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Does the Balassa-Samuelson Effect Matter for Central Europe's Transition Economies on Joining the EMU?

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I. Introduction

During their decade-long haul towards the market economy, most of Central Europe's transition economies have experienced a very rapid productivity growth, especially in their industrial sector. A first glance at some annual macroeconomic data suggests that this productivity bonanza has been accompanied by a surge in non-tradable relative prices and a substantial appreciation of the real exchange rate against the deutschemark and the US dollar.

This is something that seems to correspond exactly to what Balassa and Samuelson tell us in their seminal papers which appeared in 1964: In a given economy, productivity growth in the open or traded goods sector is usually higher relative to that of the closed or non-traded goods sector. Given that wages tend to be roughly the same across sectors, faster productivity growth in the tradable sector pushes up wages in all sectors. This in turn increases the relative prices of non-tradable goods. In fact, productivity growth in an emerging market economy is higher than in a developed country, which means higher inflation in the former. That is the main reason why the CPI based real exchange rate is likely to appreciate in the long run.

Considerable ink has been spilled on trying to validate this theory by testing it for industrialised countries as well as for emerging economies. However, there has been little econometric work done covering Central Europe's transition economies. This is reason enough to take up the challenge and to test whether this theory, often labelled as the Balassa-Samuelson productivity differential model or the productivity-bias hypothesis, is at work in transition countries during the 1990s. Thus, this study covers 5 advanced Central European transition countries, that is the Czech Republic, Hungary, Poland, Slovakia and Slovenia.

A two-step, bottom-up approach is adopted. Therefore, first the link is tested between productivity growth and relative prices of non-traded goods to those of traded goods. Then, the relationship between relative prices and the real exchange rate, measured by the CPI, is explored. In doing so, unit root tests are employed and the co-integration technique proposed by Johansen is used.

As small and open economies and having strong economic ties to EU-states, these countries are strongly interested in joining the European Union and, as soon as possible, the euro zone as well. The latter means meeting the Maastricht criteria. Given the presence of the Balassa-Samuelson effect, to meet the criterion on inflation and consequently that on interest rates may prove rather difficult. This issue seems to be very important and therefore needs to be addressed.

The rest of the paper is organised as follows: Section II presents the theoretical framework and gives an overview of the literature. Section III describes the data. Section IV discusses the method used in the paper and then presents the estimation results. With this as background, section V analyses the impact of the Maastricht criteria on CEECs. Section VI finally concludes.

II. The Purchasing-Power Parity and The Productivity Differential Theory

The Balassa-Samuelson theory was meant to be an alternative model for long-run real exchange rate determination. In effect, it recalls into question the well-known purchasing power parity theory (PPP), which has long been the tenet of international in general and of exchange

rate economics, in particular. Consider that the law of one price, centrepiece of the PPP, holds for every good. That is, in the foreign and domestic country, one should pay the same price, expressed in the local currency, for the same basket of goods. The level of the bilateral nominal exchange rate, measured as domestic currency units per foreign currency units, can be easily derived from this basic relationship: the nominal exchange rate should be equal to the domestic price level divided by the foreign price level. Provided that the absolute PPP does hold for two different moments in time, the relative version of the PPP works as well. So a relationship can be established between the variation in the nominal exchange rate and that of the price levels[2]. Given that the PPP is a long-term concept, the market exchange rate should converge to its PPP determined equilibrium value. For PPP to hold, the real exchange rate should be stationary in the longer run.

However, as the professional wisdom goes, this is hardly the case. According to the International Comparison Program carried out under the aegis of the UNO[3] and to the PPP program of the OECD and Eurostat covering European countries, the absolute PPP does not work at all in practice. This is especially true for developing and emerging countries' currencies against industrialised countries' currencies. As to the relative PPP, after the breakdown of the Bretton-Woods system, it has long been considered to perform rather poorly[4]. Recently, a line of researchers has made efforts to shed new light on the relative PPP by employing secular, or even pluri-secular time series, panel data covering the period after 1973 and the combination of very long time series and panel data[5]. The general consensus that emerges from these studies is in favour of some sort of relative PPP. Sounds wonderful. However, others point out that all this may be a merely statistical artifact[6]. Even if one were to accept relative PPP as verified, given that all these papers cover exclusively industrialised and OECD countries[7], there is no reason to think that relative PPP does hold in the transition countries considered in this paper.[8]

[2] Moosa argues that there is no reason to make difference between absolute and relative PPP [Moosa(1996), Moosa (1999)]. True, in case absolute PPP works, relative PPP too can be automatically verified. Nevertheless, all this does not imply that relative PPP could not work in the absence of absolute PPP.

[3] Summers – Heston (1991), Heston - Summers and alii (1994), The Center for International comparisons at the University of Pennsylvania, pwt.econ.upenn.edu

[4] See, for example, Frenkel(1978), Frenkel (1980), Frenkel (1981), Genberg (1978), Isard (1977) and Hakkio (1984).

[5] See, for instance, Abauf – Jorion (1990), Froot – Kim – Rogoff (1995), Lothian - Taylor (1996) for secular time series and Cecchetti et alii (2000), Engel et alii (1997), Frankel – Rose (1995), Koedijk et alii (1998), Lothian (1997), Nagayasu (1998), O'Connell (1998), Papell – Theodoridis (1998), Salehizadeh – Taylor (1999), Taylor (2000b) and Wei – Parsley (1995) for panel data.

[6] See Engel (1996), Engel et alii (1997), O'Connell (1998) and Taylor (2000a)

[7] Newly admitted countries such as the Czech Republic, Hungary and Poland are systematically excluded.

[8] There are a few papers which address the issue of PPP in transition countries. Among others, the one of Tacker (1995) rejects the relative PPP for Hungary and Poland. While Choudhry (1999) can reject relative PPP in Poland and Romania, he finds some support for the weak version in Russia and Slovenia.

Table 1. Purchasing power parities and the exchange rate, 1996

	PPP	Exchange rate	Under-valuation: Forex/PPP
Against the US			
Czech Republic	11.7	27.15	2.32
Hungary	72.6	152.60	2.10
Poland	1.36	2.66	1.95
Slovakia	12.2	30.65	2.51
Slovenia	96.0	135.40	1.41
Against Germany			
Czech Republic	5.76	18.04	3.13
Hungary	35.76	101.40	2.84
Poland	0.67	1.77	2.64
Slovakia	6.01	20.37	3.39
Slovenia	47.29	89.97	1.90

Source: OECD

Instead, as to emerging countries, there is a wide gap between the market rate and the PPP equilibrium value, as shown in table 1. According to Balassa (1964) and Samuelson (1964), the market exchange rate of emerging market economies is typically undervalued compared to that suggested by the absolute PPP. In addition, as those countries catch up with the industrialised countries in terms of economic development, their CPI based real exchange rates are likely to experience a trend appreciation. That is, the market exchange rate systematically moves closer to the PPP-based equilibrium value and so, relative PPP does not function. The very idea of the productivity differential model comes from the introduction of two sectors, notably the traded sector and the non-traded goods sector. There are several hypotheses, which should be explicitly stipulated in order to let the theory function:

1.) Administrative and non-administrative barriers do not hinder foreign trade. Thus, both absolute and relative PPP are verified for tradable goods. Deviations are though permitted against PPP, which are largely attributable to transport costs. The structure of foreign trade is supposed to be relatively stable over time.

$$r^T = e + p^{T*} - p^T \quad (1)$$

Where p^T, p^{T*}, e, r^T denote local and foreign traded goods prices, nominal exchange rate in foreign currency terms and the traded real exchange rate respectively. All the variable in this paper are expressed in natural logarithm.

2.) Tradable prices are determined by marginal cost. That is, wages in the traded sector are linked to marginal productivity in that sector. For the labour factor is considered to be rather mobile within the economy, wages for the same positions are expected to equalise across sectors.

$$prod^T + p^T = w^T \quad (2)$$
$$prod^{NT} + p^{NT} = w^{NT} \quad (3)$$

$w^T = w^{NT}$ implies that $prod^T + p^T = prod^{NT} + p^{NT}$ (4)

Where $prod^T$, $prod^{NT}$, w^T, w^{NT} stand for productivity and wages in the open and sheltered sector respectively.

3.) Productivity in the traded goods sector is considerably higher than that in the non-traded goods sector. In addition, inter-country productivity differentials are higher in the traded sector than in the non-traded sector.

$$prod^T > prod^{NT} \text{ so that } p^T < p^{NT} \quad (5)$$

4.) Capital markets are internationally integrated.

In a given economy, productivity growth in the traded goods sector is generally higher compared to that of the non-traded goods sector. Given the equalisation process for wages between sectors, faster productivity growth in the tradable sector means higher wages in all sectors. This in turn increases the relative prices of non-tradable goods. Let p be defined as weighted sums of tradable and non-tradable prices, where α and $1-\alpha$ stand for the weight of the traded good and sheltered sector in the economy as a whole:

$$p = \alpha\, p^T + (1 - \alpha)\, p^{NT} \quad (6)$$

Taking equation (4) into consideration and prices in the closed sector (equation (7a)), the overall price level is described by equation (7b):

$$p^{NT} = p^T + (prod^T - prod^{NT}) \quad (7a)$$

$$p = p^T + \alpha\,(prod^T - prod^{NT}) \quad (7b)$$

Productivity growth in an emerging market economy is indeed higher than in a developed country, which means higher inflation in the former. That is the main reason why the CPI based real exchange rate is likely to appreciate in the long run.

