Price Convergence in EU-Accession Countries: Evidence from the International Comparison

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Abstract

The authors analyse the price convergence in EU-accession countries towards the European Union (EU), using panel-data calculations based on the International Comparison Program (ICP) and related data. Using aggregate data, they estimated the price level elasticity with respect to the GDP in PPP to be 0.7–0.9 percent. They also note that there may be additional sources of price level convergence such as terms-of-trade changes or price deregulations, which may lead to a higher pace of real exchange rate appreciation in the medium run. The average speed of real exchange rate appreciation is estimated at about 3 percent a year in a benchmark scenarios, and its implications for fulfilling the Maastricht criteria are discussed. The authors develop this study further by using commodity-level data and focusing on the adjustments in the structures of relative prices in the accession countries compared with the EU. They find that it may take about 10–25 years for the price structure in the accession countries to converge to the least developed EU countries.

Keywords: Inflation, relative prices, real exchange rate, Balassa-Samuelson model
JEL Classification: E31, E52, E58, F15, P22

1. Introduction

As eight of the post-communist countries join the European Union (EU) this year, the emphasis of many policy debates has shifted towards the next steps in European integration, including future adoption of euro by these countries. Various alternative euro accession strategies have been proposed, related to different perceptions of different authors' on the acceding countries' readiness to fulfil the Maastricht convergence criteria and give up their independent monetary policies. As part of these debates, the potential conflict between real and nominal convergence has been emphasised. In particular, it is widely recognised that with convergence in productivities and GDP levels, the acceding countries are likely to experience convergence in their price levels as well. This is equivalent to a real appreciation of their currencies, which can go either through an inflation differential or nominal exchange rate appreciation. This can, among other things, create difficulties in achieving the Maastrich nominal convergence criteria, which simultaneously put restrictions on the inflation rates and nominal exchange rate fluctuations. Suppressing inflation too low may lead to a nominal exchange rate appreciation and/or put pressure on prices in some commodity groups to decline, which could complicate the necessary structural adjustments and thus slow down the real convergence process. After the euro adoption, inflation could return to higher levels, creating challenges in terms of low real interest rates and inappropriateness of the common monetary policy for the new members. A quantification is needed in order to assess the policy importance of this problem.

To address this issue, we study in this article the price convergence process of the EU-accession countries towards the EU, developing further our earlier work on this topic (Holub and Čihák, 2000; Čihák and Holub, 2001 a,b).

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The article is organized as follows. After this introduction, the second section describes the data used in the article. The third section presents the empirical relationship between the GDP and average price levels and its implications for real exchange rate appreciation during the convergence process. The fourth section analyzes past adjustments in relative prices and discusses their likely future path. The fifth section concludes.

2. Data

The key data source used in this article is the International Comparison Program (ICP). The ICP is the most authoritative source of international data on relative prices and price levels. It is organized worldwide by the United Nations (Kravis et al., 1982; Kurabayashi and Sakuma, 1990; Heston and Lipsey, 1999), and in Europe by OECD/Eurostat, in cooperation with national statistical offices. The key results of the ICP include data on prices in individual countries, both on a highly aggregated level (GDP and its components) and on a commodity group level. The price data have the form of "comparable prices." The comparable price of a commodity i, denoted as P_{ij}, is a price of the commodity i in the economy j in terms of commodity i in a reference economy (for instance, the price of bread in Hungary in terms of bread in the EU-15). The ICP calculates the P_{ij}s for various commodity groups. Private consumption, for instance, consists of thirty items.

The ICP data are published only once in three years. In addition to the ICP data, the OECD and Eurostat also calculate extrapolated annual data. To obtain a larger number of observations, we therefore use also data from Eurostat's NewCronos database, which are obtained from the ICP data by Eurostat using extrapolations based on annual data reported by national statistical offices.[1]

Even though these sources contain arguably the best available data on international prices and outputs, they still need to be treated with a degree of caution. Despite major efforts by the statistical agencies to achieve the highest possible degree of comparability across countries and to adjust the prices for factors such as quality differences, the data can still have substantial errors. For example, in the case of GDP per capita in PPP, the margin of error is estimated at as much as 5 percentage points (Schreyer, Koechlin, 2002).

Given that our analysis includes panel regressions and comparisons of ICP projects for different years, some cautionary remarks also need to be made about the comparability of the ICP data across time. Firstly, both the national accounts methodologies and ICP methodologies have been changing over time. For instance, before 1993, the transition economies were linked to the ICP through their bilateral comparisons with Austria only, whereas their comparisons are multilateral since 1996, as usual for advanced countries. Secondly, the comparisons have been influenced by a gradual introduction of the new system of national accounts, ESA95, which took place at different points of time in different countries (Stapel, 2002). Finally, a number of other changes in the ICPs have taken place, such as the way the quality adjustments are calculated, which may result in differences between new ICP data and those received by extrapolating older ICP data.[2] Notwithstanding these caveats, we think that

[1] The New Cronos data are freely available at http://europa.eu.int/comm/eurostat/newcronos/queen/index.html. See Stapel and Pasanen (2003) for explanation of the data.

[2] Schreyer and Koechlin (2002) show that in the case of Portugal in 1990–1999, the difference was as high as 6 percentage points. Similarly, at a disaggregated level, we found large differences between the 1999 ICP price data and the prices of individual commodity groups extrapolated from 1996 ICP into 1999 (Čihák and Holub, 2001).

analysing the ICP data in panel framework or comparing across time may be useful, if the interpretation of the results takes into account these changes in data methodology.

3. Price Levels

3.1 Basic Empirical Observations

The widely shared belief that the EU acceding countries will have to go through a price-level convergence process is based on a well-established empirical observation (Balassa, 1964; Samuelson, 1964) that price levels in less advanced countries tend to be lower that in developed ones. As GDP and productivity levels in the acceding countries are expected to converge to the EU average in the future, price levels should follow suit.[3]

Before presenting more rigorous estimates, let us start with some basic observations on the aggregate data reported in the ICP. Table 1 presents results of simple regressions of logarithms of price levels in each economy on the logarithm of per capita GDP levels in purchasing power parities. The estimates were carried out for a panel of European OECD countries[4] and all 13 EU-accession countries (i.e. including Romania, Bulgaria, and Turkey), using the ICP data (1993–99) and the NewCronos data (1991–2001). The regressions account for 70–90 percent of the variability in price levels. The null hypothesis of no correlation between the two variables can be rejected at the 1 percent significance level. Table 1 illustrates that the results change only marginally when the dependent variable is the price level of household consumption instead of the price level of GDP. This means that the issues discussed later for the price level of GDP can be applied almost equally for convergence in the price level of household consumption.

The estimated elasticity in the regressions varies between 0.7 and 0.9, depending on the data source and the price level index. This means that an increase in GDP per capita in purchasing power parity (PPP) units relative to the EU average by 1 per cent tends to be accompanied by an increase in the price level relative to the EU by 0.7–0.9 per cent.

