity, inflation, real exchange rate, Croatia

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1 Introduction

After initial price liberalization, macroeconomic developments in most Central and East European countries over the past fifteen years have been at least partially characterised by inflation higher than the euro-area average and by a long-term trend of real and, in some cases, nominal appreciation of the domestic currency. It is often argued that one of the main sources of such trends was the Balassa-Samuelson effect, i.e. a productivity-growth differential between tradable and nontradable sectors within a given country as compared with other countries. According to the Balassa-Samuelson effect, if the productivity growth differential between the tradable and the nontradable sector is higher in a given transition country than in the euro area, the relative price of nontradables will grow faster in this transition country. 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, consequently, the real exchange rate will 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 euro area 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 assume 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 countries. After fulfilment of the convergence criteria set out in the Maastricht Treaty those countries are obligated to introduce the euro as the national currency and become members of the Economic and Monetary Union. Since one of the criteria consists of high price stability there is a concern that a pronounced Balassa-Samuelson effect associated with real convergence could impede nominal convergence and postpone the introduction of the common currency. This could happen if the Balassa-Samuelson effect were higher than 1.5 percentage points annually - permissible divergence of inflation rate in the candidate country from the average inflation rate in three best-performing member states of the EU, according to the Maastricht Treaty.

The growth of relative productivity in Croatia from 1998 to 2006, as in other peer countries, was higher than in the euro area. On the other hand, after implementing the Stabilization Programme in the first half of the 1990s, inflation in Croatia was brought down and remained low and relatively stable, so the inflation differential vis-à-vis the euro area 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, strong competition in the retail trade after the entry of large retail chains into 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 inflation differential with respect to the euro area, changes in the real exchange rate were not as 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 euro area. Croatia did not meet the aforementioned price stability criterion in neither 2005 nor 2006. The question arises as to how much the Balassa-Samuelson effect contributed to this and whether it could impede the process of the 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 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[2]

Balassa (1964) and Samuelson (1964) identified the shortcomings of the absolute version of purchasing power parity (PPP) as a theory of exchange rate determination.[3] They identified the productivity growth differential between the internationally traded and internationally non-traded goods sectors as a factor introducing systematic biases into the relationship between relative prices and real exchange rates. Thus the model, named Balassa-Samuelson after them, says that faster productivity growth in the tradable than in the nontradable sector in a given economy compared 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 tradables; 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, at least, to the maintenance of 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[4] and abroad ($*$).

[2] The theoretical background to a large extent relies on the model presented in Mihaljek and Klau (2004).

[3] 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 return to this level in the short run if fluctuations occur for any reason whatsoever.

[4] If prices are measured by implicit GDP deflators, α is the share of tradables in GDP.

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

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

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

By expressing equations (1) and (1a) in logarithms and substituting them into equation (2)[5] 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 the 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 the model 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:

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

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

[5] 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 on capital determined on the 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 dynamic domestic version of the Balassa-Samuelson effect[6]:

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

It follows that prices of nontradables rise faster than prices of tradables if productivity growth in the tradable sector outpaces growth in the nontradable 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 the 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

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

[6] 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.

Equations (15) and (16) show that faster growth of relative productivity in the tradable sector than in the nontradable sector in the domestic economy as compared to a foreign economy, with a stable nominal exchange rate, will result in faster growth of domestic prices in relation to foreign prices and a 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 it is shown 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 main features of selected works for these countries are presented in Table 1.

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 to 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 average real appreciation rate due to the Balassa-Samuelson effect amounted to approximately 2.5%.

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 influence the relative prices of nontradables and tradables, while over the long term their impact is difficult to assess due to pronounced oscillations in the variables used.

Additionally, Égert (2002) showed that the productivity growth differential 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 driven 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 pronounced 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 nontradable prices that cannot be linked to changes in productivity.

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

Authors	Country	Period	Results
Arratibel et al. (2002)	BG, CZ, ES, HU, LT, LV, PL, RO, SI, SK	1990-2001	BS effect not significant; main source of difference in the prices of tradables and nontradables are differences in market structure.
Cipriani (2001)	BG, CZ, ES, HU, LT, LV, PL, RO, SI, SK	1995-1999	Growth of relative labor productivity of 1% on average results in growth of relative prices on nontradablews by 0.57%. Only 1% of inflation in the countries under observation can be explained by the BS effect.
Coricelli and Jazbec (2001)	19 transition countries	1990-1998	Real excange rate elasticity on productivity differential is 0.5.
Égert (2002)	CZ, HU, PL, SK, SI	1991-2001	According to the BS effect, equilibrium real appeciation was about 0% for CZ, SI, SK, about 1% for HU and about 3% for PL.
Égert (2003)	ES	1993-2002	Average contribution of the BS effect to the general price level is between 0.5 and 2 percentage points.
Égert et al. (2003)	CZ, ES, HR, HU, LT, LV, PL, SK, SI	1995-2000	BS effect does not significantly contribute to real exchange rate appreciation; other factors important.
Égert (2005)	BG, HR, RO, RU, TR, UK	1991-2004	BS effect poorly determinates the general level of inflation and real exchange of rate, with he possible exception of HR; other factors more important.
Fischer (2002)	BG, CZ, ES, 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 ans aproximately one fourth by changes in real interest rates.
Halpern and Wyplosz (2001)	CZ, ES, 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 differential 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)	MA	1995-2003	BS effect is not significant.
Lojschova (2003)	CZ, HU, PL, SK, SI	1995-2002	Average annual rate or real appreciation due to BS effect is 2.5% on average.
Mihaljek and Klau (2004)	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

Source: review prepared by authors

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 the faster growth of prices in the 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 developments. 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. Looking at inflation differentials between transition and developed countries, Égert (2005) believes that other factors must also be considered, and among the latter he stresses the impact of changes in import 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, gradual deregulation of administered prices, growth of tradables prices due to the growth of their quality, and credibility of economic policy after periods of hyperinflation.

An estimate of the Balassa-Samuelson effect in Croatia can be found in works by Mihaljek and Klau (2004) and Égert (2005), while in a work by Nestić (2004) Croatia is included in a sample of 27 European countries for which dependency of the price level on relative labour productivity is estimated. Mihaljek and Klau (2004) used data for the period from the first quarter of 1995 to the third quarter of 2001. Using the ordinary least squares (OLS) method they showed that productivity growth differential between the tradable and nontradable sectors contributed to inflation 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%) 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[7] and use of the dynamic ordinary least squares (DOLS) method and the autoregressive distributed lag (ARDL) model, Égert (2005) first econometrically tested the assumptions of the Balassa-Samuelson model and then estimated the Balassa-Samuelson effect itself. He concluded 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 than in Mihaljek and Klau (2004), which is here 20%.