What, it might be asked, is the key finding of the Balassa-Samuelson theory? It can be summarised briefly as follows: the CPI based absolute and relative PPP are unable to truly explain the level of and the variation in the nominal exchange rate. The reason for this is that this latter is chiefly determined by the price ratio of the traded goods between the two countries. In contrast, the computation of the PPP is considerably biased by the presence of non-traded goods in the goods basket and the consumer price index. Since non-tradable prices are by far lower in less developed countries, their currencies are undervalued in terms of PPP. With the catch-up process, those countries will though experience an increase in non-traded goods prices, which in turn makes their currency appreciate and move closer to the PPP value.

Let p, p*, e, r denote the domestic and foreign price level, the nominal and real exchange rates in natural logarithm. The real exchange rate can be determined as follows:

$$r = e + p^* - p = e - e^{PPP} \text{ where } e^{PPP} = p - p^* \quad (8)$$

It is clear that, as long as the PPP based exchange rate is lower than the nominal exchange rate, the real exchange rate turns out to be undervalued. As the price level of the domestic economy moves closer to the foreign price level, the PPP value increases. This does make, according to equation (8), the real exchange rate appreciate.

The usual way to show the relationship between relative prices and real exchange is the so-called real exchange rate decomposition. Among the numerous decompositions that can be found in the literature, that of McDonald(1998) is chosen - one of the simplest and the most understandable - to demonstrate the influence relative prices have on real exchange rate movements. Let us take into account equation (6) and (8) and let an asterisk denote the foreign country, the real exchange rate can be written as follows[9]:

$$r = e + p^{T*} p^{T} + (\alpha-1) (p^{T} - p^{NT}) + (1 - \alpha^*) (p^{T*} - p^{NT*}) \qquad (9)$$

$$r^{T} = e + p^{T*} p^{T} \qquad (10)$$

$$r = r^{T} + (\alpha-1) (p^{T} - p^{NT}) + (1 - \alpha^*) (p^{T*} - p^{NT*}) \qquad (11)$$

The first paper ever to test the theory is, not surprisingly, the one of Balassa. He looked at a cross section of countries at different stages of development. Naturally, he found evidence in favour of his theory. Research made afterwards concerned mainly OECD countries[10] and Asian emerging economies[11]. Most of those papers carried out econometric tests for time series. However, others considered cross section or panel data. Per capita income and other indicators for economic development such as the share of machinery in export are commonly used proxies for productivity. A large number of papers have conducted tests either for just one part of the theory – productivity-relative prices or relative prices-real exchange rate - or in a single stage, leaping relative prices over.

The conclusion that can be drawn according to the research done till now is that the Balassa-Samuelson theory works reasonably well for some emerging countries against developed countries. As far as Central Europe's transition economies are concerned, Simon-Kovács(1998) and Jakab-Kovács(1999) find strong empirical evidence in favour of the productivity differential theory in Hungary for the period 1991-96 and 1992-98 respectively. According to Rother(2000), the contribution of the productivity differential to CPI in Slovenia accounts for an annual rate of 2.6% during 1993-98. While the same mechanism seems to hold in the Czech Republic, the evidence for Slovakia and Estonia is less clear-cut. In Sinn-Reutter(2001), if results suggest the productivity-bias hypothesis be robust in the Czech Republic, Estonia, Hungary, Poland and Slovenia, the extent to which productivity differentials contribute to CPI varies substantially. With respect to an EU21 including the EU15, the five CEECs and Turkey, they compute inflation rates compatible with the absence of deflation in Germany, the country with the lowest

[9] For ease of exposition, only the final equations are presented here.

[10] See Chinn (1997a), De Gregorio et alii (1994), De Gregorio – Giovannini – Wolf (1994), De Gregorio – Wolf (1994), Dutton – Strauss (1997), Hsieh (1982), Kakkar – Ogaki (1999), Strauss (1995) and Strauss (1996) for time series and Asea-Mendoza (1994), Canzeroni – Cumby – Diba (1999), Chinn – Johnston (1997), Strauss (1999) for panel data. Heston et alii (1994) study panel data coming from the International Price Comparison project.

[11] See Chinn (1997b), Ito - Isard - Symansky (1997), Bahmani-Oskooee – Rhee (1996) and Lothian (1990) for Asian countries and Edwards (1988) for developing countries, in general.

productivity differential, and find 2.88%, 3.38%, 4.06%, 4.16% and 6.86% the appropriate rate for the Czech Republic, Slovenia, Estonia, Poland and Hungary respectively. It is argued that including CEECs do not imply a noteworthy change in the CPI for Euroland as a whole.

But if only industrialised economies are studied, according to Rogoff (1996), the results are more colourful, not to say more controversial. Depending on the econometric method used and the data set applied, results vary quite substantially. But after all, as econometric methods, particularly for panel data, grow more sophisticated and more detailed data become available for a longer span of time, a shift is under way in favour of the theory. Recently, there has been a score of papers, focusing on EU-countries in particular, which have provided strong evidence for the Balassa-Samuelson effect (ECB(1999), Sinn-Reutter(2001)). Differences in development and growth seem to be substantial enough to generate notable gaps in productivity differentials and relative prices among those countries.

III. Description of the Data and Notes on the Method Used

A. Data

The data used in this paper consist of monthly productivity data, relative prices of non-traded goods, nominal and real exchange rates and cover the period from 1991:1 to 2000:8 for the Czech Republic, Hungary and Poland and that from 1993:1 to 2000:8 for Slovakia and Slovenia. All the data are, if necessary, seasonally adjusted. The choice of the period under study is largely dictated by data availability, in particular by that of productivity data. Though, since in the first years of transition, other factors beside the Balassa-Samuelson effect turn out to drive real exchange rate movements (Halpern and Wyplosz (1997)) and with structural breaks as a pretty common phenomenon during the whole transformation process, we try to eliminate the early 1990s and to account for the aforementioned breaks in the underlying fundamentals by determining sub-periods. We regress productivity on relative prices and relative prices on the CPI-based real exchange rate by starting with a sample of 20 observations and then adding one data at a time until 2000:07 is reached. As a matter of fact, we compute recursive coefficient estimates so as to see whether the coefficients are constant over the whole period. The sub-periods considered in this paper are 1995:1-2000:7 for the Czech Republic, 1995:3-2001:7 for Hungary, 1994:6-2000:7 for Poland, 1995:12-2000:7 for Slovakia and 1995:4-2000:7 for Slovenia.[12]

[12] Sharp changes in the t-stat can be observed in 1995:1 for the Czech Republic, in 1995:3 and in 1998:3 – 1998:11 for Hungary, in 1995:12, 1998:12 and 2000:2 for Slovakia and in 1995:4 and 1999:6 for Slovenia. While the evidence for a marked structural break for Poland is less straightforward, there is also a very smooth but significant change between 1993:1 and 1995:8. These dates coincide remarkably well with changes in the marcoeconomic framework in each country but the Czech Republic. In March 1995, a vast stabilisation programme has been implemented in Hungary. End-1995 is the beginning of serious external and internal imbalances due to deteriorating competitiveness and expansionary fiscal policy in Slovakia. The period from early-1999 onwards is marked by an adjustment package in Slovakia. Raising concerns with respect to the degradation in external competitiveness pushed the Bank of Slovenia to let the tolar depreciate by heavily intervening on the foreign exchange market from mid-1995 on. The year 1999 has been something of a milestone for Slovenia as to the liberalisation of capital flows. As far as Poland is concerned, the period between 1993 and 1995 marks the beginning of substantial capital inflows and increased exchange rate volatility within an ever widening fluctuation band around the crawling rate brought about by good macroeconomic prospects for the “soaring eagle”.

The productivity series come from the OECD's Main Economic Indicators (MEI) database available on the Internet[13] and are measured as labour productivity for the industrial sector, except the US where manufacturing productivity is used. No monthly data regarding the non-tradable sector's productivity growth is available, therefore it shall be considered as zero.[14]

Relative prices of non-traded goods are measured as service prices compared to the prices of durable consumer goods. Services are supposed the least likely to be traded, while durable consumer goods are believed the most likely to be traded among the components of the consumer price index. For this reason, service and durable consumer goods prices are considered as good proxies for non-traded and traded goods prices respectively. It is worth noting that there is no such thing as purely tradable goods, because every traded good contains a non-traded component to some extent. Price series for services and durable goods mainly come from the MEI. Exceptions are those of Slovakia and Slovenia where data are issued from the statistics of the National Bank of Slovakia and the Statistical Office of the Republic of Slovenia. Due to the fact that relative prices skyrocket in 1991 and early 1992 and then stay flat during the eight consecutive years in Poland, they are replaced by the CPI/PPI ratio coming from the MEI.

Exchange rates are end-of-period figures, measured as domestic currency units per US dollar[15] and German mark. The source of exchange rates data is either the MEI or central banks[16]. Here, three different, CPI based real exchange rates are considered: the bilateral real exchange rates against the US dollar and the German mark on the one hand, and one synthetic currency basket based on the structure of the foreign trade in 1999 (see table 21 in the appendix), on the other hand. When econometric tests are carried out, it is obvious that the other variables should be comparable with the real exchange rate data. So, productivity and relative prices are weighted the same way as is the real exchange. That is, if some currency basket composed of the dollar and the deutschemark is considered, the foreign productivity data is constructed by the US and German productivity, with the same weights used for the exchange rate. So too are the relative prices.

B. Methodological Notes

Since the Balassa-Samuelson theory is supposed to remedy the pitfalls of the PPP, the relative prices – real exchange rate relation is believed to be more important than the relationship between productivity and relative prices. For this reason, the relative prices – real exchange rate

[13] www.sourceoecd.org

[14] It can be argued that progress in non-tradable productivity across countries is nearly the same, which in turn means no-biased estimates of the productivity differential.