In spite of the good overall fit of the simple regressions in Table 1, there are still important residuals in explaining the price levels, which increases uncertainty in forecasting their future developments and drawing policy implications.[5] For example, Table 2 shows that the 2001 residuals in the estimate 2 for the thirteen accession countries ranged roughly from -30 to +30 percent of the estimated price levels. In the following sub-section, therefore, we introduce other explanatory variables besides the GDP that can help explain a substantial part of these residuals.

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[3] The Balassa-Samuelson proposition is a part of the purchasing power parity (PPP) framework, which models exchange rates as a function of relative prices (see Froot and Rogoff (1995) for a review of the PPP framework). We briefly discuss some departures from the Balassa-Samuelson (and PPP) framework later in this article. Égert (2004) reviews alternative theories of real exchange rate determination and their empirical estimates for the EU accession countries.

[4] Luxembourg was excluded from the regression as an outlier and influential point. Its inclusion would lead to strong non-normality and heteroscedasticity of the residuals, both confirmed by standard tests at the 1 percent probability level.

[5] For example, a significantly negative residual of the Czech Republic has led some economists to question whether it is not a symptom of some negative characteristics of the Czech economy, and/or if there is not a danger of significant price jumps in the run up towards the EMU accession (see, for instance, Vintrová et al., 2002).

Table 1. Price Level vs. GDP per capita in PPP, 1991–2001

Estimate	Dependent variable	Data source	No. of countries	No. of observations	Intercept	Slope	R^2
1	Log (price level of GDP)	ICP	30	125	0.01*	0.85*	0.70*
					(0.001)	(0.001)	(0.26)
2	Log (price level of GDP)	NewCronos	29	250	1.05*	0.77*	0.91*
					(0.04)	(0.01)	(0.13)
3	Log (price level of consumption)	ICP	36	157	-0.01*	0.90*	0.83*
					(0.003)	(0.01)	(0.21)
4	Log (price level of consumption)	NewCronos	29	250	1.23*	0.73*	0.88*
					(0.04)	(0.01)	(0.14)

Notes: * significant at 1 percent level; standard errors (White heteroscedasticity consistent) in parentheses.
In all estimates, the explanatory variable is the logarithm of GDP per capita in PPP, and the method used is GLS (cross-section weights with iterations). The reported R^2 statistics are unweighted. For both the dependent and the explanatory variable, Germany = 100 in ICP estimates, EU15=100 in New Cronos data.

Table 2. Accession Countries: Price Level Residuals, 2001

	Price level in 2001		Residual in estimate 2 (Table 1)	
	Actual	Estimated	percentage points (actual-estimated)	percent of forecasted price level
Bulgaria	32	35	-3	-9
Cyprus	80	81	-2	-2
Czech Republic	47	66	-19	-29
Estonia	51	47	4	8
Hungary	47	59	-11	-19
Lithuania	44	46	-2	-4
Latvia	47	42	5	11
Malta	68	74	-6	-8
Poland	55	50	5	11
Romania	35	33	2	6
Slovenia	69	73	-4	-5
Slovak Republic	41	53	-11	-21
Turkey	42	33	10	30

Source: Own calculations based on the NewCronos data.

3.2 Additional Variables Explaining Price Levels

The Balassa-Samuelson model (Balassa, 1964; and Samuelson, 1964) assumes that the law of one price holds for tradable commodities, but not for non-tradable ones. It also assumes perfect labour force mobility among sectors within an individual economy, but zero mobility of labour force among

different economies. Under these assumptions, it can be shown (Holub and Čihák, 2003) that with a one-factor production function, the comparative price level of a country should be equal to[6]

$$\frac{P}{P^*} = \left(\frac{A_T}{A_T^*}\right)^{1-\gamma}\left(\frac{A_N^*}{A_N}\right)^{1-\gamma} = \left(\frac{GDP_{nom}}{GDP_{nom}^*}\right)^{1-\gamma}\left(\frac{A_N^*}{A_N}\right)^{1-\gamma} = \left(\frac{GDP_{PPP}}{GDP_{PPP}^*}\right)^{\frac{1-\gamma}{\gamma}}\left(\frac{A_N^*}{A_N}\right)^{\frac{1-\gamma}{\gamma}}, \qquad (1)$$

where P is the price level, A_T and A_N are the labour productivities in the tradable and non-tradable sectors, respectively, $(1-\gamma)$ is the share of non-tradable goods in GDP and γ is the share of tradables, GDP_{nom} is the GDP per employee expressed using the nominal exchange rate, and GDP_{PPP} is the GDP per employee (as opposed to GDP per capita) in PPP. Foreign variables are denoted with an asterisk. The last step in equation (1) uses the definition $GDP_{nom} \equiv P^*GDP_{PPP}$. It can be demonstrated that the same relationship holds (with some minor modifications) also for more advanced versions of the Balassa-Samuelson model with a two or three-factor production function, if we treat A_N as the conventionally measured total labour productivity in the non-tradable sector (Holub and Čihák, 2003).

Based on (1), the simple empirical analysis of subsection 3.1 can be extended in the following ways:

- **GDP per capita vs. GDP per employee**: In the regressions in Table 1, we used the GDP per capita. However, according to equation (1), productivity should be measured as GDP *per employee* (or, ideally, per hour worked). Measuring product per capita can create distortions, as there are important differences among countries in their labour participation rates within the working-age populations, as well as differences in the ratio of their working-age populations to total inhabitants. The ratio of total employment to population ranges from 35 to 55 percent in our sample of countries, and is positively correlated with the GDP in PPP. In the regression below, we define the variable $GDP_{PPP}/empl$ as the GDP in PPP per employed person relative to the EU average.
- **Productivity in the non-tradable sector**: As shown in (1), the simple regressions of Table 1 omit cross-country differences in productivities of their nontradable sectors. According to our own estimates based on the Eurostat data on sectoral output in PPP and employment, there are significant differences in labour productivities between the candidate countries and the EU in services (Table 3). In construction, trade, transport, and communications, financial and business services, and public services (used here to approximate nontradables), the labour productivity of accession countries reaches just about 55 percent of the EU15 average (compared to about 35 percent of the EU in manufacturing and agriculture). To take account of these differences, we used productivity in nontradable sector (denoted *prodNT*) as an additional explanatory variable. From (1), the expected coefficient sign for this variable is negative: countries with more productive nontradable sector are expected to have lower price levels.
- **Share of non-tradables in GDP**: As also shown in (1), for any given level of GDP in PPP and productivity in the non-tradable sector, the price level depends on the relative shares of non-tradables and tradables in GDP, $(1-\gamma)/\gamma$. For a country with a low productivity in tradables and high productivity in non-tradables, a high share of non-traded goods tends to lower the relative price level, and vice versa. If we again define non-tradables as construction, trade, transport and

[6] This also assumes a geometric form of the price index. Such a form is optimal if the utility function has unitary elasticity of substitution between tradable and non-tradable commodities. The commonly used arithmetic average can be thought of as a log-linear approximation of the geometric price index (see, for instance, Obstfeld and Rogoff, 1998).

communications, financial and business services, and public services (which might be arguably too broad a definition), their share on GDP varies from about 55 to 85 percent in the EU and accession economies. These are important differences that cannot be ignored.