[7] Certain assumptions are tested for shorter periods depending on the availability of data.

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 concluded that the higher price level in Croatia than in other transition countries can be partially explained by labour productivity differentials in the tradable and nontradable sectors. He also argues that, given the higher price level in Croatia in comparison to other transition countries and a relatively similar structure of prices 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 euro area for the period from the first quarter of 1998 to the third quarter of 2006 are constructed below, as well as the real kuna/euro 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 break in the price series, and every effort was made to avoid this. In addition, value-added tax was introduced in Croatia in 1998, so a one-off influence of the tax system change on prices was avoided in this fashion.[8] 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, 2004). Average labour productivity was computed as the ratio of gross value added (constant 1997 prices) and number of employed in individual branches of the National Classification of Activities[9] (NCA), which included those employed in legal entities and those employed in crafts and trades and the free lances.[10]

The existing literature does not offer a single unified method for classifying activities in the tradable and nontradable 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 pos-

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

[9] 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, healthcare and social work, other community, social and personal services and activities of households.

[10] 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.

sible criteria. These criteria are often difficult to apply to available data, so the classification largely depends on the subjective view of the author. Nonetheless, as Table 2 shows, the tradable 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.

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
Coricelli and Jazbec (2001)	Manufacturing, extraction, electricity, gas and water supply, constructions	Other
Égert (2002)	Industry	Services
Égert (2003)	Agriculture, hunting, forestry, fishing, manufacturing (incl. and excl. constructions)	Wholesale and retail trade; hotels and restaurantes; financial intermediation; real estate, renting and business activities (incl. And excl. Constructions); transportations, storage and communications; mining and extraction; electricity, gas and water supply; public administration and defence; education; healhtcare; other activities
Égert et al. (2003)	Two combinations: industry and agriculture; industry	Other (excl. agriculure)
Égert (2005)	Several combinations: industry; industry and agriculture, transport and telecommunications, hotels and restaurantes; industry, transport, telecommunications, hotels and restaurantes	Several combinations: other; other and real estate; other, real estate and agriculute; education; healthcare, public administration and other utilities and agriculure
Fischer (2002)	Industry	Services (excl. Agriculture)
Halpern and Wyplosz (2001)	Industry	Services
Jazbec (2002)	Industry	Services
Loko and Tuladhar (2005)	Agriculure, manufacturing, extraction, trade	Other
Lojschova (2003)	Manufacturing	Services and construction
Mihaljek and Klau (2004)	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 service, hotels and restaurantes, transport, storage and communications, financial intermediation, real esate, renting and business services
Rother (2000)	Manufacturing	Other (excl. agriculture)

Source: review prepared by authors

In this analysis, two sets of productivity data were constructed for Croatia. In the first set, the tradable sector includes industry, mining and quarrying and electricity, gas and water supply[11] (*PROD_T*), while in the second hotels and restaurants (*PROD_T2*) are added due to the high share of travel services (tourism) in the overall exports of goods and services in Croatia.[12] The nontradable 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 in the euro area there is disaggregation into 6 branches of the NACE[13], one set was 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 Euro Area

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			
PROD_T	C, D, E	PROD_NT	F, G, H, I, J, K, L, M, N, O, P
PROD_T2	C, D, E, H	PROD_NT2	F, G, I, J, K, L, M, N, O, P
Euro area			
PROD_T_E	C, D, E	PROD_NT_E	F, G, H, I, J, K, L, M, N, O, P

Source: prepared by authors

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 activities[14] were used. In this regard, when assessing the do-

[11] Activity electricity, gas and water supply should be excluded from the analysis due to substantial price regulation by the government. However, in available data it can not be separated from industry and is therefore included in the tradable sector. This should not significantly influence the results of the analysis since the share of this activity in the total annual gross value added in Croatia is on average just around 3 percent.

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

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

[14] 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 distinguished. Additionally, it is subject to the influence of indirect taxes, subsidies and price controls. Even though the producer price index follows price changes in tradables better, 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). GDP deflator is a significantly broader price index because it reflects the prices of all goods and services produced within one economy. It also includes the prices of investment goods and exports, while it excludes the prices of imports. It is appropriate for this analysis due to its broad definition and high comparability with the production structure of an economy.

mestic Balassa-Samuelson effect, two data sets are distinguished. The first set includes prices of tradables expressed by the goods prices index (*CPI_T*) and prices of nontradables by the services prices index (*CPI_NT*) of the consumer price index. For the second set, implicit deflators were used, so the prices of tradables (*DEF_T*) are expressed by the 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 (*DEF_NT*) 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 index of consumer prices for the euro area (*HICP_E*) 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 the Eurostat methodology for compiling a harmonized index of consumer prices. The domestic consumer price index differs from the harmonized index in a few segments, which should not influence the results of this analysis.[15]

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 kuna/euro exchange rate and the ratio of foreign and domestic prices. In the first case (*RER_CPI*), the ratio between the harmonized index of consumer prices for the euro area and the consumer price index for Croatia was used, while in the second case (*RER_DEF*) the ratio between implicit GDP deflators was used, and in the third case (*RER_PPI*) the ratio between producer price indices was used.

5 Descriptive Analysis

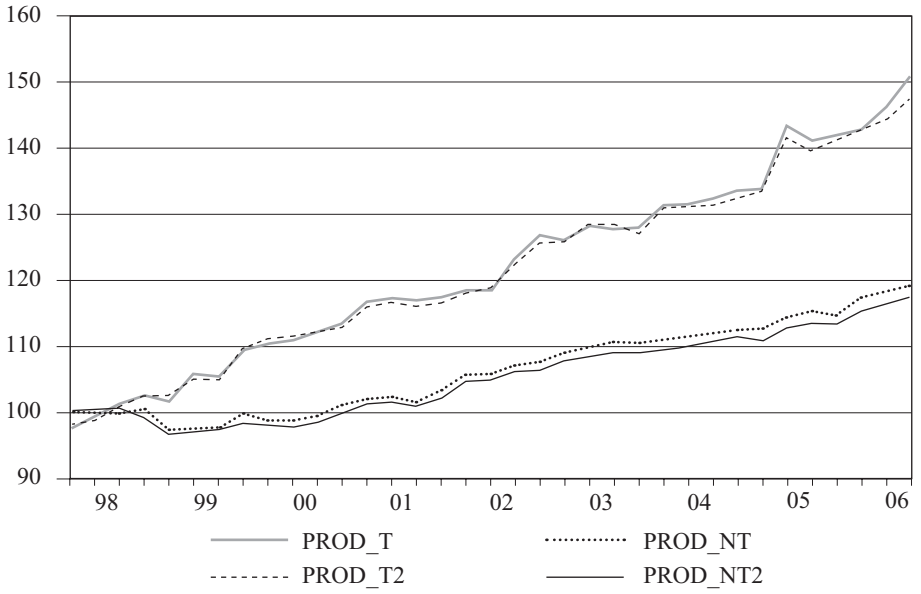
Average labour productivity in Croatia from 1998 to 2006 increased by one fourth. Even though growth occurred in both sectors, Figure 1 shows that productivity growth in the tradable sector (*PROD_T* and *PROD_T2*) was considerably more intense than in the nontradable sector (*PROD_NT* and *PROD_NT2*). This is backed by data on average annual productivity growth, which was twice as high in the tradable sector as in the nontradable sector. By adding hotels and restaurants to the tradable sector, productivity growth in the tradable as well as in nontradable sector is slightly reduced. However, gross value added of hotels and restaurants[16] only partly reflects the importance of tour-