[15] Testing PPP and the Balassa-Samuelson effect for US dollar based real exchange rates might miss the point. First, as empirical results show, PPP not holding even among US cities and regions over longer periods, it makes little sense to test for PPP against the US dollar. Second, with respect to tradable goods, the arbitrage mechanism supposed to ensure PPP to hold in the longer run is actually quasi-absent in that share of exports and imports towards and from the US economy represents ranging from as little as 2% to a mere 5% of total exports of CEECs. True, the dollar denominated share of exports is not that low but a major part of US dollar denominated trade concerns raw materials such as oil and energy vis-à-vis Russia and other CIS countries among others. That is, not the US inflation data should be used.

[16] The data were obtained either upon request via e-mail or from the official website of the central banks. (www.mnb.hu – National Bank of Hungary, www.cnb.cz – National Bank of Czech Republic, www.nbp.pl – National Bank of Poland, www.nbs.sk - National Bank of Slovakia, and www.bsi.si - Bank of Slovenia)

relation is usually tested first. In this top-down approach, it is only in the second stage that the productivity – relative price relationship is considered. However, in this paper, testing the theory for transition economies is done the other way around. This approach is a bottom-up one because whether productivity growth and relative prices move together is looked at first. From a point of view of joining Euroland, it is believed firmly that the increase in relative prices pushed by productivity growth is undoubtedly the most crucial factor. This issue shall be dealt with more extensively in the last section of the paper.

First, for each country it will be examined to what extent the productivity growth and the relative prices of non-traded goods are co-integrated. The Johansen co-integration technique will be utilised. Then, local productivity growth compared to that of the foreign country and domestic relative prices related to foreign relative prices are studied. In theory, they too should be co-integrated. Finally, whether or not the relative price ratio and the real exchange rate are co-integrated will be investigated.

Equation (11) makes it crystal clear that the CPI based real exchange rate does not only depend on relative prices but on the tradable prices based real exchange rate as well. Recall hypothesis 1 of the productivity differential model. For the model to hold, relative PPP should be verified for the tradable sector. In order to be able to accept the model fully and wholeheartedly, it needs to be found not only that the relative prices and the real exchange rate are co-integrated, but also the relative PPP does hold for tradable goods. This also implies that relative PPP cannot be verified for the CPI based real exchange rate.

But which version of PPP, one might rightly ask, should be tested for? There are basically three versions of the relative PPP, namely the strong, the semi-strong and the weak. The strong version refers to the symmetry and proportionality conditions. For the strong version to hold, domestic and foreign prices should have the same, one-to-one effect on the nominal exchange rate[17]. The semi-strong version only implies the symmetry condition while the weak version means some sort of co-movement between prices and exchange rates without assuming proportionality and symmetry. It is only the strong version that matters here since even if the semi-strong and weak versions turn out to function, the real exchange rate could experience a systemic upward or downward movement. This is why only the strong version is tested for, based both on CPI and traded goods prices by performing unit root tests.

IV. Results

Given the problems in terms of the relatively small time-span and while collecting data, one should not forget, in the first place, results be treated and interpreted with cautiousness.

To begin with, we investigate the impact of the productivity differential on the non-traded goods relative price differential and how the relative price differential affects the CPI-based real exchange rate. To this end, we employ the cointegration methodology proposed by Johansen. The first step in the cointegration analysis is to test for the unit root in each variable since the cointegration technique consists of finding a stationary, linear combination of a set of variables, which are themselves non-stationary. The second step involves performing the Johansen test itself. In this analysis, there is a third step, namely to explore whether the traded good-based real

[17] Symmetry between domestic and foreign prices and proportionality between prices and the exchange rate.

exchange rate contains a unit root. According to the productivity bias hypothesis, for the strong version of relative PPP to hold, this real exchange rate should be difference stationary.

Table 2. Johansen cointegration tests, Czech Republic

Vector = X β'

X1 = [productivity differential, non-traded relative price differential], β'= [1, β_1], expected signs [1,-]

X2 = [non-traded relative price differential, CPI based real exchange rate], β'= [1, β_1], expected signs [1,+]

	H_0	λ_{trace}	β_1	H_0	λ_{trace}	β_1
	1991-2000			**1995-2000**		
Czech Rep	R=0	41.001**	-2.039	R=0	20.446*	-4.049
X1	R=1	4.405	(0.938)	R=1	7.563	(1.086)
			-2.174			-3.728
Germany						
X1	R=0	51.164**	-2.702	R=0	27.105**	-0.756
	R=1	3.611	(0.954)	R=1	2.723	(0.193)
			-2.832			-3.917
X2	R=0	29.734*	0.505	R=0	17.052*	-0.074
	R=1	10.097	(0.181)	R=1	3.488	(0.135)
			2.790			-0.548
Basket						
X1	R=0	50.212**	-2.148	R=0	25.398**	-0.711
	R=1	4.687	(0.756)	R=1	1.508	(0.144)
			-2.841			-4.938
X2	R=0	33.508**	0.698	R=0	16.279*	-0.447
	R=1	11.252	(0.148)	R=1	2.869	(0.290)
			4.716			-1.541
US						
X1	R=0	53.610**	-1.364	R=0	23.488**	-0.665
	R=1	11.549	(0.558)	R=1	0.002	(0.094)
			-2.444			-7.074
X2	R=0	40.392**	1.668	R=0	7.895	
	R=1	11.587	(0.224)	R=1	0.147	
			7.446			

Note. λ_{trace} is the Johansen statistics, the critical values are those tabulated in Osterwald-Lenum(1992)

* H_0 is rejected at the 5% significance level, ** H_0 is rejected at the 1% significance level, S.E. in parenthesis and t-statistics of the CE below S.E.

The results of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests in levels and first differences assuming a constant and a time trend, solely a constant and none of them are reported in the appendix (see Tables 1-20). While the single-equation ADF and PP test statistics are able to reject the null hypothesis of a unit root at the 5% confidence level for some variables which mainly turn out to be trend stationary (that is particularly the case for Poland (1991-2000), Slovakia (1993-2000) and Slovenia (1993-2000)), the majority of variables seem to be non-stationary with or without trend and stationary in first differences, that is integrated of order 1 (I(1)). It ought to be mentioned that for most of the stationary variables, the US is used as the benchmark. As to the CPI-based real exchange rate, difference stationarity would mean that relative PPP does hold. However, the results listed in Tables 1 to 20 of the appendix show that these variables are rather trend stationary and not difference stationary and therefore provide no evidence in favour of the strong version of relative PPP. Now, let the traded good-based real exchange rate be considered. Tests are unable, with a few exceptions, to reject the null hypothesis of a unit root at the 5% confidence level. So relative PPP does not seem to work, contrary to what the theory predicts. One reason for this may be that there were considerable trade barriers between the countries under study and the US and Germany, especially at the beginning of the periods considered. True, administrative and non-administrative traded barriers are indeed gradually abolished between CEEC and EU-countries from the middle of the 1990s. However it cannot yet be detected via econometric methods. Another reason might be the well-known price stickiness phenomenon due to pricing-to-market strategies of multinational companies.

Next, VAR-based Johansen cointegration tests are performed[18]. If the null hypothesis of no cointegrating vectors (r=0) is rejected, then a long-run cointegration equilibrium exists between the variables in question[19]. According to theoretical assumptions presented earlier in the paper, an increase (decrease) in the productivity differential variable is related to an increase (decrease) in the differential of domestic and foreign relative prices of non-traded goods. In plain English, productivity should bear a positive relationship to relative prices. In terms of the estimated coefficients of the cointegration vector, the estimate of β_1 for relative prices should enter with a negative sign. As an increase (decrease) in the differential of domestic and foreign non-traded goods relative prices is expected to induce an appreciation (depreciation) of the consumer price-based real exchange rate, the β_1 for the real exchange rate should be positive. The results of Johansen cointegration tests on the vectors X1 = [productivity differential, non-traded relative price differential] and X2 = [non-traded relative price differential, CPI based real exchange rate] are presented in Tables 2-6. The estimated results are very colourful with respect to the countries, the period and the benchmark countries. As to the Czech Republic, the variables are cointegrated and always have the right signs and are significant in the cointegration equation at the 5% level for 1991-2000. Concerning the sub-period, productivity and relative prices turn out to be cointegrated with the expected signs while the relative prices and real exchange rates are not correctly signed if cointegrated at all. As far as Hungary is concerned, in case the whole period is considered, there are only two cointegration vectors, namely for the productivity-relative price relationship, with the appropriate signs, against the German mark and the basket. However, we find that in addition to productivity and relative prices, relative prices and real exchange rates are also cointegrated with the right positive sign during the period from 1995 to 2000 with respect to the deutschemark and the basket. We note the absence of a cointegration relationship for the US dollar. When it comes to Poland, a linkage in form of cointegration is found between productivity and relative prices entering with the correct sign and significance, for all three benchmarks concerning both the whole period 1991-2000 and the sub-period. With regard to the second cointegration relationship, results are rather poor, since there is only one cointegrating vector with the expected sign and significance, notably against Germany during 1994-2000. Results for Slovakia for 1993-2000 are quite similar than those for Hungary. That is to say, there are 2 cointegrating vectors for X1 and X2 against Germany and the basket. Like in Hungary, variables enter with the appropriate signs and are significant. However, the coefficients in the cointegration equations are fairly low, -0.28 and –0.35 respectively. Though, estimations regarding the sub-period do not yield any significant results. To end with, it is noteworthy to have a closer look at Slovenia. The thing is that with regard to the period 1993-2000, the linkage between productivity and relative prices, and relative price and real exchange rate movements seems to be very strong with Germany and the basket as benchmark since coefficients in the cointegration equation all have the expected sign. There is a remarkable one-to-one link between productivity and relative prices. It is interesting to note that the Slovenian wage formation seems to contribute heavily to the Balassa-Samuelson effect by not allowing greater wage dispersion across sectors reflecting sectoral-specific productivity gains and thus providing a very clear case

[18] With regard to the assumption on deterministic trends and constants, the following three models have been tested in accordance with the unit root tests: (1) Series without a deterministic trend and cointegration equation with a constant, (2) Series with a linear deterministic drift and cointegration equation with a constant, (1) Series and cointegration equation with a linear deterministic drift.