Table 3. Accession Countries: Productivity in Tradable and Nontradable Sectors (2001; EU15=100)

	Tradables	Nontradables	Total
Bulgaria	n.a.	n.a.	31
Cyprus	n.a.	n.a.	80
Czech Republic	49	54	53
Estonia	32	43	41
Hungary	50	62	61
Lithuania	30	40	38
Latvia	23	41	36
Malta	n.a.	n.a.	89
Poland	25	63	48
Romania	19	43	29
Slovenia	49	74	67
Slovak Republic	48	54	53
Turkey	n.a.	n.a.	34
AC 13 average	36	53	51

Note: AC 13 are the thirteen accession countries listed in this table; n.a. stands for not available.
Source: Own computations based on Eurostat data

So far, we have concentrated only on the Balassa-Samuelson approach to explaining the price convergence. However, there may be other factors determining the price levels besides those available within the Balassa-Samuleson framework that could explain at least some portion of the remaining price level differences among countries. We outline the key factors here:

- **Government interference**: Price levels can be distorted by various government actions, such as price regulations, taxes, and subsidies. In order to approximate the fiscal influences, we included the share of general government revenues on GDP (*govrev*). Another proxy variable for the governments' actions in the estimate is the size of agricultural employment in each country (*wagremp*). This approximates the political temptation to regulate/subsidise the agricultural sector. The expected sign of the slope coefficient is positive in this case.[7]
- **Terms of trade impact**: Finally, the law of one price may not hold even for the tradable goods, contrary to the Balassa–Samuelson assumptions. Much of the literature that examined the law of one price shows that the law fails, particularly in the short to medium run (see, for instance, Engel 1993). If the law of one price does not hold, price developments may be partly explained by terms of trade in tradable goods. In Čihák and Holub (2001a,b), we suggested that less developed countries have to cope with less favourable prices, if they are to export higher value added products. In order to estimate the impact of this factor, we included in the regression the share of

[7] We also tried to use a dummy variable to capture the distortionary effect of the EU's agricultural policy (=1 for EU countries; =0 otherwise). Its coefficient was positive, but not significant.

exports of the SITC groups 6, 7, and 8 on total exports of the individual economies (*exp6_8*). The relationship between this variable and the price level cannot be expected to be monotonic, though, since underdeveloped economies must undercut their prices, while "luxury" products from advanced countries can enjoy a monopolistic premium. Therefore, we also included in the regression the cross-term of this export share and the logarithmic GDP in PPP per employee of individual countries (*exp6_8*log[GDP$_{PPP}$/empl%]*).

We estimated an extended panel regression incorporating the factors described above (Table 4). The estimation method used was feasible generalized least squares assuming the presence of cross-section heteroskedasticity. Overall, the explanatory power of this regression is high. All the included explanatory variables are statistically significant and their coefficients have the expected signs. Table 4 presents results for two different dependent variables, price level of GDP and price level of consumption. Even though the individual coefficient estimates are different, they have the same signs and significance. In the following discussion, we will focus on the regression with price level of GDP.

Table 4. Results of the Extended Panel Regression

	Dependent Variable #1: Log (Price Level of GDP)	Dependent Variable #2: Log (Price Level of Consumption)
$(1-\gamma)/\gamma$ * log[GDP$_{PPP}$/empl]	0.17*	0.09*
	(0.01)	(0.02)
$(1-\gamma)/\gamma$ * log[prodNT]	-0.32*	-0.17*
	(0.02)	(0.02)
log(wagremp)	0.009*	0.031*
	(0.003)	(0.005)
exp6_8	-5.90*	-5.54*
	(0.08)	(0.12)
exp6_8*log[GDP$_{PPP}$/empl%]	1.26*	1.19*
	(0.02)	(0.03)
log (govrev)	0.23*	0.34*
	(0.01)	(0.01)
Constant	3.62*	3.33*
	(0.03)	(0.06)
R-squared (unweighted)	0.83*	0.84*
	(0.16)	(0.15)
No. of countries	22	22
No. of observations	128	128

Notes: * significant at 1 percent level; standard errors are White heteroscedasticity consistent.
The estimation method used is GLS (cross-section weights with iterations). EU15=100 for all variables except the ratios (*govrev* and *exp6_8*).

The foreign trade variables are highly statistically significant. The estimate suggests that the relationship between *exp6_8* and the price level is indeed non-monotonic: for economies with GDP in

PPP per employee below 105 percent of the EU average (i.e., all the accession countries), an increase in the share of industrial exports leads to a lower average price level, and vice versa.[8] This supports the hypothesis that less developed countries have to cope with less favourable prices, if they are to export higher value added products. The fact that the structure of foreign trade has an important influence on the price level speaks against the Balassa-Samuelson simplifying assumption that the law of one price holds perfectly for tradable goods. As a result, it is necessary to take into account the terms of trade changes as part of the price convergence process.

In this model, growth in the GDP in PPP per employee is associated with increases in price levels through two channels. The first one is the Balassa-Samuelson effect, which appears to be much smaller than suggested by the simple estimates in Table 1. The second channel works through the structure of trade (or terms of trade) impact, i.e. through the variable (*exp6_8*log[GDP$_{PPP}$/empl%]*). Table 5 shows, for each country, the implied elasticity of the price level with respect to GDP in PPP per employee. The elasticity differs for countries depending on the share of higher value products in their exports *exp6_8*. These findings highlight the importance of focusing on all channels of the equilibrium real appreciation in monetary policy discussions, and not concentrating on the Balassa-Samuelson effect only. The experience of many transition economies has been in line with this conclusion, as their long-run trend of real effective exchange rate appreciation (typically around 2–5 percent a year on CPI basis) has substantially exceeded the estimated size of Balassa-Samuelson effect (typically 1–2 percent at most; see e.g. Flek, at al., 2002; Halpern and Wyplosz, 2001).

Table 5. Implied Elasticities of Price Level to GDP in PPP per Employee

	Elasticity 1/		Residual (2001) 2/
	Total	Of which: Structure (Terms) of Trade	
Bulgaria	0.79	0.70	...
Czech Republic	1.12	1.02	-0.30
Estonia	0.93	0.83	0.02
Hungary	1.05	0.95	...
Lithuania	0.74	0.64	-0.30
Latvia	0.77	0.67	-0.22
Poland	1.04	0.94	...
Romania	1.03	0.95	0.43
Slovenia	1.13	1.04	...
Slovakia	1.06	0.95	-0.18

Notes: 1/ Elasticity of price level of GDP to GDP in PPP per employee, implied by the first estimate in Table 4. Includes the Balassa-Samuelson impact as well as the impact through terms of trade. 2/ Difference between the actual and the estimated value of the logarithm of the price level of GDP.