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

[16] Gross value added of hotels and restaurants amounts to approximately 3.5% of average annual value added of Croatian economy. Total tourism consumption is also included in other branches, i.e. retail sale in specialized and non-specialized stores (part of branch G), activities of travel agencies and tour operators, tourist assistance activities n.e.c. (part of branch I), etc.

ism for the entire economy due to the strong direct and indirect effects of tourism on other economic activities.

Figure 1 Labour Productivity in Croatia, 1998=100



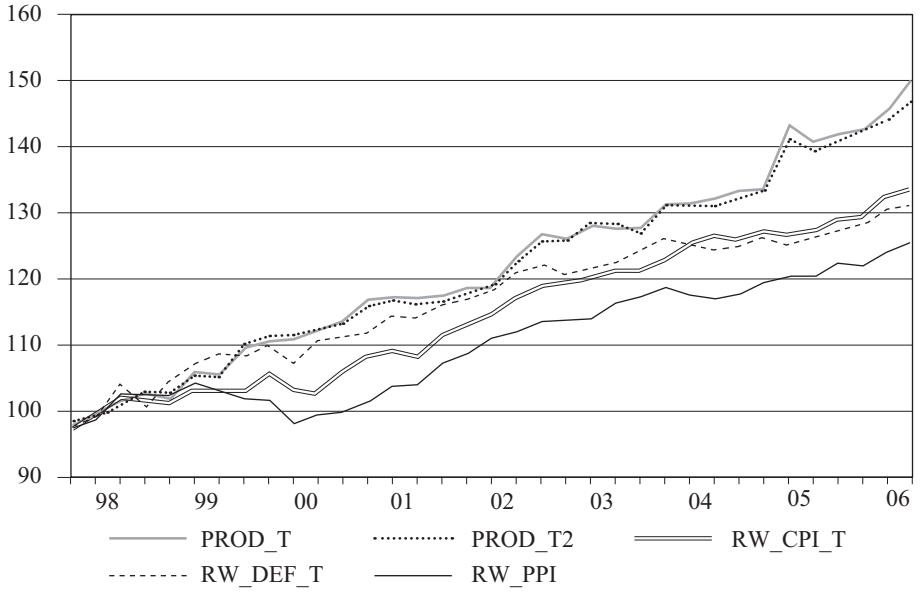
Source: CBS; authors' computation

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 strongest labour productivity growth in trade, recorded in 2002, was the result of the entry of foreign retail chains into 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 the proportional growth of value added and the number of employed.

In compliance with the theoretical assumptions of the Balassa-Samuelson effect, real wages in the tradable sector should be determined by productivity in that sector, while labour mobility between sectors should result in equalization of nominal wages between tradable and nontradable sectors. This is how the transmission mechanism works, with the labour productivity growth differential between sectors influencing the inflation differential between tradables and nontradables. Thus, it is necessary to observe wage trends in Croatia more closely hereinafter.

To compute real wages[17] (*RW*) in Croatia, three different tradables price indices were used: the price index for goods (*CPI_T*), the producer price index (*PPI*)[18] and the implicit deflator in the tradable sector (*DEF_T*). Even though real wages in the tradable sector in Croatia increased by almost a third during the relevant period (Figure 2), their growth lagged behind productivity growth. This may be reflected in the weaker influence of the relative productivity of tradables on relative prices of nontradables. These real wage trends in the tradable sector can be partially explained by the currently high unemployment and relatively high unit labour cost. However, in the long run, the growth of wages cannot be expected to lag behind productivity growth, so the aforementioned transmission mechanism should gradually strengthen.

Figure 2 Labour Productivity and Real Wages in the Tradable Sector in Croatia (1998=100)



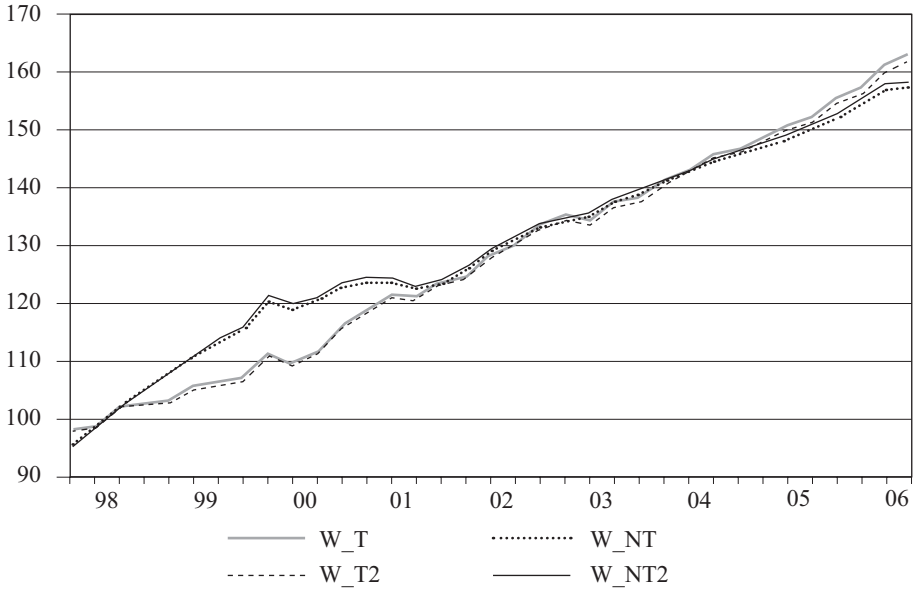
Source: CBS; authors' computation

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

[18] Producer prices of industrial products are the prices at which a producer sells its products on the domestic market in the largest quantities or prices a producer charges to other companies. Producer prices are often used as an approximation for prices of tradables. The growth of the producer price index recorded in the period from 1998 to the third quarter of 2006 was slightly higher than the growth of the goods price index and the implicit deflator index in the tradable sector. The changes of producer price index were influenced the most by the changes of oil prices and prices of other energy products. At the same time, the growth of producer prices of final products, which directly enter retail sales, was moderate.