[19] It is worth noting that if the rank of cointegration is equal to the number of variables, that is r=2 in this case, the variables are stationary with no exception (the I(0) case).

for wage equalisation across sectors[20]. Nevertheless, after 1995, this relationship cannot be investigated with the cointegration technique because of the stationary nature of the variables.

Though, some common patterns seem to emerge from Tables 2-6. Germany and the trade weighted basket being the benchmark, a long-run cointegration relationship is found pretty often between productivity and relative prices, with significant coefficients having the expected signs, especially in case the whole period is considered. Furthermore, relative prices and the real exchange rate are also cointegrated with the correct sign in a number of cases. On the other hand, results usually turn out to be something of a disappointment with the US as benchmark.

Table 3. Johansen cointegration tests, Hungary

Co-integration vector = X β'

X1 = [productivity differential, non-traded relative price differential], β'= [1, β_1], expected signs [1,-]

X2 = [non-traded relative price differential, CPI based real exchange rate], β'= [1, β_1], expected signs [1,+]

	H_0 1991-2000	λ_{trace}	β_1	H_0 1995:3-2000:08	λ_{trace}	β_1
Hungary						
X1	R=0	27.457*	-1.144	R=0	15.948*	-0.963
	R=1	8.603	(0.480)	R=1	2.392	(0.038)
			-2.379			-25.342
Germany						
X1	R=0	30.433*	-0.479	R=0	29.766*	-1.254
	R=1	9.598	(0.156)	R=1	5.823	(0.438)
			-3.069			-2.861
X2	R=0	17.712		R=0	36.658*	0.313
	R=1	3.046		R=1	5.692	(0.166)
						1.882
Basket						
X1	R=0	29.249*	-0.499	R=0	30.501**	-1.299
	R=1	9.148	(0.201)	R=1	6.373	(0.537)
			-2.487			-2.419
X2	R=0	19.325		R=0	39.086**	0.403
	R=1	3.822		R=1	6.454	(0.176)
						2.289
US						
X1	R=0	32.862**	I(0) case	R=0	23.376	
	R=1	12.476*		R=1	8.678	
X2	R=0	32.986**	I(0) case	R=0	16.953	
	R=1	13.919*		R=1	4.561	

Note. λ_{trace} is the Johansen statistics, the critical values are those tabulated in Osterwald-Lenum(1992)

* H_0 is rejected at the 5% significance level, ** H_0 is rejected at the 1% significance level, S.E. in parenthesis and t-statistics of the CE below S.E.

[20] Wages are determined by a tripartite social agreement at national level and accompanied by a strong explicit indexation

Table 4. Johansen cointegration tests, Poland

Co-integration vector = X β'

X1 = [productivity differential, non-traded relative price differential], β'= [1, β_1], expected signs [1,-]

X2 = [non-traded relative price differential, CPI based real exchange rate], β'= [1, β_1], expected signs [1,+]

	H_0	λ_{trace}	β_1	H_0	λ_{trace}	β_1
	1991-2000			1994-2000		
Poland						
X1	R=0	19.03*	-3.346	R=0	21.526*	-2.134
	R=1	2.988	(0.463)	R=1	2.374	(0.504)
			-7.227			-4.234
Germany						
X1	R=0	28.312*	-2.607	R=0	26.959**	-1.562
	R=1	5.267	(1.138)	R=1	5.321	(0.181)
			-2.291			-8.629
X2	R=0	26.878*	1.763	R=0	22.302*	1.243
	R=1	7.011	(1.881)	R=1	9.108	(0.101)
			0.937			12.306
Basket						
X1	R=0	34.778**	-1.997	R=0	24.405*	-1.610
	R=1	7.195	(0.772)	R=1	7.003	(0.233)
			-2.587			-6.909
X2	R=0	27.457*	-6.598	R=0	16.427	
	R=1	6.804	(40.204)	R=1	4.147	
			0.164			
US						
X1	R=0	37.889**	-1.023	R=0	21.567*	-2.703
	R=1	9.047	(0.312)	R=1	8.559	(0.862)
			-3.278			-3.136
X2	R=0	10.932		R=0	12.552	
	R=1	0.0001		R=1	2.623	

Note. λ_{trace} is the Johansen statistics, the critical values are those tabulated in Osterwald-Lenum(1992)

* H_0 is rejected at the 5% significance level, ** H_0 is rejected at the 1% significance level, S.E. in parenthesis and t-statistics of the CE below S.E.

Table 5. Johansen cointegration tests, Slovakia

Co-integration vector = X β'

X1 = [productivity differential, non-traded relative price differential], β'= [1, β_1], expected signs [1,-]

X2 = [non-traded relative price differential, CPI based real exchange rate], β'= [1, β_1], expected signs [1,+]

	H_0	λ_{trace}	β_1	H_0	λ_{trace}	β_1
	1993-2000			1995-2000		
Slovakia						
X1	R=0	15.078		R=0	14.582	
	R=1	6.55		R=1	3.327	
Germany						
X1	R=0	28.907*	-0.280	R=0	12.346	
	R=1	7.867	(0.108)	R=1	4.946	
			-2.414			
X2	R=0	18.567		R=0	25.615*	-0.745
	R=1	4.237		R=1	4.613	(0.192)
						-3.880
Basket						
X1	R=0	27.762*	-0.347	R=0	12.672	
	R=1	7.110	(0.129)	R=1	4.669	
			-2.677			
X2	R=0	22.046		R=0	30.003*	-0.964
	R=1	3.793		R=1	5.144	(0.227)
						-4.246
US						
X1	R=0	25.958*	0.078	R=0	14.957	
	R=1	7.573	(0.154)	R=1	3.817	
			0.506			
X2	R=0	19.500		R=0	21.205	
	R=1	3.399		R=1	5.053	

Note. λ_{trace} is the Johansen statistics, the critical values are those tabulated in Osterwald-Lenum(1992)

* H_0 is rejected at the 5% significance level, ** H_0 is rejected at the 1% significance level, S.E. in parenthesis and t-statistics of the CE below S.E.

Table 6. Johansen cointegration tests, Slovenia

Co-integration vector = X β'

X1 = [productivity differential, non-traded relative price differential], β'= [1, β_1], expected signs [1,-]

X2 = [non-traded relative price differential, CPI based real exchange rate], β'= [1, β_1], expected signs [1,+]

	H_0	λ_{trace}	β_1	H_0	λ_{trace}	β_1
	1993-2000			1995-2000		
Slovenia						
X1	R=0	17.601*	-2.299	R=0	26.384**	-3.436
	R=1	0.009	(0.294)	R=1	7.845	(0.746
			-7.819			-4.605
Germany						
X1	R=0	20.004*	-0.857	R=0	32.249**	
	R=1	1.192	(0.117)	R=1	12.608*	
			7.324			
X2	R=0	24.739**	0.660	R=0	17.906*	0.458
	R=1	0.247	(0.093)	R=1	1.979	(0.092)
			7.097			4.978
Basket						
X1	R=0	21.356**	-0.933	R=0	23.262**	
	R=1	2.116	(0138)	R=1	10.196**	
			6.761			
X2	R=0	27.328**	0.704	R=0	20.801**	0.608
	R=1	0.898	(0.115)	R=1	2.811	(0.153)
			4.542			3.973
US						
X1	R=0	25.695**		R=0	12.002	
	R=1	4.252*		R=1	0.688	
X2	R=0	19.571*	0.418	R=0	19.054*	0.258
	R=1	0.755	(0.107)	R=1	0.033	(0.049
			3.906			5.265

Note. λ_{trace} is the Johansen statistics, the critical values are those tabulated in Osterwald-Lenum(1992)

* H_0 is rejected at the 5% significance level, ** H_0 is rejected at the 1% significance level, S.E. in parenthesis and t-statistics of the CE below S.E.

V. The Maastricht Criteria for the CEECs

But what, a more pragmatic person might ask, are the practical implications of all this for policymakers? Primo, in line with productivity growth and an increase in relative prices, the real exchange rate may appreciate in such a way that competitiveness does not deteriorate. For countries such as Hungary, Poland and Slovenia where inflation rates used to be and are still considerably higher compared to those of other industrialised countries, real appreciation, via the nominal exchange rate anchor, offers, among others, a good tool for bringing down inflation. Secondo, higher productivity growth induces structural changes in relative prices, which in turn means higher overall inflation, With positive and high productivity differentials, Central Europe's transition economies are going, in all likelihood, to experience far higher inflation rates, even in the longer term. Though, it is interesting to note that even though a strong cointegration relation might be detected between productivity and relative prices, in case the productivity differential among countries is not that high, the increase in relative prices can be weakened by a smaller or even negative productivity differential as has been the case in the Czech Republic since the recession triggered by the turmoil on the foreign exchange rate market in late-1997.