The estimated elasticities in Table 5 can be used for assessing the average pace of real exchange rate appreciation in the accession economies. If the economy's elasticity is, say, 0.9, and if it achieves a growth differential compared to the EU of, for example, 2 percentage points a year (which we think might be realistic), its real exchange rate appreciation should reach about 1.8 percentage points on

[8] The threshold of 105 percent was derived by solving the equation -5.90 + 1.26 *log[GDP$_{PPP}$/empl%]*=0, where -5.90 and 1.26 are the estimated slope coefficients of the two export variables.

average.[9] Interestingly, this is close to the real exchange rate appreciation that some recent empirical studies predict for transition economies based on the Balassa-Samuelson effect (see e.g. Halpern and Wyplosz, 2001; Begg, et al., 2002; and Deutsche Bundesbank, 2001).

We should also remember that some countries are far from the estimated regression line, as indicated by the right column in Table 5. Their "actual" elasticities may be thus different from the "theoretical" ones. They will be higher for countries below the regression line, implying a higher long-term real exchange rate appreciation, and vice versa for countries with a positive residual.

From the monetary policy point of view, it is important that the realistic pace of real appreciation is slow enough for most EU-accession countries with flexible exchange rates to allow them fulfil the Maastricht inflation and stay within the wide ±15 percent fluctuation band of the ERM II mechanism. If a country plans to spend in the ERM II the shortest required period of two years, the maximum ERM II-consistent speed of real appreciation is 8–9 percent a year.[10] This is way above any realistic estimate based on our cross-country comparisons. There may be some problems, though, if the narrow ±2.25 percent fluctuation band was treated as the benchmark for assessing exchange rate stability, as interpreted by some EU institutions, or if some country wanted to stay in the ERM II for a prolonged period. But the interpretation of the criterion gives more tolerance to exchange rate appreciation than depreciation, and the appreciating trend may thus not be a big de facto problem even if the exchange rate moved outside of the ±2.25 interval on this side.

For countries with hard exchange rate pegs, however, even a real appreciation speed of 1.8 percentage points might be a problem. In their case, the only channel of the real appreciation is inflation, and the Maastricht limit is just 1.5 percentage points above the average inflation in the best three performers among the EU countries. Moreover, the accession countries with currency boards have relatively lower GDPs per capita; as pointed above, their average speed of real convergence may thus easily exceed 2 percentage points a year, leading to a faster real appreciation.

4. Relative Prices

4.1 General Observations on Structures of Relative Prices

The international price differences do not concern the average price levels only, but also relative prices. The differences in structures of relative prices in the accession countries and the EU according to the Eurostat data are illustrated in Table 6. Typically, rents, schooling, and health care are at less than 35 percent of the EU price level, while communications, cars and alcoholic beverages have prices much closer to the EU average. Moreover, substantial changes in structures of relative prices have been taking place over time, and these changes and their speed in many cases differ considerably among the individual accession countries.

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[9] This calculation is only approximate, as it assumes a constant growth differential. In longer horizons, we would need to take into account the fact that growth rates in converging countries tend to decline during the convergence process.

[10] The maximum real exchange rate appreciation via the inflation differential is 1.5 percent under the Maastricht criteria. The maximum nominal appreciation is 15 percent in two years in the ERM II, which means roughly 7.5 percent a year. Taken together, the maximum possible real appreciation is 9 percent in relation to the three EU countries with lowest inflation rates.

Table 6. Prices in Accession Countries Relative to the EU, 2001 (EU=100)

	BG	**CZ**	**EE**	**HU**	**LT**	**LV**	**PL**	**RO**	**SI**	**SK**
HOUSEHOLD CONSUMPTION, of which:	**32**	**44**	**46**	**44**	**42**	**45**	**54**	**34**	**68**	**39**
Food, non-alcoholic beverages	54	54	70	60	59	67	61	53	85	53
Alcoholic beverages, tobacco	33	52	62	51	59	64	78	40	59	48
Garments and shoes	54	73	81	67	76	76	85	40	87	62
Rent, fuel, energy	25	34	32	34	23	22	39	25	64	25
Housing equipment, maintenance	46	69	65	65	66	74	69	46	66	58
Health and medical care	21	31	33	30	26	27	40	23	62	29
Transportation	52	61	65	71	63	68	74	48	75	57
Communications	69	77	76	82	128	129	133	91	57	86
Recreation and culture	41	49	59	52	53	56	68	43	81	45
Education	10	26	21	23	19	21	30	12	61	20
Restaurants, cafes, hotels	28	48	58	51	51	69	71	49	61	42
Other goods and services	26	42	44	38	40	43	52	29	66	37
GDP TOTAL	**32**	**47**	**51**	**47**	**44**	**47**	**55**	**35**	**69**	**41**

Source: Eurostat.

In order to quantify the changes in structures of relative prices over time and the differences across countries, it is useful to summarize the extent of (and changes in) relative price differences in a single number. This can be done by calculating a *coefficient of relative price differences* (Holub and Čihák (2000) and Čihák and Holub (2001a,b)), defined as a weighted standard deviation of comparable prices of individual goods in the given country relative to the average comparable price level,

$$\rho = \sqrt{\sum_i w_i \left(\frac{P_i}{\mu} - 1\right)^2}\ , \qquad (2)$$

where w_i is the weight of commodity i in the consumption basket, P_i is the comparable price of commodity i (i.e. price of the commodity i in the given economy in terms of commodity i in a reference economy) and μ is the average price level of consumption. If structures of relative prices in the given country and the reference country were identical, all comparable prices would be the same (and equal to μ), and the coefficient of relative price differences would reach its minimum value of zero. The higher the differences in relative prices, the higher the dispersion of comparable prices around their average, and the higher the value of ρ.[11]

There are two ways of calculating ρ, depending on the choice of weights of individual commodities in the consumption basket. First, we can use the structure of nominal consumption by households ("nominal weights"). Second, we can calculate "real weights" of commodities by imputing their internationally comparable prices. The nominal weights tend to underestimate the importance of items with artificially low (regulated) prices, thereby biasing downward the coefficient of relative price differences in transition economies. The "real weights", on the other hand, are likely to overestimate the extent of price distortions, since they assume that the real structure of consumption in transition

[11] Theoretically, ρ is not limited from above, but empirical values for European countries tend to be well below 1 (Table 4). For a more detailed discussion of the properties of the coefficient, see Holub and Čihák (2003).

countries would not change with changes in relative prices. In this article, we calculate the results for both real weights and for nominal weights, which allows us to assess the range of likely values and scenarios.

Table 4 below shows coefficients of relative price differences for 31 countries in 1990–2001, with Germany as the reference country.[12] The calculations are based on the standard breakdown to 29 (30 for 1999 and 2001) commodity groups of private consumption used in the ICP. The results with nominal weights are not qualitatively different from those for real weights. In general, coefficients of relative price differences in the EU countries are not higher than 0.35, and in the "core" EU countries they are well below 0.20. The coefficients in the accession countries are in most cases much higher, typically above 0.50.