On the other hand, Figure 3 shows how the assumption of the equalization of the nominal wages between the tradable (*W_T*)[19] and nontradable sector (*W_NT*), or the equalization of their growth if using the dynamic model, is met. A slightly higher absolute level of wages was recorded in the nontradable sector, as a result of higher wages in the public sector in the period from 1999 to the beginning of 2001[20] and in financial intermediation in the whole observed period. On the other hand, although since the beginning of 2005 nominal wages in the tradable sector grew somewhat faster than in the nontradable sector, mainly due to an increase in manufacturing, we can conclude that changes of nominal wages in the whole observed period enabled the transmission of productivity growth effects on the growth of prices of nontradables. That is, actual wage growth in the nontradable sector, which was higher than productivity growth in this sector, was possible only by raising prices. Figure 4 confirms that the prices of nontradables (*CPI_NT* and *DEF_NT*) grew faster than prices of tradables (*CPI_T* and *DEF_T*).

Figure 3 Nominal Wages in Croatia (1998=100)

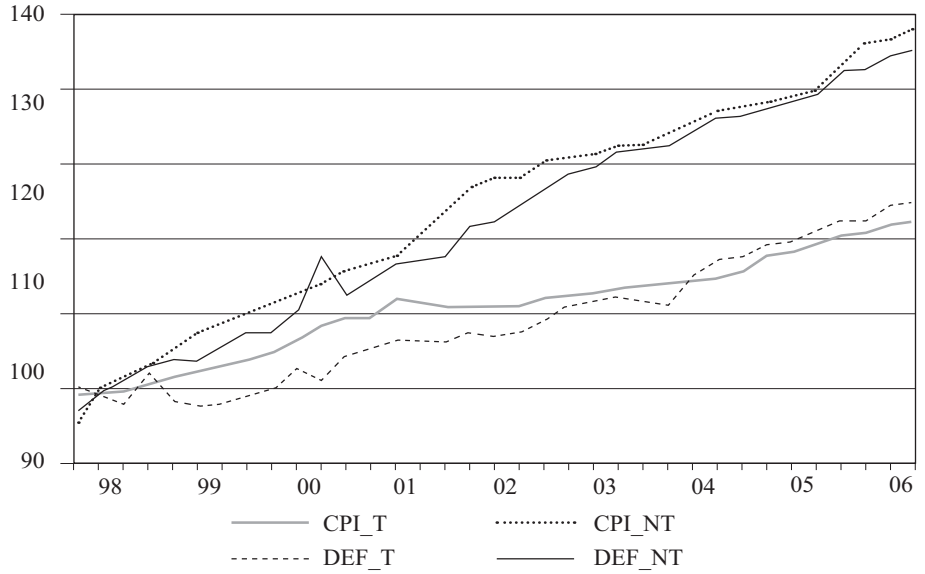


Source: CBS; authors' computation

[19] Depending on the method for classifying activities in the tradable and nontradable sectors, two data sets were constructed for wages in each sector.

[20] The temporary mismatch in wage levels recorded from the first quarter of 1999 to the first quarter of 2001 is the result of increased salaries in public administration, defence and healthcare.

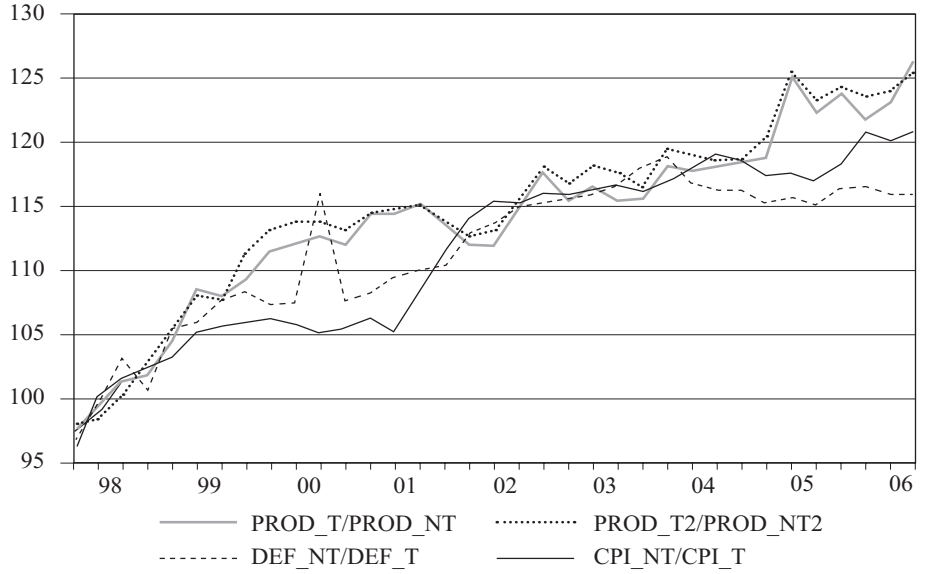
Figure 4 Prices of Tradables and Nontradables in Croatia (1998=100)



Source: CBS; authors' computation

Finally, Figure 5 shows how, according to the theoretical model, relative prices of nontradables kept pace with relative productivity growth in the tradable sector, which supports the domestic version of the Balassa-Samuelson effect.

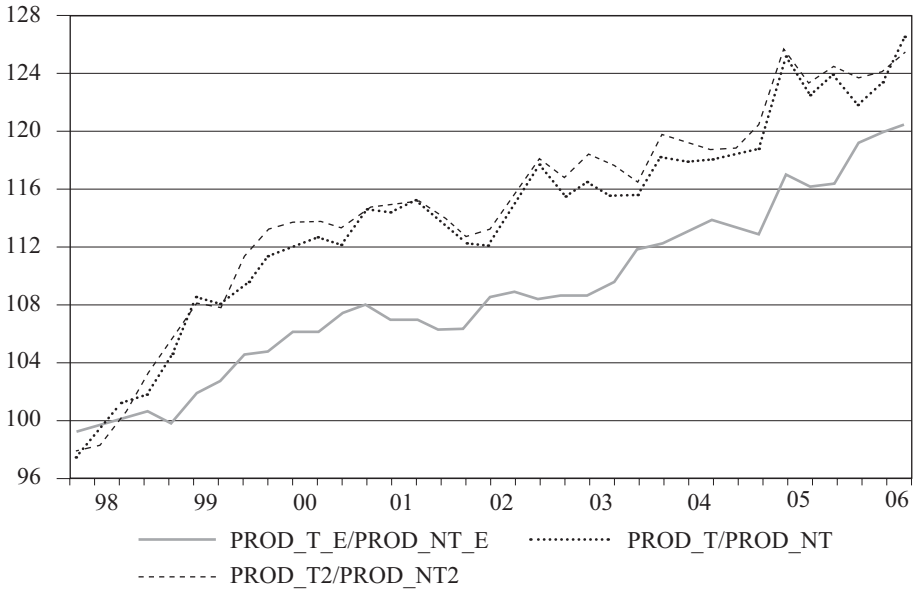
Figure 5 Relative Prices and Relative Productivity in Croatia (1998=100)



Source: CBS; authors' computation

On the other hand, if the productivity growth differential between the tradable and nontradable sectors is higher in Croatia than in the euro area, the international Balassa-Samuelson effect comes into play. This means that prices in Croatia will grow faster than in the euro area, which should result in appreciation of the real kuna/euro exchange rate. Figures 6-8 show relative productivity trends in the tradable sector (in relation to the nontradable sector) and general price levels in Croatia and the euro area from 1998 to 2006, as well as the real exchange rate during that same period.