As there is no "opting-out" possibility any more for news accession countries, after having joint the EU, they are expected to enter EMU sooner or later. However, there will be bumps on the road, which can delay full EMU-membership. According to the Treaty on European Union, better known as the Maastricht Treaty, the condition for joining the EMU is the achievement of a high degree of convergence in terms of exchange rate stability, inflation,

interest rates and public finances. Articles 1 and 3 of protocol n°6 of the Treaty define the criteria on inflation and exchange rate stability as follows:

"The criterion on price stability (…) shall mean that a Member State has a price performance that is sustainable and an average rate of inflation, observed over a period of one year before the examination, that does not exceed by more than 1 1/2 percentage points that of, at most, the three best performing Member States in terms of price stability. Inflation shall be measured by means of the consumer price index on a comparable basis, taking into account differences in national definitions."

"The criterion on participation in the Exchange Rate mechanism of the European Monetary System (…) shall mean that a Member State has respected the normal fluctuation margins provided for by the Exchange Rate Mechanism of the European Monetary System without severe tensions for at least the last two years before the examination. In particular, the Member State shall not have devalued its currency's bilateral central rate against any other Member State's currency on its own initiative for the same period"

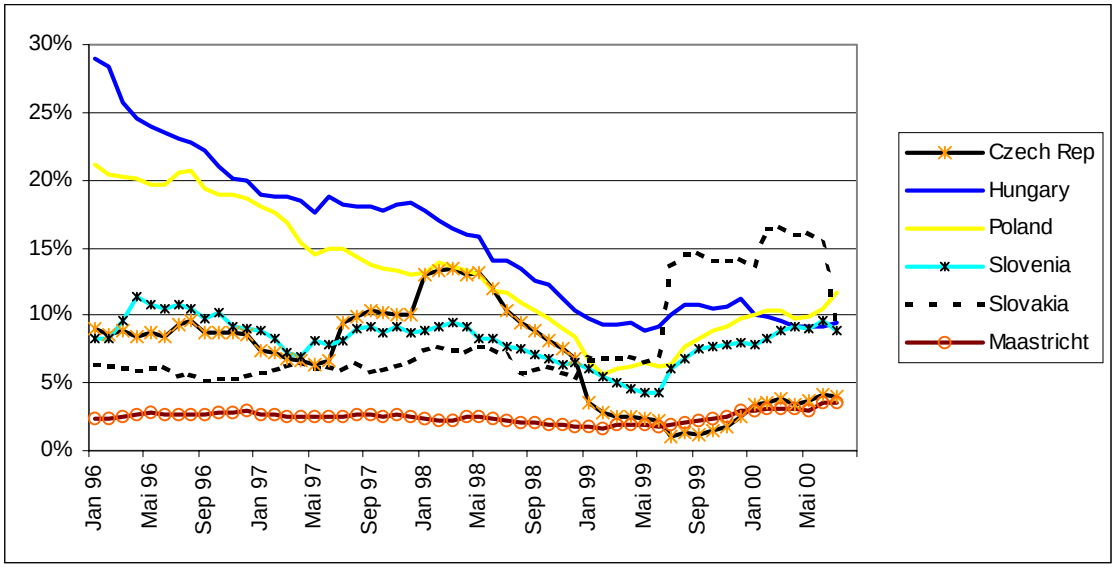
In accordance with the aforementioned Article 3, once entered EU, new members supposed to become a member of Euroland have to take part in an EMS-like exchange rate system. In the first place, they should bring down inflation to as low as about 5%. With the Balassa-Samuelson effect as background, CEEC5 then will be able to peg their currency to the European single currency without jeopardising external competitiveness. Assuming that average inflation in the euro zone remains at about 2-2.5%, with inflation as high as 5%, CPI-based real exchange rates would appreciate at an annual average rate of roughly 2.5-3%, which could be referred to as an "equilibrium real appreciation".

Nevertheless, there are two sides of the coin. The second one is somewhat inconvenient in light of the Maastricht criterion on inflation since the presence of a strong Balassa-Samuelson implies higher inflation rates[21]. As can be seen from figure 1., in spite of a relatively speedy decrease in inflation, in particular in Poland and Hungary, inflation rates are still a far cry from EMU standards. An exception is the Czech Republic[22] where prices grow, from mid-1999, roughly at the same pace as in EMU Member States.

[21] Actually, the decrease in or the disappearance of the Balassa-Samuelson effect or a "negative" Balassa-Samuelson effect would be disastrous. While meeting inflation targets would not pose a problem in this case, the absence of the Balassa-Samuelson effect would mean no catch-up in terms of economic growth and per capita GDP as higher productivity growth usually goes in tandem with higher economic growth. Furthermore, pegging to the euro would not be sustainable even in the medium run without undermining external competitiveness.

[22] Mainly due to the aforementioned „negative" Balassa-Samuelson effect since 1997.

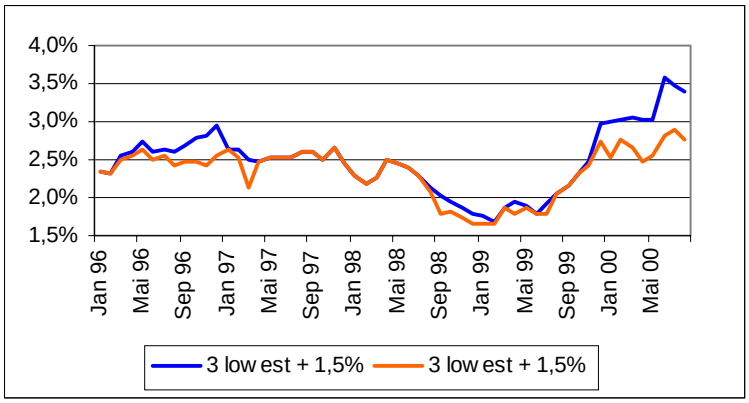
Figure 1. Year-on-year consumer price indices in CEEC and the Maastricht criterion on inflation



Source: OECD, Main Economic Indicators

However, as consumer-prices will keep on growing faster in other candidate countries relative to western economies, meeting the Maastricht criterion on inflation invites a set of reflections. Countries such as Denmark, the UK and Sweden, even though they have opted for a wait-and-see sort of policy vis-à-vis the single European currency, are expected to join the EMU in the longer run. Given that those economies, mainly Sweden and the UK, have recently done even better in terms of inflation than EMU-countries taking pride in their low inflation track record - and they will probably continue doing so - the inflation criterion will be considerably revised downward as shown in figure 2. Actually, it makes more than half a percentage point difference in the inflation threshold.

Figure 2. The Maastricht criterion on inflation with and without Denmark, the UK and Sweden



Source: Eurostat, harmonised CPI (all items)

This brings us to another question as to how to estimate the impact of productivity progress on overall inflation in the five transition countries under study. As a matter of fact, what we are interested in is whether productivity growth may hinder these countries to meet the

Maastricht criterion on inflation. Considering equation (7b), we can define the inflation differential between to given economies as follows:

$$p\text{-}p^* = p^T - p^{T*} + \alpha[(prod^T - prod^{NT}) - (prod^{T*} - prod^{NT*})] \quad (12)$$

E.quation (12) assumes a one-to-one link between the productivity differential between countries and the differential in relative prices. As can be seen from the cointegration vector X1 for Germany, it may not be the case in practice. That is the reason why equation (12) is to be modified by taking account of β_1 in the standardised cointegration vector:

$$p\text{-}p^* = p^T - p^{T*} + \alpha(-\beta_1)[(prod^T - prod^{NT}) - (prod^{T*} - prod^{NT*})] \quad (13)$$

Joining the European Union necessarily means a higher integration in the framework of the single market, which is supposed to ensure the free circulation of goods. For this reason, the term $p^T - p^{T*}$ is considered to be negligible by the time of entering EMU, and therefore is set to zero in further calculations. So, what in fact is needed so as to quantify the extent to which the Balassa-Samuelson affects inflation, is to determine the average yearly change in the productivity differential between countries. These figures are calculated for the whole period and the sub-period considered and presented in Table 7. Since Germany is one of the countries with the lowest inflation in Euroland, inflation differential vis-à-vis Germany lower than 1.4%-1.6% would be compatible with the criterion on inflation. Figures in table 7 clearly show that the Czech Republic, Slovakia and Slovenia could meet the criterion in question without any difficulties if productivity in their traded goods sector continue to increase at a pace observed during the 1990s. As to Poland and Hungary, these two countries' inflation attributable to the Balassa-Samuelson effect is rather high, ranging from roughly 1.5% to as high as 5.3% for Hungary and from 3.8% to about 9.9% for Poland. Despite of the fact that an inflation as high as 9.9% due to the Balassa-Samuelson effect in Poland seems to be not plausible, results are telling and indicating a very strong Balassa-Samuelson effect in these two countries.

Table 7. Estimated impact of the Balassa-Samuelson effect (B-S) on inflation

	WHOLE PERIOD	β_1	B-S [a]	B-S [b]	**SUB-PERIOD**	β_1	B-S [a]	B-S [b]
	Average change in the productivity differential vis-à-vis Germany [c]				Average change in the productivity differential vis-à-vis Germany [c]			
Czech Republic	0.935%	-2.702	*0.655%*	*1.768%*	1.296%	-0.759	*0.907%*	*0.688%*
Hungary	4.223%	-0.479	*2.956%*	*1.416%*	5.986%	-1.254	*4.190%*	*5.255%*
Poland	5.427%	-2.607	*3.799%*	*9.904%*	5.961%	-1.562	*4.123%*	*6.518%*
Slovakia	-0.403%	-0.280	*-0.282%*	*-0.079%*	1.353%		*0.947%*	
Slovenia	2.000%	-0.857	*1.400%*	*1.199%*	1.619%		*1.330%*	

[a] according to equation (12)
[b] according to equation (13)
[c] The Hodrick-Prescott filter has been applied in order to compute long-term trend in the series.