A general decline in price dispersion in the accession countries was not observed over the 1993–2001 period (Table 7). Actually, the non-weighted average of the coefficient with real weights for the transition countries declined just marginally from 0.65 to 0.60 between 1993 and 2001, and the average coefficient with nominal weights went down from 0.53 to 0.50 over the same period. Moreover, an increase in the average coefficient was in fact observed in 1996. At the same time, both coefficients have de facto stagnated in EU countries. A panel regression of the coefficient of relative price differences with respect to price levels and time dummy variables confirms these observations, since it yields insignificant estimates for the dummy variables. The results do not depend on the choice of Germany as a benchmark; even when another "core" EU country, such as France, is chosen as a benchmark instead of Germany, the major conclusion still remains valid.[13]

Table 7. Coefficients of Relative Price Differences; Germany=benchmark

	Real Weights					Nominal Weights				
ICP year	1990	1993	1996	1999	2001[3/]	1990	1993	1996	1999	2001[3/]
Austria	0.16	0.13	0.19	0.15	0.12	0.16	0.13	0.17	0.15	0.11
Belgium	0.16	0.13	0.12	0.15	0.12	0.15	0.13	0.12	0.15	0.12
Bulgaria	...	0.55	0.76	0.77	0.76	...	0.52	0.79	0.72	0.63
Cyprus	...	...	...	0.35	0.35	...	...	...	0.35	0.35
Czech Republic [1/]	0.51	0.59	0.57	0.64	0.51	0.53	0.53	0.48	0.52	0.43
Denmark	0.22	0.17	0.30	0.21	0.17	0.23	0.18	0.28	0.21	0.18
Estonia	...	0.67	0.81	0.64	0.61	...	0.59	0.63	0.56	0.50
Finland	0.31	0.24	0.25	0.21	0.22	0.40	0.27	0.27	0.22	0.25
France	0.19	0.16	0.12	0.15	0.17	0.18	0.16	0.12	0.14	0.16
Greece	0.37	0.31	0.35	0.33	0.34	0.40	0.31	0.31	0.30	0.31
Hungary	0.56	0.45	0.59	0.60	0.55	0.52	0.42	0.49	0.53	0.46
Ireland	0.29	0.26	0.32	0.24	0.23	0.28	0.25	0.35	0.24	0.24
Island	0.37	0.36	0.37	0.32	0.31	0.43	0.38	0.36	0.32	0.34
Italy	0.27	0.23	0.32	0.29	0.23	0.23	0.20	0.27	0.24	0.20
Latvia	...	0.72	1.02	0.94	0.77	...	0.48	0.63	0.72	0.57

[12] The coefficients for 2001 have to be treated with caution, as they are based on the Eurostat's extrapolations of comparative prices and the 1999 ICP weights.

[13] For brevity's sake, the results for France as a benchmark are not reported here, but are available from the authors.

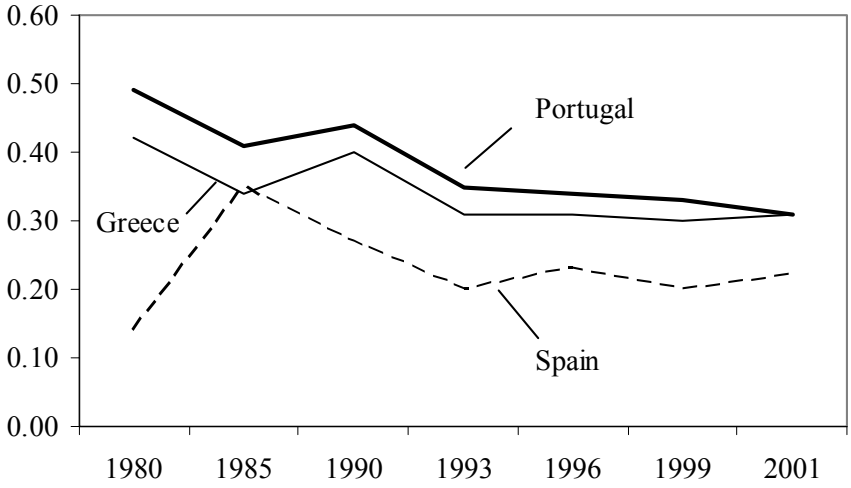
Lithuania	...	1.02	0.90	0.78	0.76	...	0.66	0.66	0.64	0.55
Luxembourg	0.18	0.17	0.16	0.15	0.16	0.17	0.15	0.15	0.14	0.16
Malta	...	...	...	0.38	0.38	...	...	...	0.39	0.38
Netherlands	0.15	0.12	0.12	0.18	0.13	0.14	0.12	0.12	0.19	0.13
Norway	0.29	0.26	0.30	0.30	0.30	0.34	0.28	0.32	0.30	0.33
Poland	0.60	0.68	0.83	0.57	0.54	0.62	0.58	0.64	0.51	0.51
Portugal	0.46	0.39	0.38	0.42	0.38	0.44	0.35	0.34	0.33	0.31
Romania	0.52	0.72	0.91	0.56	0.63	0.74	0.53	0.64	0.57	0.58
Russia	0.69	0.89	0.81	...	...	0.84	0.66	0.57	...	...
Slovakia	...	0.73	0.86	0.68	0.59	...	0.58	0.46	0.52	0.47
Slovenia	...	0.38	0.42	0.35	0.26	...	0.38	0.35	0.33	0.25
Spain	0.29	0.21	0.25	0.23	0.24	0.27	0.20	0.23	0.20	0.22
Sweden	0.25	0.15	0.19	0.22	0.17	0.29	0.15	0.22	0.24	0.18
Switzerland	0.19	0.14	0.14	0.17	0.18	0.20	0.14	0.13	0.16	0.17
Turkey	0.51	0.44	0.57	0.58	0.66	0.65	0.48	0.46	0.51	0.56
United Kingdom	0.22	0.18	0.27	0.21	0.26	0.23	0.18	0.29	0.22	0.27
AC-11 average [2/]	...	0.65	0.77	0.65	0.60	...	0.53	0.58	0.56	0.50
EU15 avg. (excl. Germany)	0.25	0.20	0.24	0.22	0.21	0.26	0.20	0.23	0.21	0.20

Sources: OECD, Eurostat, own computations.
1/ The 1990 figure refers to Czechoslovakia. 2/ AC-11 are the accession countries of Table 3, excluding Cyprus and Malta. 3/ Calculations for 2001 are based on the Eurostat's extrapolations of comparable prices and the 1999 ICP weights, which may lead to some distortions.

There are several explanations of why the coefficient of relative price differences in transition countries, as well as in the EU, did not decline monotonously in 1993–2001: (i) The data methodology has been changing over time, as discussed in section 2. (ii) Prices in the EU countries were influenced by the impact of the crisis of the EMS and the forced devaluation of several currencies between 1993 and 1996, and later on by the introduction of the euro. (iii) If the downward flexibility of prices in individual countries differs, the economic slowdown in 1996 might have led to an increase in the coefficient of relative price differences relative to Germany. (iv) The price system in the new EU member countries (i.e. Austria, Sweden) might have been temporarily disturbed by the preparation for EU accession and by the accession itself. A similar development was observed before EU accession in Spain, where the coefficient of relative price differences temporarily increased in 1985 (Figure 1). This development can be explained by the fact that the acceptance of common EU policies or tax harmonization increased some groups of prices in the less advanced countries, thereby distorting the system of relative prices temporarily; it is only afterwards that the relative prices begin to "settle down," and that the coefficient of relative price differences starts to decrease again.