Figure 6 Relative Productivity in Croatia and the Euro Area (1998=100)



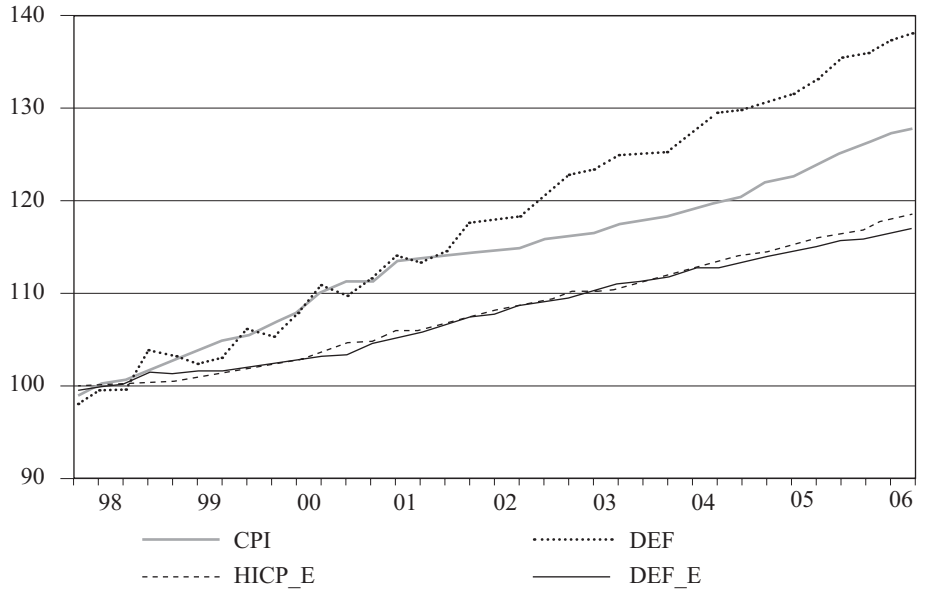
Sources: CBS; Eurostat; authors' computation

During the period under observation, the growth of relative productivity in Croatia was somewhat faster than in the euro area, but the inflation differential between Croatia and the euro area 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 the inflation differential between Croatia and the euro area 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 the maintenance of low and stable consumer price inflation in Croatia without simultaneously affecting implicit deflators. Maintenance of nominal exchange rate stability between the Croatian kuna and euro also greatly contributed to price stability.

The nominal exchange rate between the Croatian kuna and the euro from 1998 to 2006 fluctuated 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 pre-

dominantly 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 significant foreign borrowing, inflow of foreign direct investment (including privatization revenues), tourism revenues, appreciation expectations, etc.

Figure 7 Prices in Croatia and the Euro Area (1998=100)



Sources: CBS; Eurostat; authors' computation

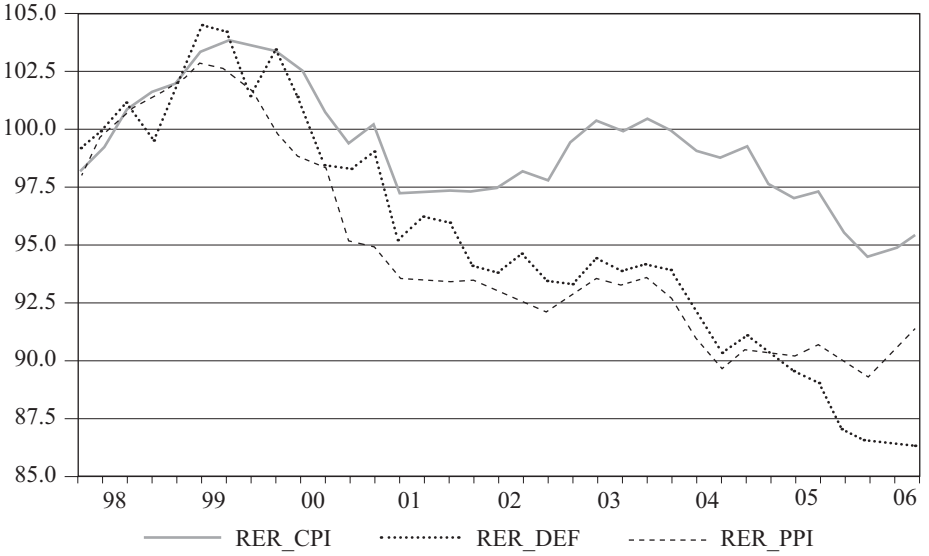
Due to the relatively stable nominal exchange rate between the Croatian kuna and euro and the relatively small inflation differential in comparison to the euro area, changes in the real exchange rate in Croatia were not very pronounced. From 1998 to 2006 the real exchange rate deflated by the consumer price index moved within a range of +/- 5%. The average annual real appreciation rate was only 0.6%,[21] which is considerably less than in many countries from the two preceding waves of European Union enlargement.

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

[21] The average annual appreciation rate of the real kuna/euro exchange rate index deflated by the producer price index was 0.3%, the real effective exchange rate index deflated by the consumer price index was 0.7%, and deflated by the producer price index 0.3%.

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 (*RER_PPI*) would have to be stationary (Égert, 2003). Given that Figure 8 clearly shows that during the observed period the real kuna/euro 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.

Figure 8 Real kuna/euro Exchange Rate (1998=100)



Note: A decline of the index indicates real exchange rate appreciation.

Sources: CBS; Eurostat; CNB; authors' computation

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):

$$BS^d = \beta_1 \left(\Delta PROD\_T - \Delta PROD\_NT \right) \tag{17}$$

$$InflationBS = (1-\alpha)\beta_1 \left(\Delta PROD\_T - \Delta PROD\_NT \right) \tag{18}$$

where β_1 is the coefficient that links 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. The value of β_1 will be econometrically tested in the next section of the paper, but in line with the theoretical model, we can assume that it moves within a range from 0 to 1.