Some economists suggest the criterion on inflation be modified in line with the productivity growth differential. As per capita GDP is believed to be a good proxy for it, Szapáry advocates for modifying the criterion in function of the per capita GDP (Szapàry [2000]). Inflation rates in transition countries should be compared to those in the least developed EMU-countries, namely Greece, Portugal and Spain. Szapáry points out that to increase the 1.5%

deviation vis-à-vis the three best performing EMU-countries in matters of inflation would also be a fairly good compromise. Another alternative is to replace the three lowest inflation rates with the average interest rate of the whole Euro zone. But that is easier said than done. Undeniably, all this would be a watering down of the criterion on inflation in the eye of Europe's top dogs. On the one hand, it would certainly widen the gap between low and not-so-low inflation countries, which is likely to make the single monetary policy's task more delicate to maintain price stability with one single interest rate. On the other hand, letting in countries with relatively, say 1 or 1,5% higher inflation rates could be considered in the public eye as a wrongdoing to the single currency's stability. But, a quick look at table 8 suggests that because of the CEECs' small size in terms of GDP relative to EMU, a 3% difference in inflation between the 5 CEECs and Euroland would only mean approximately a 0.1% increase in Euroland's GDP weighted inflation. If only Hungary and Poland are taken into consideration, this figure is even lower, that is 0.7%. Let's take a 4-5% difference in inflation in favour of Hungary and Poland, as shown in table 7 and the increase in the aggregate European inflation is just slightly higher.

Table 8. Inflation scenarios[23]

Inflation differential between CEECs and EMU[24]	**EMU-11**	**EU-15**
	(EMU/EU15+CEECs inflation) – (EMU/EU15 inflation)	
1.0%	0.0484%	0.0355%
2.0%	0.0969%	0.0710%
3.0%	0.1453%	0.1065%
4.0%	0.1938%	0.1421%
5.0%	0.24225%	0.1776%
6.0%	0.2907%	0.2131%
Inflation differential between (Poland + Hungary) and EMU	(EMU/EU15+Poland+Hungary) – (EMU/EU15 inflation)	
1.0%	0.0328%	0.02415%
2.0%	0.0656%	0.0483%
3.0%	0.0983%	0.0724%
4.0%	0.1312%	0.0966%
5.0%	0.1639%	0.1207%
6.0%	0.1968%	0.1449%

Source: Author's calculations

With EU-accession ahead, policy-makers in CEECs are eager to reconsider Maastricht criteria in their countries' favour. However, even entry into the EU may not prove as easy as hoped earlier. Contrary to what CEECs thought in the early 1990s, first-round countries are now expected to join the EU as soon as 2004 or 2005. Full integration into the EU internal market, let alone issues such as total labour mobility, will probably take much more time than previously thought. Joining the EU should foster structural reforms and promote economic growth in accession countries. Thus, relative price movements due to market liberalisation could be complete by the time it comes to entering EMU. According to our own calculations, Hungary, among others, would need about 18-20 years, all things being equal, to catch up with EU-average

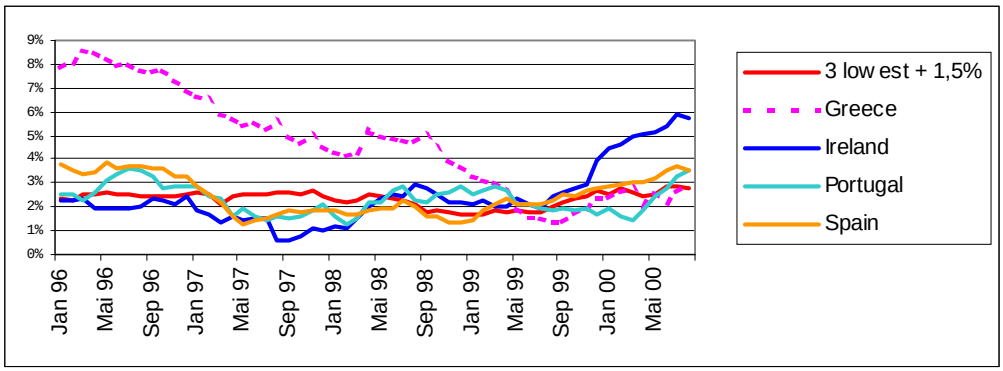
[23] GDP weighted harmonised CPI for the euro area and national CPI statistics for the CEEC5.GDP in 1999 was as high as USD 6116.4 billion and USD 8340.7 billion with regard to EMU-11 and EU 15 respectively. As to the CEEC5, the figures are $48.08 billion, $155.53 billion, $53.35 billion, $18.68 billion and $20.01 billion at 1999 average USD exchange rates for Hungary, Poland, the Czech Republic, Slovakia and Slovenia. Thus, the GDP of the CEEC5 as a whole compared to that the EMU12 and the EU15 accounts for as little as 0.04845% and 0.03553% respectively.

[24] Inflation differential between the 5 CEECs as a whole and the entire euro aera.

per capita income. This might be the case for the Czech Republic, Poland and Slovakia as well, let alone Slovenia. To put it differently, while financial convergence in terms of the Maastricht criteria is very important, there is also a need for real convergence.

But once inflation is under control and even though high enough for relative prices to increase, it may be not so difficult to moderate it for a while in line with the Maastricht criterion. That seems to be the case for Ireland and Portugal, and to some extent for Spain. Back in late 1998 and early 1999, at the time of the decision as to which countries would be allowed in take part of the Euro adventure, these countries looked ready to fulfil the inflation criterion. But soon after that, from late 1999 onwards, their inflation rates turned out to be higher than that. That is exactly what new accession countries can do. Hence, the "Ins" are already expecting this to happen, they are going to put off entry into the EMU for those countries knocking on the door.

Figure 3. 12-month consumer-price inflation in EMU Member States and the Maastricht criterion on inflation



Source: Eurostat, harmonised CPI (all items)

Conclusion

The key finding of this paper is the strong empirical evidence in favour of the Balassa-Samuelson effect in the Czech Republic, Hungary, Poland and Slovenia and to some extent in Slovakia with Germany as a benchmark. As to the US, econometric results are less convincing. Investigating the impact of the productivity-bias hypothesis on inflation, it is noteworthy that in Hungary and Poland, the productivity differential against Germany is far higher than that in the Czech Republic, Slovenia and Slovakia. While for the latter, inflation due to the Balassa-Samuelson effect is estimated to be 0%-1.5% higher compared to that in Germany, as far as Hungary and Poland go, inflation seems to exceed the German CPI by 1.5-6% during the periods studies. This raises the question as to how these countries are going to be able to meet the Maastricht criterion on inflation with respect to their future accession to EMU. Certainly, there is a need for higher real convergence between those countries and Euroland which won't come overnight. On the other hand, European policy-makers should reconsider the criterion on inflation in a more flexible way for these countries since significantly higher inflation in these countries compared to that in the EMU won't significantly affect price stability in the euro zone given CEECs' small size in terms of GDP relative to that of Euroland.

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Appendix

Table 1. Unit root tests in levels, Czech Republic

1991:01-2000:07	ADF in levels			PP in levels		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[2]-2.632 [a-]		[2]-5.307**	[2]-2.872 [a-]		[2]-11.331**
Relative prices in the country	[1]-2.413	[1]-2.311 [b]		[1]-1.762	[1]-1.473	[1]1.716
Productivity differential against						
Germany	[2]-2.632 [a]			[2]-2.933 [a]		
Trade weighted basket	[2]-2.832 [a]			[2]-2.917 [a]		
US	[2]-2.774 [a]			[2]-2.726 [a]		
Relative prices against						
Germany	[1]-3.358 [a]			[1]-1.744	[1]-1.711	[1]0.639
Trade weighted basket	[1]-2.861	[1]-2.662 [b]		[1]-2.229	[1]-1.736	[1]0.637
US	[1]-1.685	[1]-2.739 [b]		[1]-1.053	[1]-1.822	[1]0.694
Real exchange rate (CPI)						
Germany	[2]-2.283 [a]			[2]-3.883 [a]		
Trade weighted basket	[2]-1.716	[2]-1.524	[2]-2.136*	[2]-3.124	[2]-3.279 [b]	
US	[1]-1.435	[1]-2.285 [b]		[1]-1.262	[1]-2.669 [b]	
Real exchange rate –traded goods						
Germany	[2]-2.708 [a]			[1]-8.426** [a]		
Trade weighted basket	[2]-1.981	[2]-1.718	[2]-1.647	[2]-7.423** [a]		
US	[1]-1.024	[1]-1.966	[1]-0.635	[1]-3.338	[1]-4.223** [b]	

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 2. Unit root tests in first difference, Czech Republic

1991:01-2000:07	ADF in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[2]-5.291** [b]			[2]-11.331**	[2]-11.153** [b]	
Relative prices in the country	[1]-9.444** [b]			[1]-9.696**	[1]-9.513** [b]	
Productivity differential against						
Germany	[2]-5.478**	[2]-5..438**	[2]-5.461**	[2]-11.274**	[2]-11.116**	[2]-11.165**
Trade weighted basket	[2]-5.478**	[2]-5.423**	[2]-5.446**	[2]-11.280**	[2]-11.131**	[2]-11.181**
US	[2]-5.315**	[2]-5.354**	[2]-5.355**	[2]-11.204**	[2]-11.121**	[2]-11.171**
Relative prices against						
Germany	[1]-9.749** [a]			[1]-9.649**	[1]-9.612**	[1]-9.531**
Trade weighted basket	[1]-9.791** [a]			[1]-9.677**	[1]-9.6582**	[1]-9.494**
US	[1]-9.845** [a]			[1]-9.859** [a]		
Real exchange rate (CPI)						
Germany	[2]-6.467**	[2]-6.529**	[2]-6.173**	[2]-6.467**	[2]-6.529**	[2]-6.173**
Trade weighted basket				[1]-7.921**	[1]-7.819** [b]	
US	[1]-6.222** [a]			[1]-11.514** [a]		