The coefficients of relative price differences could be expected to decline over time in transition countries, as their real GDP and overall price level converge to the EU. Greece, Spain, Portugal, three countries with the lowest GDP per capita in the current EU15 countries, have gone through a substantial price adjustment since their accession (Figure 1). However, it should be noted that the adjustment was far from monotonic—see in particular the spike in Spain's coefficient in mid-1980s.

Figure 1. Spain, Portugal, and Greece: Coefficients of Relative Price Differences, 1980–2001



Source: Own calculations based on ICP data.

4.2 Relative Prices vs. Price Levels Across Countries

A negative relationship appears to exist between the degree of differences in relative prices and the aggregate price level. Results of a panel regressions of the average price level of consumption (μ) on the coefficient of relative price differences ρ, as defined in (2), are summarized in Table 8. The estimated relationship in both regressions (for nominal and real weights) is significant at the 1 percent significance level.[14] This negative relationship between relative price dispersions and price levels can be, in a sense, viewed as an analogy to the relationship between the relative price of tradable and non-tradable goods in the Balassa-Samuelson model. The difference is that the Balassa-Samuelson model distinguishes two types of goods only (tradables vs. non-tradables), whilst our statistical approach allows to consider many commodity groups without specifying the degree of their tradability (see below for more detail).

Table 8. Panel Regression of the Price Level on the Coefficient of Relative Price Differences

	Number of countries	Number of observ.	Intercept	Slope	Std. Error	R^2	F-stat. (p-value)
Nominal weights 1980–99	30	138	1.18*	-1.41	0.04	0.61	0.000
Real weights 1980–99	30	134	1.13	-1.07	0.02	0.66	0.000

This finding suggests that the increases in relative price differences, found in previous sub-section for the period of 1996-99, could be only temporary. The results in Table 8 mean that accession countries with similar relative price structures to Germany tend to have price levels closer to Germany (i.e.,

[14] Alternatively, the relationship between μ and ρ could be fitted by a hyperbola. However, given that the "hyperbolic" function does not add much new insight or precision and the notation becomes more cumbersome, we use the assumption of a linear function here.

higher). The stability of this relationship gives credibility to the hypothesis that in the longer term, with output convergence, relative price differences can be expected to decline, while aggregate price levels would increase. We quantify these relationships in greater detail in the next subsection.

4.3 Macroeconomic Developments and Relative Price Adjustments

In the previous sub-section, we have illustrated that the structures of relative prices in the EU accession countries are very different from those in the EU. In our previous research (e.g. Holub and Čihák, 2000; Čihák and Holub, 2001a,b), we argued that the future adjustment of the structures of relative prices may push towards a higher inflation rate in accession economies compared with the EU, assuming that the prices are asymmetrically downward-sticky. We used this to discuss the implications for the appropriate choice of inflation targets in the Czech Republic. At present, though, the medium-term inflation targets are publicly announced in most accesssion countries with flexible exchange rates. The need for nominal convergence is also anchored by the Maastricht inflation criterion. Therefore, it is reasonable to turn our earlier questions around, and ask what the existing inflation targets mean in combination with the real convergence process for the individual prices. And if some of the prices are likely to be forced to decline in nominal terms over the convergence process, the relevant question now is how the potential downward-stickiness problem could be reduced, e.g. by appropriate wage bargaining mechanism, so as to minimize the negative consequences for the real economy.

In order to answer these questions, we need to establish empirically the sensitivity of individual prices with respect to GDP in PPP. This requires to run regressions between prices and GDP, similar to those shown in Table 1, but separately for each commodity group. As explanatory variable we use logarithmic GDP per capita in PPP. The dependent variable is not the general price level as in Table 1, but the logarithmic price of a specific commodity group. For a tradable commodity, one can expect that the slope coefficient will not be significantly different from zero, while for a nontradable commodity, it will. Moreover, the estimated coefficient may be used to compute an "empirical degree of nontradability," based on equation (1).[15]

The results of these panel regressions for 30 commodity groups in 30 European OECD and/or EU-accession countries are summarized in Table 9.[16] The results seem to confirm that there are many different "degrees of nontradability" of the various commodity groups, as measured by the slope coefficient in the regression between their prices and GDP in PPP, ranging from 0.10 (the most tradable) to 0.60 (the least tradable). Only few commodity groups can be characterised as being closed to purely "tradable" (cars, communication and recreation equipment) since the relationship between the price and GDP in PPP per capita was positive in all groups and highly statistically significant in

[15] In theory, tradability could be analyzed more directly, by investigating whether foreign competition participates in a particular market. In practice, such an analysis is impaired by data constraints and by the difficulty of defining precisely "foreign competition in a particular market." This leads us to the indirect method, which is based on the fact that the estimated elasticity in the regression of each commodity price on per GDP in PPP should be equal $(1-\gamma_i)/\gamma_i$, where $(1-\gamma_i)$ is the non-tradable component of commodity *i*. Therefore, the slope coefficient would theoretically be 0 for a perfectly tradable commodity and infinite for a perfectly nontradable commodity.

[16] We used New Cronos data for 1995–2001 in these regressions, as these data cover a more recent period than the ICP data, and thus allow for more up-to-date simulations in the rest of this section.

most cases. This finding can be explained for example by the fact that retail prices of even the most "tradable" commodities include nontradable elements, such as transportation costs, wholesale margins, and retail margins. Also, there may be systematic differences in terms of trade in tradable goods between more and less developed countries (see section 3.2). In any case, the classical Balassa-Samuelson distinction of tradable vs. nontradable commodities appears to be artificial in practice, and our empirical approach can be understood as an attempt to generalise the price convergence debate in order to make it more realistic.

Table 9. Price vs. GDP Regressions for 30 Commodity Groups

Commodity group	Intercept	Slope	R2 1/	Empirical nontradability (%)
Bread and cereals	1.72	0.64	0.71	39
Meat	1.60	0.66	0.80	40
Fish	2.94	0.37	0.58	27
Milk, cheese and eggs	2.72	0.42	0.55	30
Oils and fats	3.40	0.27	0.41	21
Fruits, vegetables, potatoes	2.07	0.56	0.72	36
Other food	3.29	0.29	0.45	23
Non-alcoholic beverages	3.01	0.36	0.43	27
Alcoholic beverages	2.55	0.43	0.04	30
Tobacco	0.54	0.86	0.76	46
Clothing including repairs	2.51	0.46	0.73	32
Footwear including repairs	2.60	0.45	0.58	31
Rentals for housing	-1.53	1.34	0.74	57
Maintenance, household services	0.17	0.96	0.72	49
Electricity, gas and other fuels	1.50	0.66	0.65	40
Furniture, floor coverings, textiles	1.88	0.59	0.75	37
Household appliances and repairs	3.17	0.32	0.41	24
Other household goods and services	2.26	0.51	0.73	34
Medical products and equipment	2.30	0.49	0.58	33
Medical services	-1.83	1.38	0.91	58
Personal transport!equipment	3.67	0.23	0.11	18
Operation of transport!equipment	2.37	0.48	0.72	33
Purchased transport!services	0.05	0.99	0.80	50
Communication	3.30	0.28	-0.04	22
Recreational equipment and repairs	4.10	0.11	0.20	10
Recreational and cultural services	0.58	0.87	0.88	46
Newspapers, books and stationery	1.19	0.74	0.64	42
Education	-2.14	1.46	0.89	59
Restaurants and hotels	2.17	0.52	0.69	34
Miscellaneous goods and services	0.52	0.88	0.87	47

Note: 1/ Unweighted statistic.