Table 4 Domestic Balassa-Samuelson Effect I – Simple accounting framework (annual percentage changes)

	CPI	CPI_NT	CPI_T	CPI_NT-CPI_T**	PROD_T	PROD_NT
1999	4.02	8.14	2.88	5.25	5.47	-2.09
2000	4.62	5.12	4.48	0.63	5.77	1.56
2001	3.73	5.36	3.35	2.01	4.81	2.70
2002	1.70	7.27	0.30	6.98	4.07	4.22
2003	1.75	2.57	1.56	1.01	4.67	3.27
2004	2.06	3.27	1.68	1.59	3.63	1.55
2005	3.34	2.89	3.44	-0.55	6.05	2.20
2006	3.02	5.09	2.41	2.68	4.65	3.60
Average	3.03	4.96	2.51	2.45	4.89	2.13

	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 BS effect to inflation** (β_1=1)
1999	1.51	3.03	4.54	6.05	7.57	1.74
2000	0.84	1.69	2.53	3.37	4.22	0.97
2001	0.42	0.85	1.27	1.69	2.12	0.49
2002	-0.03	-0.06	-0.09	-0.12	-0.15	-0.03
2003	0.28	0.56	0.84	1.12	1.40	0.32
2004	0.42	0.83	1.25	1.66	2.08	0.48
2005	0.77	1.54	2.31	3.08	3.85	0.88
2006	0.21	0.42	0.63	0.84	1.04	0.24
Average	0.55	1.11	1.66	2.21	2.77	0.64

*Notes: ** represents change in percentage points. Balassa-Samuelson effect is computed by multiplying assumed coefficient β1 and a difference in annual growth of average labour productivity between tradable and nontradable sectors (hotels and restaurants are included in the nontradable sector). Contribution of Balassa-Samuelson effect to inflation is computed by multiplying the share of nontradables in consumer basket and estimated Balassa-Samuelson effect.*

Source: authors' computation

Table 4 shows that during the observed period the difference in the average annual growth of prices of nontradables and tradables 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 transmits into the inflation dif-

ferential 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 considering 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, which is almost identical to the result 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 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.

Table 5 Domestic Balassa-Samuelson Effect II – Simple accounting framework (annual percentage changes)

	DEF	DEF_NT	DEF_T	DEF_NT-DEF_T**	PROD_T2	PROD_NT2
1999	3.44	5.20	-1.61	6.81	5.57	-2.59
2000	4.62	6.44	3.71	2.72	6.00	1.10
2001	4.52	4.02	4.07	-0.05	3.90	2.92
2002	4.70	6.03	1.69	4.35	4.23	4.01
2003	4.65	5.77	3.68	2.09	5.10	2.90
2004	3.15	3.35	2.94	0.40	3.11	1.60
2005	3.73	3.34	4.61	-1.27	5.77	2.03
2006	3.63	3.05	4.40	-1.35	4.23	3.41
Average	4.06	4.65	2.94	1.71	4.74	1.92

	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 BS effect to inflation** (β_1=1)
1999	1.63	3.26	4.89	6.53	8.16	5.55
2000	0.98	1.96	2.94	3.92	4.90	3.33
2001	0.19	0.39	0.58	0.78	0.97	0.66
2002	0.04	0.09	0.13	0.17	0.22	0.15
2003	0.44	0.88	1.32	1.76	2.20	1.49
2004	0.30	0.60	0.90	1.21	1.51	1.02
2005	0.75	1.50	2.25	3.00	3.74	2.55
2006	0.16	0.33	0.49	0.66	0.82	0.56
Average	0.56	1.13	1.69	2.25	2.81	1.91

*Notes: ** represents change in percentage points. Balassa-Samuelson effect is computed by multiplying assumed coefficient β1 and a difference in annual growth of average labour productivity between tradable and nontradable sectors (hotels and restaurants are included in the tradable sector). Contribution of Balassa-Samuelson effect to inflation is computed by multiplying the share of nontradables in GVA and estimated Balassa-Samuelson effect.*

Source: authors' computation

Results are significantly different if implicit deflators are used in the assessment of the contribution of the Balassa-Samuelson effect to inflation in Croatia. Namely, average annual inflation rate measured by implicit deflators was 4.1% or 1 percentage point more than average annual inflation of consumer prices (*CPI*). On the other hand, although hotels and restaurants are part of tradable sector and not of the nontradable sector, the productivity differential between these two sectors has remained almost unchanged (2.81 percentage points). Assuming the same value of β_1, this results in an only slightly changed domestic Balassa-Samuelson effect. However, the estimated contribution of Balassa-Samuelson effect to inflation measured by the implicit deflator is significantly higher because the share of nontradables in GVA is three times higher than in consumer basket.

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

$$BS^{in} = \Delta p - \Delta p^* = \Delta e + \beta_2 \left[(1-\alpha)(\Delta PROD\_DIF) - (1-\alpha^*)(\Delta PROD\_E\_DIF) \right] \quad (19)$$

where $\Delta p - \Delta p^*$ is the inflation differential between Croatia and the euro area, Δe is the change of the nominal kuna/euro exchange rate, $\Delta PROD\_DIF$ is the productivity growth differential between tradables and nontradables, $\Delta PROD\_E\_DIF$ is the productivity growth differential between tradables and nontradables in the euro area and β_2 is the coefficient that relates the relative productivity differential between Croatia and the euro area to the inflation differential. As in the case of the domestic version of the Balassa-Samuelson effect, the value of coefficient β_2 will be econometrically estimated subsequently, but for now we shall assume that it is between 0 and 1.

The productivity growth differential between tradables and nontradables during the observed period was slightly higher in Croatia than in the euro area, but the share of nontradables in the euro area consumer basket is almost twice as high as in Croatia (41% as compared to 23%). In line with the theoretical model, we could expect higher inflation in the euro area than in Croatia and/or depreciation of the nominal kuna/euro exchange rate, i.e. a negative Balassa-Samuelson effect. As can be seen in Table 6, in the observed period the nominal kuna/euro exchange rate depreciated on average by 0.36% annually, but this is primarily the result of strong depreciation in 1999 driven by recession and the continuation of the banking crises that started in 1998. In the remaining part of the observed period the nominal kuna/euro exchange rate appreciated, which is opposite from the theoretical model. It follows that some other factors exerted a greater impact on inflation differentials between Croatia and the euro area.