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 3. Unit root tests in level, Czech Republic

1995:01-2000:07	ADF in level			PP in level		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[3]-2.259	[3]1.356	[3]1.342	[3]-1.954	[3]1.292	[3]1944
Relative prices in the country	[1]-2.565	[1]-2.322 [b]		[1]-2.322	[1]-2.178 [b]	
Productivity differential against						
Germany	[2]-2.478	[2]-2.643 [b]		[2]-2.214	[2]-2.361 [b]	
Trade weighted basket	[2]-2.339	[2]-2.507 [b]		[2]-2.123	[2]-2.296 [b]	
US	[2]-1.922	[2]-1.907	[2]0.302	[2]-1.854	[2]-1.903	[2]0.362
Relative prices against						
Germany	[1]-2.874	[1]-2.881 [b]		[1]-2.538	[1]-2.496 [b]	
Trade weighted basket	[1]-2.791	[1]-2.868 [b]		[1]-2.472	[1]-2.554 [b]	
US	[1]-2.595 [a]			[1]-2.427 [a]		
Real exchange rate (CPI)						
Germany	[2]-2.487	[2]-1.815	[2]-2.053*	[2]-2.487	[2]-1.815	[2]-2.053*
Trade weighted basket	[2]-2.734	[2]-2.070 [b]		[2]-2.734	[2]-2.070 [b]	
US	[1]-2.486 [a]			[1]-2.486 [a]		
Real exchange rate –traded goods						
Germany	[1]-2.686 [a]			[1]-2.309	[1]-1.487	[1]-1.371
Trade weighted basket	[1]-2.631	[1]-2.377 [b]		[1]-2.303	[1]-2.197 [b]	
US	[3]-2.739 [a]			[3]-2.649 [a]		

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 4. Unit root tests in first difference, Czech Republic

1995:01-2000:07	ADF in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[3]-1.954	[3]1.292	[3]1944	[3]-8.480**	[3]-8.526**	[3]-8.086**
Relative prices in the country	[1]-2.322	[1]-2.178 [b]		[1]-7.254**	[1]-7.176**	[1]-6.885**
Productivity differential against						
Germany	[2]-2.214	[2]-2.361 [b]		[2]-8.216**	[2]-8.208**	[2]-8.208**
Trade weighted basket	[2]-2.123	[2]-2.296 [b]		[2]-8.280**	[2]-8.259**	[2]-8.266**
US	[2]-1.854	[2]-1.903	[2]0.362	[2]-8.383**	[2]-8.319**	[2]-8.360**
Relative prices against						
Germany	[1]-2.538	[1]-2.496 [b]		[1]-7.294**	[1]7.309**	[1]-7.287**
Trade weighted basket	[1]-2.472	[1]-2.554 [b]		[1]-7.288**	[1]-7.268**	[1]-7.294**
US	[1]-2.427 [a]			[1]-7.348**	[1]-7.134**	[1]-7.156**
Real exchange rate (CPI)						
Germany	[2]-2.487	[2]-1.815	[2]-2.053*			
Trade weighted basket	[2]-2.734	[2]-2.070 [b]		[2]-4.541**	[2]-4.489**	[2]-4.317**
US	[1]-2.486 [a]			[1]-5.545**	[1]-5.582**	[1]-5.583**
Real exchange rate –traded goods						
Germany	[1]-2.309	[1]-1.487	[1]-1.371			
Trade weighted basket	[1]-2.303	[1]-2.197 [b]				
US	[3]-2.649 [a]					

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 5. Unit root tests in level, Hungary

1991:01-2000:07	ADF in level			PP in level		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[3]-2.219 [a]			[3]-2.142 [a]		
Relative prices in the country	[2]-1.871	[2]0.234	[2]3.849	[2]-2.313 [a]		
Productivity differential against						
Germany	[3]-3.143 [a]			[3]-2.767 [a]		
Trade weighted basket	[1]-3.269 [a]			[1]-2.995 [a]		
US	[1]-2.177 [a]			[1]-2.176 [a]		
Relative prices against						
Germany	[2]-1.362	[2]0.679	[2]2.945	[2]-1.685	[2]0.375	[2]4.708
Trade weighted basket	[2]-1.904 [a]			[2]-2.434 [a]		
US	[2]-3.910* [a]			[2]-4.887** [a]		
Real exchange rate (CPI)						
Germany	[1]-4.118** [a]			[1]-3.652* [a]		
Trade weighted basket	[1]-4.656** [a]			[1]-4.207** [a]		
US	[1]-1.832 [a]			[1]-1.707 [a]		
Real exchange rate –traded goods						
Germany	[1]-2.174	[1]-1.912	[1]-0.746	[1]-2.102	[1]-1.838	[1]-0.771
Trade weighted basket	[1]-2.294	[1]-2.221 [b]		[1]-2.305	[1]-2.247 [b]	
US	[1]-1.159 [a]			[1]-1.773 [a]		

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 6. Unit root tests in first difference, Hungary

1991:01-2000:07	ADF in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[3]-4.327**	[3]-3.620** [b]		[3]-10.616** [a]		
Relative prices in the country	[2]-5.749**	[2]-5.772** [b]		[2]-8.994**	[2]-9.046** [b]	
Productivity differential against						
Germany	[3]-4.548** [a]			[3]-10.594** [a]		
Trade weighted basket	[1]-7.919** [a]			[1]-10.725** [a]		
US	[1]-10.613**			[1]-10.612** [a]		
Relative prices against						
Germany	[2]-5.535**	[2]-5.427** [b]		[2]-8.733**	[2]-8.761** [b]	
Trade weighted basket	[2]-5.617**	[2]-5.611** [b]		[2]-8.731**	[2]-8.787** [b]	
US	[2]-4.887** [a]					
Real exchange rate (CPI)						
Germany						
Trade weighted basket						
US	[1]-6.304** [a]			[1]-13.977** [a]		

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 7. Unit root tests in level, Hungary

1995:03-2000:07	ADF in level			PP in level		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]-1.254	[5]1.106	[5]2.736	[1]-1.278	[5]1.512	[5]5.736
Relative prices in the country	[2]-3.719* [a]			[2]-4.663** [a]		
Productivity differential against						
Germany	[1]-0.512	[4]1.181	[4]2.991	[1]-0.498	[4]1.536	[4]7.709
Trade weighted basket	[1]0.103	[4]1.429	[4]2.830	[1]0.086	[4]1.193	[4]10.227
US	[2]-2.751 [a]			[2]-7.254** [a]		
Relative prices against						
Germany	[2]-3.283 [a]			[2]-4.392** [a]		
Trade weighted basket	[2]-3.679* [a]			[2]-4.610** [a]		
US	[2]-3.507* [a]			[2]-3.967* [a]		
Real exchange rate (CPI)						
Germany	[1]-2.099	[1]-1.449	[1]-1.838	[1]-2.135	[1]-1.570	[1]-2.038
Trade weighted basket	[1]-2.114	[1]-1.738	[1]-1.393	[1]-2.159	[1]-1.895	[1]-1.583
US	[1]-2.343	[1]-0.004	[1]1.917	[1]-2.957 [a]		
Real exchange rate –traded goods						
Germany	[1]-1.543	[1]-1.769	[1]-1.930	[1]-1.622	[1]-1.964	[1]-2.195*
Trade weighted basket	[1]-1.353	[1]-1.970	[1]-1.462	[1]-1.453	[1]-2.237 [b]	
US	[1]-0.752	[1]-0.902	[1]-1.91	[1]-1.023	[1]-0.852	[1]1.767

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 8. Unit root tests in first difference, Hungary

1995:03-2000:07	ADF in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]-5.685**	[5]-2.969* [b]		[1]-7.691**	[5]-7.508* [b]	
Relative prices in the country						
Productivity differential against						
Germany	[1]-6.833**	[4]-3.085* [b]		[1]-6.913**	[4]-6.673** [b]	
Trade weighted basket	[1]-6.524** [a]			[1]-6.521* [a]		
US	[2]-6.226**	[2]-6.243**	[2]-5.889**			
Relative prices against						
Germany	[2]-7.215** [a]					
Trade weighted basket						
US						
Real exchange rate (CPI)						
Germany	[1]-5.137**	[1]-5.153**	[1]-4.872**	[1]-7.585**	[1]-7.606**	[1]-7.290**
Trade weighted basket	[1]-5.373**	[1]-5.366**	[1]-5.213**	[1]-7.506**	[1]-7.501**	[1]-7.346**
US	[1]-8.571**	[1]-8.464** [b]		[1]-10.111**	[1]-10.087**	[1]-9.641**

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 9. Unit root tests in level, Poland