The estimates from Table 9 can be used to determine how prices in these individual groups are likely to develop in the future depending on the speed of real economic convergence. If π is the domestic inflation rate, ε_i is the estimated elasticity for commodity group i, and $\bar{\varepsilon}$ is the average elasticity for the overall consumption basket (see Table 1 above), than the domestic price of commodity group i (denoted P_i^D) should develop according to :

$$\frac{\Delta P_i^D}{P_i^D} = \pi + \left(\varepsilon_i - \bar{\varepsilon}\right)\frac{\Delta GDP_{PPP}}{GDP_{PPP}}. \qquad (3)$$

As an example, let us consider the price of recreational equipment, which has the lowest elasticity in the regression on GDP per capita in PPP. The average elasticity for the overall consumption basket was estimated in Table 1 as $\bar{\varepsilon}$ =0. 73. This means that for personal transport equipment, the term in the brackets on the right-hand-side of (3) approximately equals to –0.62. Assuming that inflation is about 3.0 percent,[17] prices of recreational equipment will stagnate if the GDP growth reaches about 4.8 percent a year. For a GDP growth rate higher than that, prices of this commodity group would be forced to decline, which may 'hit the constraint' of lower downward flexibility of prices.

A growth rate of 4.8 percent does not appear to be a binding constraint for more advanced accession countries, as the benchmark convergence scenarios include a slower growth in their case. However, it does not have to be true for less advanced countries for which one could expect a higher growth differential. Moreover, the above result needs to be treated with a degree of caution. First, at a more disaggregated level, it might be possible to find commodities with a smaller elasticity than the 0.11 for recreational equipment, which would decrease the figure for GDP growth not pushing some prices to decline. Second, the above calculations count too much on the average estimated relationships in the simplest versions of the estimates. As we have shown in section 3, additional factors beside the GDP growth may influence the average price level, and thus also the real exchange rate appreciation and changes in relative prices. Note that the GDP growth rate of 4.8 percent should be on average associated with real appreciation of about 2.0 percentage points, while the actual speed of real appreciation in many accession countries has been historically above that level even with a GDP growth rate below 4.8 percent. It is thus quite possible that some prices may be forced to decline in nominal terms even with a growth rate smaller than 4.8 percent.

Finally, the actual exchange rate, economic growth, and inflation developments may deviate substantially from their long-run trends in the short or medium run. This may push on a decline of some nominal prices in these periods even though there is no need for them to decline in a long time horizon. If the inflation rate reaches for example 2.0 percent only, GDP growth can become "binding" (i.e. some prices may have to decline) at around 3.2 percent only. The more likely candidates for price declines are those commodity groups for which the price-GDP slope coefficients, as reported in Table 9, are below average. Besides recreational equipment, this includes commodities such as personal transport equipment, oils and fats, household appliances or communications.

With convergence in output and the appreciation in the real effective exchange rate, the degree of differences in relative prices is likely to decline in the accession countries, too. We provide a benchmark scenario for relative price convergence in Table 10. The table is based on the assumption that the rate of GDP convergence to the EU would be 2.5 percent per year, i.e. that 2.5 percent of the output gap with respect to the EU average would be closed each year.[18] We also assume that the factors influencing the residuals in the price-GDP regressions (such as those discussed in section 3) adjust towards their EU levels. In particular, it is assumed that the residuals in the price-GDP

[17] This should be roughly equal to the upper bound of the Maastricht inflation criterion to which all the acceding countries should converge.

[18] The 2.5 percent convergence rate is consistent with most cross-country studies of economic growth and convergence (see for instance Barro, 1991).

regressions decline over time at a rate of 10 percent per year. This adjustment speed was set consistent with the error-correction parameter, which we estimated in a dynamic version of the regression for the price level of household consumption presented in Table 1 (for New Cronos data). The regressions presented in Table 9 were used in combination with these assumptions to project the future price developments in each commodity group for all acceding countries.[19]

As shown in Table 10, assuming that the price adjustment follows the GDP convergence and that the adjustment of price residual does not proceed in jumps, it may take one (and in some cases even two) decade for the aggregate price level to reach 60 percent of the EU price level in most acceding countries (except for Slovenia). And it may take several decades to reach 80 percent of the EU price level. Similarly, it would take 10-25 years to reach the degree of relative price differences compared with the core of eurozone as now observed in the least developed EU countries. This shows that the price level and relative price adjustment in the acceding countries is to be considered a long-run matter.

The rate of real exchange rate appreciation associated with the price adjustment in our scenario is also presented in Table 10. On average, the real appreciation should reach roughly 3 percent over the next five years and 2 percent over the next 15 years. It should be much lower in Slovenia, though, which has a price level close to some current EU members already at present.[20] On the other hand, some countries may experience a real appreciation of more than 4 percent according to this scenario (Bulgaria, Czech Republic, Romania, and Slovakia). Following the discussion in section 3, such rates of real exchange rate appreciation should be still manageable from the ERM II participation point of view. But they further highlight the importance of not insisting on the narrow fluctuation band, staying in the ERM II for the minimum required period of two years and tolerating some nominal appreciation within the ERM II band. For the hard exchange rate peg countries (Estonia, Latvia, Lithuania, and Bulgaria), on the other hand, the real appreciation projected in Table 10 could be challenging in terms of fulfilling the Maastricht inflation criterion. In their case, the nominal exchange rate strengthening cannot be used to achieve the real appreciation, which might lead to an upward pressure on inflation.

Table 10. Accession Countries: Speed of Adjustment vs. EU15

	BG	CZ	EE	HU	LT	LV	PL	RO	SI	SK
Real exchange rate, 5yrs 1/	5.6	4.6	1.9	3.8	3.3	2.3	1.4	4.3	1.3	4.6
Real exchange rate, 15 yrs 2/	3.9	2.9	1.7	2.6	2.5	1.9	1.3	3.2	1.0	3.1
μ reaches 60 percent of EU 3/	19	6	10	7	12	13	6	19	0	11
μ reaches 80 percent of EU 3/	47	25	39	31	40	43	37	48	16	36
ρ reaches 40 percent 3/	13	1	8	3	8	10	7	11	0	4
ρ reaches 30 percent 3/	27	8	22	13	21	23	19	23	0	14
Weight of falling prices, π=3% 4/	19.8	19.0	4.8	15.8	10.7	7.9	7.9	11.4	1.8	11.2

[19] The factors influencing the adjustment of residuals in the relative prices can be analyzed explicitly by replacing the simple regressions for commodity prices on GDP in PPP with extended regressions such as the one in Table 4. However, it is not clear how quick might be the adjustment of some of the explanatory factors (such as the share of agricultural employment in a country), if they adjust at all. Price adjustment is then likely to be less speedy or less smooth then suggested in Table 10. Another improvement might be to estimate the error-correction parameter for each commodity group separately, which would modify the projected process of relative price adjustment. We avoid this complication here, taking advantage of the simple scenario's suitability for sensitivity analysis.