Table 6 International Balassa-Samuelson Effect – Simple accounting framework (annual percentage changes)

	CPI	HICP_E	CPI_DIFF**	E	(1-α*)*PROD_E_DIFF*	(1-α)*PROD_E_DIFF**
1999	4.02	1.14	2.88	6.20	1.74	0.94
2000	4.62	2.12	2.50	0.74	0.97	1.58
2001	3.37	2.36	1.38	-2.16	0.49	0.34
2002	1.70	2.27	-0.56	-0.86	-0.03	0.39
2003	1.75	2.07	-0.32	2.11	0.32	0.59
2004	2.06	2.14	-0.08	-0.90	0.48	1.31
2005	3.34	2.17	1.16	-1.27	0.88	0.91
2006	3.02	2.00	1.03	-1.00	0.24	1.51
Average	3.03	2.03	1.00	0.36	0.64	0.95

	BS effect** (β_2=0,2)	BS effect** (β_2=0,4)	BS effect** (β_2=0,6)	BS effect** (β_2=0,8)	BS effect** (β_2=1)
1999	0.16	0.32	0.48	0.64	0.80
2000	-0.12	-0.24	-0.36	-0.49	-0.61
2001	0.03	0.06	0.09	0.12	0.15
2002	-0.08	-0.17	-0.25	-0.34	-0.42
2003	-0.05	-0.11	-0.16	-0.21	-0.26
2004	-0.17	-0.33	-0.50	-0.67	-0.83
2005	0.00	-0.01	-0.01	-0.02	-0.02
2006	-0.25	-0.51	-0.76	-1.02	-1.27
Average	-0.06	-0.12	-0.19	-0.25	-0.31

*Notes: ** represents change in percentage points. Balassa-Samuelson effect is computed by multiplying assumed coefficient β2 and a difference in annual growth of average labour productivity between tradable and nontradable sectors (corrected for the share of nontradables in consumer basket in Croatia and the euro area). Hotels and restaurants are included in the nontradable sector.*

Source: authors' computation

6 Econometric Analysis

What follows is an econometric analysis of the domestic and international Balassa-Samuelson effect in Croatia based on the theoretical model from chapter 2. For the needs of econometric analysis, the series described in the preceding two sections were transformed into natural logarithms and then first differenced to estimate Balassa-Samuelson effect in Croatia according to a dynamic (linearized) version of the model. The use of first differences enables us to monitor inflation developments related to changes in growth rates of labour productivity (Rother, 2000). Prior to the actual estimate of the Balassa-Samuelson effect, the stationarity of all observed variables was tested using Phillips-Perron (PP) and Augmented Dicky-Fuller (ADF) tests; the results are shown in Appendix 1. Since all of the time series proved stationary after first differentiating 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:

$$\Delta \log(\frac{CPI\_NT}{CPI\_T})_t = c + \beta_0 \Delta \log(\frac{PROD\_T}{PROD\_NT})_t + \varepsilon_i \quad (20)$$

where *CPI_NT* is the nontradables (service) price index, *CPI_T* is the tradables (goods) price index, *PROD_T* is labour productivity in the tradable sector and *PROD_NT* is labour productivity in the nontradable 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:

$$\Delta \log(\frac{CPI\_NT}{CPI\_T})_t = c + \beta_0 \Delta \log(\frac{PROD\_T}{PROD\_NT})_t + \beta_1 \Delta \log(\frac{CPI\_NT}{CPI\_T})_{t-1} + \varepsilon_i \quad (21)$$

Table 7 Estimated Coefficients and Accompanying t-statistics for Domestic Balassa-Samuelson Effect I

	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)
$\Delta \log(\frac{PROD\_T}{PROD\_NT})_t$	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

*Notes: In this model prices are shown by consumer price index and in productivity series hotels and restaurants are included in the nontradable sector. ***, **, * indicates rejection of the null hypothesis at significance levels of 1%, 5% and 10%.*

Source: authors' computation

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, pertaining in particular to coefficient β_0, which plays a key role in the assessment of the domestic ver-

sion 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 productivity differential between the tradable and nontradable sectors. Coefficient β_1, in equation (21) proved somewhat more significant.

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 (see Table 8).

Table 8 Estimated Coefficients and Accompanying t-statistics for Domestic Balassa-Samuelson Effect II

	Dependent var.: $\Delta \log(\frac{DEF\_NT}{DEF\_T})_t$	
Independent variables	Equation (20)	Equation (21)
C	0.0035 (0.7506)	0.0051 (1.2626)
$\Delta \log(\frac{PROD\_T2}{PROD\_NT2})_t$	0.2488 (1.0621)	0.2019 (0.3951)
$\Delta \log(\frac{DEF\_NT}{DEF\_T})_{t-1}$	–	**-0.3684 (-2.2621)
N	34	33
R^2	0.0299	0.1734

*Notes: In this model prices are shown by implicit deflators and in productivity series hotels and restaurants are included in the tradable sector. ***, **, * indicates rejection of the null hypothesis at significance levels of 1%, 5% and 10%.*

Source: authors' computation

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. As in the simple accounting framework, equations are estimated based on the first definition of tradable and nontradable sectors, with hotels and restaurants added to the nontradable sector.

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

$$\Delta \log RER_t = c + \beta_0 \Delta PROD\_DIF1_t + \varepsilon_i \tag{22}$$

where *RER* is the real Croatian kuna exchange rate deflated by consumer price index, while *PROD_DIF1* is the productivity growth differential between tradable and nontradable sector between the euro area and Croatia, weighted by shares of nontradables in consumer baskets $PROD\_DIF1 = (1-\alpha^*)\log(\frac{PROD\_T\_E}{PROD\_NT\_E}) - (1-\alpha)\log(\frac{PROD\_T}{PROD\_NT})$.

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 inflation differential between Croatia and the euro area. The independent variables are the nominal kuna/euro exchange rate and the productivity growth differential between tradable and nontradable sectors in Croatia and the euro area weighted by shares of nontradables in consumer baskets $PROD\_DIF2 = (1-\alpha)\log(\frac{PROD\_T}{PROD\_NT}) - (1-\alpha^*)\log(\frac{PROD\_T\_E}{PROD\_NT\_E})$:

$$\Delta\log(\frac{CPI}{HICP\_E})_t = c + \beta_0\Delta PROD\_DIF2_t + \beta_1\Delta\log E_t + \varepsilon_i \quad (23)$$

Due to the problem of serial correlation, and to improve the model's features, in equation (23) the lagged value of the inflation differential between Croatia and the euro area was added as an independent variable:

$$\Delta\log(\frac{CPI}{HICP\_E})_t = c + \beta_0\Delta PROD\_DIF2_t + \beta_1\Delta\log E_t + \beta_2\Delta\log(\frac{CPI}{HICP\_E})_{t-1} + \varepsilon_i \quad (24)$$

Table 9 Estimated Coefficients and Accompanying t-statistics for the International Balassa-Samuelson Effect

	Dependent variable: $\Delta\log RERt$	Dependent variable: $\Delta\log(\frac{CPI}{HICP\_E})_t$	
Independent variables	Equation (22)	Equation (23)	Equation (24)
C	-0.006 (-0.3396)	***0.0026 (3.4549)	*0.0014 (1.7714)
Δ *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)
$\Delta\log(\frac{CPI}{HICP\_E})_{t-1}$	–	–	**0.4378 (2.6998)
N	34	34	33
R^2	0.0104	0.0476	0.2298

*Notes: In this model prices are shown by consumer price index and in productivity series hotels and restaurants are included in the nontradable sector. ***, **, * indicates rejection of the null hypothesis at significance levels of 1%, 5% and 10%.*

Source: authors' computation

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 inflation differential between Croatia and the euro area. The same result in models with different dependent variables is expected due to relatively small changes of the nominal kuna/euro exchange rate in the observed period.