[20] The same conclusion applies to Cyprus and Malta, which are not reported here for the sake of brevity.

Weight of falling prices, π=2% 4/	20.7	30.6	13.8	33.0	14.5	8.9	8.9	15.0	13.7	31.1

Notes: 1/ Average annual real exchange rate appreciation in percent over the next 5 years. 2/ Average annual real exchange rate appreciation in percent over the next 15 years. 3/ Number of years to reach the threshold. 4/ Nominal weight in percent of falling prices in consumption basket with overall inflation equal to 3 percent or 2 percent, respectively.

Table 10 also presents the nominal weight in consumption of commodity groups the prices of which might be forced to decline over time for each convergence scenario. The computations were done both for the overall inflation being at the upper edge of the Maastricht criterion (assumed to be 3 percent here), as well as at the ECB' target (rounded up to 2 percent here). This is a more detailed approach compared with equation (3), as it takes into account not only the GDP growth, but also the existing residuals of the country. Table 10 shows that for the baseline scenario with realistic economic growth and real exchange rate appreciation, the prices representing 10–20 percent of basket would need to decline at the 3 percent inflation rate (again except of Slovenia). With the 2 percent inflation rate, however, their share in the basket may go up further, in some cases even to 30 percent. This shows the economic importance of setting the inflation targets close to the upper edge of the Maastricht criterion, rather than trying to push the inflation as far as the euro area average.

We calculated a range of alternative scenarios to assess the sensitivity of the results of Table 10 to alternative assumptions.[21] In particular, we varied the GDP convergence parameter between 1.5, 2.5 and 4.0 percent, and the residual adjustment speed from between 5, 10 and 15 percent. In general, the adjustment of price levels appears to be more sensitive to the overall GDP growth, while the adjustment of structures of relative prices is more sensitive to the factors that influence the speed with which the residuals in the simple "price vs. GDP" regression are eliminated. The speed of residual adjustment is very important for the real exchange rate appreciation particularly in those countries that have a large overall residual at present. Changes in the speed of GDP convergence influence both aggregate price levels as well as structures of relative prices, but the impact on relative prices is relatively smaller.

In the most upside scenario, which is of a higher policy interest than the conservative scenarios that pose no particular monetary policy challenges, the average speed of real appreciation went up to slightly more than 4 percent (and in some cases even to 5–8 percent) for the five-year period. The time required for the price level and relative price convergence to reach the level of the less developed current EU members declined below 10 years on average (and below 15 years even for the extreme cases). The average weight of falling prices in the consumer basket increased to 18 percent (in some cases as much as 30 percent) for a 3 percent inflation rate, and to 23 percent (for some countries over 30 percent) for a 2 percent inflation rate. This further highlights he importance of having a flexible interpretation of the Maastricht exchange rate stability criterion, and of targeting a slightly higher inflation rate than in the EU.

Nevertheless, even under such reasonable policies we cannot exclude the possibility of some prices being forced to decline under the realistic scenarios. This leads us to the question if the potential downward rigidity of prices is really a serious problem. According to the economic theory, there are reasons why prices may be more downward-sticky in the short or medium run. Yet there is no theory, which would argue that prices may be downward-sticky in a longer run. The mainstream economic theory maintains that in the long run, prices flexibly adjust to their equilibrium levels, as companies

[21] The numerical results of these scenarios are available from the authors upon request.

are able to reset their costs and output prices in line with the macroeconomic fundamentals. On the other hand, it is possible that the behaviour of the economic agents in some markets – for example in the labour market – is not fully rational and downward flexibility of prices can be achieved only at some economic cost even in a medium or longer run. Even if it is hard to give convincing explanation of such a phenomenon, it might be prudent from the policy perspective to take it into account (a similar argument was recently used by those who feared deflation or very low inflation in industrialised countries) and try to minimise its likelihood.

What is thus the appropriate response from policy makers and economic agents? It is the companies' and labour unions' responsibility to realise the above fact and to adjust their behaviour to the circumstances of low inflation, nominal exchange rate appreciation, and falling prices of the most tradable goods. Unfortunately, the only thing that the policymakers could possibly do in this respect – besides setting higher inflation targets which is constrained by the need to achieve the Maastricht criterion – is to communicate more actively to the private sector the implications of the nominal and real convergence processes. This may help overcome the behavioural aspect of the downward rigidity of prices and its real macroeconomic costs, which may stem from the lack of companies' and labour unions' experience with the low-inflationary and real convergence environment.

5. Conclusion

The results of the calculations in this article show that there is a significantly positive cross-country relationship between aggregate price levels and outputs. This relationship can provide reasonable predictions of the average pace of real exchange rate appreciation in transition economies, which is estimated at around 3 percent per year (with differences for individual countries) under our benchmark scenario. This real appreciation rate should be manageable in the ERM II regime, if the exchange rate stability criterion is assessed in a flexible manner and if the inflation is targeted at the upper bound of the Maastricht criterion. The real appreciation might be more challenging, though, for the hard peg countries, as it might push their inflation rates upwards, potentially above the Maastricht limit.

We also consider other factors determining the price level besides the per capita GDP. We use GDP per employee rather than GDP per capita, allow for differences in productivity in the non-tradable sector, shares of non-tradables in GDP, the government policies and the structure of foreign trade. These factors are significant for explaining price level differences. This shows that the debates on price convergence should not focus on its link to the GDP convergence and Balassa-Samuelson effect only, but should take into account other factors as well.

We also demonstrate that a strong negative relationship exists between price levels and the degree of differences in structures of relative prices in individual countries. We show how the prices of individual commodity groups, and therefore also the structures of relative prices as well the aggregate price levels, are likely to adjust as the accession countries converge to EU. We find out that the structure of relative prices is quite sensitive with respect to the above mentioned additional explanatory factors, in particular in those countries that currently have high residuals in the simple regression. The impact of GDP convergence speed is also important for the convergence in price levels and relative prices.

Using the panel data estimates, we assessed whether the convergence of output can force prices of some commodity groups to decline, given the nominal convergence process required by the Maastricht criteria. This is essentially a restatement of a question analyzed in our previous research, whether the

process of adjustment in structures of relative prices can lead to inflationary pressures, given that some prices may not be very downward-flexible. We found that even in the benchmark scenario, more than 10 percent of prices might be forced to fall if the inflation is around the upper bound of the Maastricht criterion. Moreover, if additional factors such as a significant exchange rate appreciation exceeding the benchmark scenario speed put additional downward pressure on inflation, the share of declining prices may go up even further.

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