In studies where the international version of the Balassa-Samuelson effect is estimated for Central and Eastern Europe countries, the real exchange rate is more often used as a dependent variable. Regarding Croatia, according to Égert (2005) the difference in relative productivity leads to equilibrium appreciation of the real exchange rate. However, in this manner it is not possible to distinguish changes of nominal exchange rate and changes of inflation differential which is, among other, important for the fulfilment of Maastricht criteria[22]. Therefore equations where inflation differential (expressed by consumer price index) between Croatia and the euro area is the dependant variable are estimated as well. This also enables comparison of the results with Mihaljek and Klau (2004).

The described results comply with their research, for they 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 in their estimate they used 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 inflation differential in Croatia and the euro area, meaning that the impact of the Balassa-Samuelson effect in Croatia is considerably less marked 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 pertaining to inflation and the exchange rate.

However, the Balassa-Samuelson model is based on relatively rigid assumptions that are only partially met in Croatia. That is, real wages in the tradable sector grew less than productivity, and absolute PPP does not hold for tradable goods. Despite this, by using a 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 a considerably lower share of nontradables in Croatia's consumer basket as compared to the euro area's contributing to this.

To assess more precisely the Balassa-Samuelson effect in Croatia an econometric analysis was conducted. Two definitions of tradable and nontradable sectors were used

[22] Fulfilment of Maastricht price stability criterion is shown in Appendix 2.

(depending to what sector hotels and restaurants are added), two measures of prices (consumer price index and implicit deflators) and, in the international version of the Balassa-Samuelson effect, two different dependant variables (real exchange rate and inflation differential between Croatia and the euro area). In all model specifications results of econometric analysis show 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. 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, which in turn limited higher price growth. Growth in nontradables prices, however, was probably greatly influenced by the process of deregulation of earlier administratively regulated prices.

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 rate 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 crucial to a better understanding of this economic phenomenon.

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

Variables	PP			ADF		
	t-value			t-value		
	None	Intercept	Trend and intercept	None	Intercept	Trend and intercept
Δ CPI_NT_T	-4.4385***	-4.9367***	-4.7825***	-4.4357***	-4.9444***	-4.7804***
Δ DEF_NT_T	-5.8701***	-7.8073***	-7.5067***	-2.2362**	-3.6310**	-3.8096**
Δ PROD_T_NT	-5.5186***	-6.7111***	-6.7666***	-5.5111***	-3.4557**	-3.4760*
Δ PROD_T2_NT2	-4.9034***	-5.9228***	-6.2511***	-4.8678***	-5.9233***	-6.2117***
Δ RER	-4.8806***	-4.8371***	-4.8826***	-4.7866***	-4.7640***	-4.7670***
Δ CPI_DIF	-3.2700***	-3.7670***	-4.1349**	-3.3604***	-3.8052***	-4.0796**
Δ PROD_DIF	-6.2037***	-6.7730***	-8.5485***	-6.1150***	-6.1367***	-5.4444***
Δ E	-3.9414***	-3.8936***	-4.1835**	-3.9605***	-3.9021***	-4.0950**

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

Source: authors' computation

Description of variables:

$$CPI\_NT\_T = \ln(\frac{CPI\_NT}{CPI\_T})$$

$$DEF\_NT\_T = \ln(\frac{DEF\_NT}{DEF\_T})$$

$$PROD\_T\_NT = \ln(\frac{PROD\_T}{PROD\_NT})$$

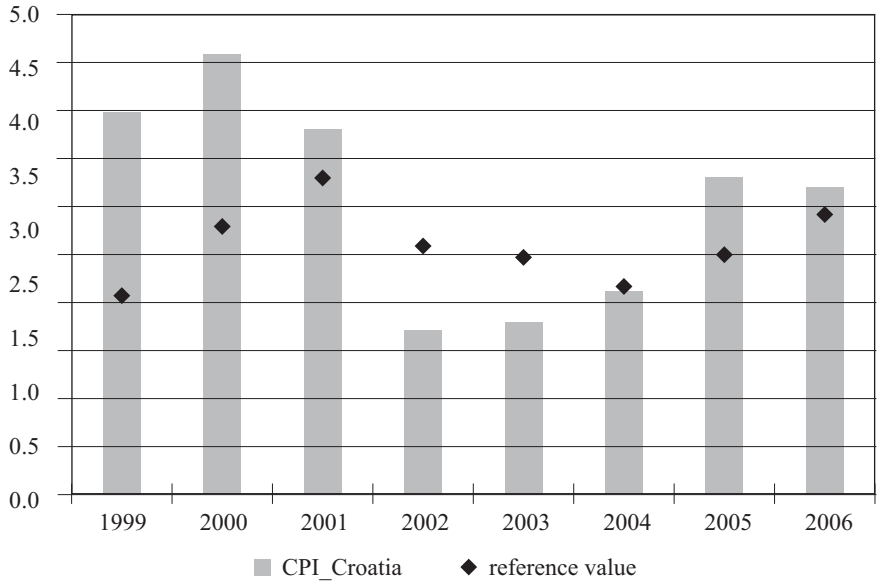
$$PROD\_T2\_NT2 = \ln(\frac{PROD\_T2}{PROD\_NT2})$$

$$RER = \ln(RER)$$

$$CPI\_DIF = \ln(\frac{CPI}{CPI\_E})$$

$$PROD\_DIF = (1-\alpha)\ln(\frac{PROD\_T}{PROD\_NT}) - (1-\alpha^*)\ln(\frac{PROD\_T\_E}{PROD\_NT\_E})$$

Appendix 2 Fulfilment of Maastricht Price Stability Criterion in the 1999-2006 Period (in %)



Sources: CBS; ECB

Regarding the price stability criterion, in 2002, 2003 and 2004 the average annual inflation rate in Croatia was below reference values but this does not hold for other years shown in the graph. Inflation rates above reference values indicate that the challenges facing Croatia on its road to EMU should not be underestimated. However, due to a slightly higher price level in Croatia than in some other transition countries and the similarity of the price structure with that of the EU (Nestić, 2004; Faulend et al., 2005), significant price corrections are not expected in the process of further convergence.