1991:01-2000:07	ADF in level			PP in level		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[7]-0.633	[7]1.242	[7]3.483	[7]-2.698[a]		
Relative prices in the country	[1]-4.215** [a]			[1]-3.942* [a]		
Productivity differential against						
Germany	[7]-1.832	[6]0.231	[6]2.647	[7]-3.804* [a]		
Trade weighted basket	[7]-2.347 [a]			[7]-4.377** [a]		
US	[7]-3.509* [a]			[7]-4.946** [a]		
Relative prices against						
Germany	[2]-3.208 [a]			[2]-3.666* [a]		
Trade weighted basket	[2]-3.345 [a]			[2]-3.521* [a]		
US	[2]-3.103 [a]			[2]-2.953 [a]		
Real exchange rate (CPI)						
Germany	[2]-4.194** [a]			[2]-4.754** [a]		
Trade weighted basket	[3]-3.201	[3]-3.881** [b]		[3]-4.425**	[3]-5.155** [a]	
US	[2]-1.659	[3]-1.783	[3]-0.891	[2]-2.482	[3]-2.820 [a]	
Real exchange rate –traded goods						
Germany	[2]-3.659*	[1]-3.499* [b]		[2]-3.914*	[1]-3.973** [b]	
Trade weighted basket	[1]-2.762	[1]-3.044* [b]		[1]-3.449	[1]-3.878** [b]	
US	[1]-2.024	[1]-2.077 [b]		[1]-1.931	[1]-2.020	[1]-0.065

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 10. Unit root tests in first difference, Poland

1991:01-2000:07	ADF in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[7]-3.850*	[7]3.481*[b]		[7]-11.304**	[7]10.604** [b]	
Relative prices in the country	[1]-5.890**					
Productivity differential against						
Germany	[7]-4.293**	[6]4.444**[b]				
Trade weighted basket	[7]-4.575**	[6]4.781** [b]				
US						
Relative prices against						
Germany	[2]-5.890**	[2]-7.737**[b]				
Trade weighted basket	[2]-5.598**	[2]-7.392** [b]				
US	[2]-5.403**	[2]-5.472** [b]		[2]-8.147**	[2]-8.104**[b]	
Real exchange rate (CPI)						
Germany						
Trade weighted basket						
US	[2]-7.877**	[3]-6.625**	[3]-6.477**	[2]-8.983**	[3]-8.959**	[3]-8.969**

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 11. Unit root tests in level, Poland

1994:06-2000:07	ADF in level			PP in level		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]0.281	[6]0.631	[6]1.627	[1]0.313	[6]1.759	[6]4.587
Relative prices in the country	[1]-2.956[a]			[1]-2.547[a]		
Productivity differential against						
Germany	[8]-0.811	[6]0.571	[6]2.098	[8]-0.643	[6]1.536	[6]4.525
Trade weighted basket	[1]-0.537	[6]0.368	[6]1.898	[1]-0.658	[6]1.237	[6]4.323
US	[1]-0.934	[6]-0.061	[6]1.592	[1]-1.116	[6]0.574	[6]3.376
Relative prices against						
Germany	[1]-2.959[a]			[1]-2.682[a]		
Trade weighted basket	[1]-2.515[a]			[1]-2.232[a]		
US	[1]-1.721[a]			[1]-1.858[a]		
Real exchange rate (CPI)						
Germany	[2]-2.168	[1]-1.276	[1]-2.128*	[2]-2.228	[1]-1.072	[1]-2.288*
Trade weighted basket	[2]-2.636	[1]-2.709[b]		[2]-2.596	[1]-2.844[b]	
US	[11]-3.013[a]			[11]-3.078[a]		
Real exchange rate –traded goods						
Germany	[2]-2.782[a]			[2]-2.697[a]		
Trade weighted basket	[2]-2.951	[1]-3.218*[b]		[2]-2.645	[1]-2.867[b]	
US	[1]-2.691[a]			[1]-2.707[a]		

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 12. Unit root tests in first difference, Poland

1994:06-2000:07	ADF in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]5.236**[q]			[1]8.214**	[6]8.130**[b]	
Relative prices in the country	[1]-5.984**	[6]-6.042**[b]		[1]-6.926**	[6]-6.989**[b]	
Productivity differential against						
Germany	[8]-2.085	[6]-2.473[b]		[8]-8.507**	[6]-8.318**[b]	
Trade weighted basket	[1]-6.338**	[6]2.286[b]		[1]-8.863**	[6]8.719**[b]	
US	[1]-6.104**	[6]-2.266	[6]-1.448	[1]-9.262**	[6]-9.192**[b]	
Relative prices against						
Germany	[1]-5.886**	[1]-5.922**[b]		[1]-7.016**	[1]-7.063**[b]	
Trade weighted basket	[1]-5.691**	[1]-5.708**[b]		[1]-6.573**	[1]-6.597**[b]	
US	[1]-3.873*	[1]-5.789**	[1]-5.457**	[1]-5.06**	[1]-6.043**	[1]-5.819**
Real exchange rate (CPI)						
Germany						
Trade weighted basket	[2]-5.629**	[1]-6.161**	[1]-5.951**	[2]-6.158**	[1]-6.271**	[1]-6.137**
US	[1]-5.094**	[2]-4.871**	[2]-4.907**	[1]-6.277**	[2]-6.183**	[2]-6.219**

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,

Table 13. Unit root tests in level, Slovakia

1993:01-2000:07	ADF in level			PP in level		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]-3.857*[a]			[1]-3.522*[a]		
Relative prices in the country	[1]-2.147	[1]-1.516	[1]0.189	[1]-1.887	[1]-1.434	[1]0.3832
Productivity differential against						
Germany	[1]-4.069**	[1]-4.534**[b]		[1]-3.645*	[1]-4.154**[b]	
Trade weighted basket	[1]-4.247**	[1]-4.704**[b]		[1]-3.795*	[1]-4.275**[b]	
US	[1]-4.541**	[1]-4.676**[b]		[1]-4.132**	[1]-4.285**[b]	
Relative prices against						
Germany	[1]-1.977	[1]-2.060	[1]-0.494	[1]-1.666	[1]-1.736	[1]-0.329
Trade weighted basket	[1]-2.102	[1]-2.199[b]		[1]-1.809	[1]-1.868	[1]-0.374
US	[1]-2.657	[1]-2.403[b]		[1]-2.550	[1]-2.066	[1]-0.485
Real exchange rate (CPI)						
Germany	[2]-2.902[a]			[2]-2.475[a]		
Trade weighted basket	[2]-2.509[a]			[2]-2.289	[2]-1.335	[2]-1.603
US	[1]-1.619	[1]-1.805	[1]-0.188	[1]-1.541	[1]-1.734	[1]-0.186
Real exchange rate –traded goods						
Germany	[1]-2.403	[1]-1.182	[1]-0.956	[1]-2.274	[1]-1.302	[1]-1.149
Trade weighted basket	[1]-2.004	[1]-1.726	[1]-0.552	[1]-1.904	[1]-1.777	[1]-0.695
US	[1]-1.372	[2]-1.134	[2]0.408	[1]-1.179	[2]-0.924	[2]0.482

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 14. Unit root tests in first difference, Slovakia

1993:01-2000:07	ADF in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country						
Relative prices in the country	[1]-6.147**	[1]-6.148**	[1]-6.178**	[1]-1.887	[1]-1.434	[1]0.3832
Productivity differential against						
Germany						
Trade weighted basket						
US						
Relative prices against						
Germany	[1]-6.171**	[1]-6.094**	[1]-6.115**	[1]-8.206**	[1]-8.163**	[1]-8.198**
Trade weighted basket	[1]-6.142**	[1]-6.115**	[1]-6.131**	[1]-8.156**	[1]-8.156**	[1]-8.187**
US	[1]-6.080**	[1]-6.116**	[1]-6.119**	[1]-8.048**	[1]-8.096**	[1]-8.115**
Real exchange rate (CPI)						
Germany	[2]-5.244**	[2]-5.273**	[2]-4.936**	[2]-7.372**	[2]-7.403**	[2]-7.193**
Trade weighted basket	[2]-5.215**	[2]-5.243**	[2]-5.059**	[2]-7.861**	[2]-7.901**	[2]-7.773**
US	[1]-7.351**	[1]-7.206**	[1]-7.249**	[1]-8.757**	[1]-8.661**	[1]-8.710**

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 15. Unit root tests in level, Slovakia

1995:12-2000:07	ADF in level			PP in level		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]-2.459[a]			[1]-2.441[a]		
Relative prices in the country	[1]-2.036	[1]-1.130	[1]0.714	[1]-2.133	[1]-1.344	[1]0.793
Productivity differential against						
Germany	[1]-2.264	[2]-2.043[b]		[1]-2.275	[2]-1.857	[2]0.322
Trade weighted basket	[1]-2.386	[1]-2.148[b]		[1]-2.393	[1]-2.189[b]	
US	[1]-2.555	[1]-2.628[b]		[1]-2.527	[1]-2.589[b]	
Relative prices against						
Germany	[2]-1.966	[2]-1.199	[2]0.409	[2]-2.067	[2]-1.455	[2]0.487
Trade weighted basket	[2]-1.989	[2]-1.399	[2]0.188	[2]-2.081	[2]-1.659	[2]0.283
US	[2]-2.062	[2]-1.994[b]		[2]-2.122	[2]-2.178[b]	
Real exchange rate (CPI)						
Germany	[2]-2.212	[1]-1.162	[1]-1.338	[2]-1.717	[1]-1.027	[1]-1.719
Trade weighted basket	[1]-2.048	[1]-1.756	[1]-0.764	[1]-1.761	[1]-1.495	[1]-0.911
US	[1]-3.110[a]			[1]-2.884[a]		
Real exchange rate –traded goods						
Germany	[1]-1.785	-1.897	-0.707	[1]-1.537	-1.743	-1.068
Trade weighted basket	[2]-2.168	-20.97[b]		[2]-1.753	-1.762	-0.244
US	[1]-2.428[a]			[1]-1.972	[1]-0.375	[1]1.551

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 16. Unit root tests in first difference, Slovakia

1995:12-2000:07	ADF in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]-5.327**	[1]-3.642**	[1]-3.318**	[1]-7.241**	[1]-7.244**	[1]-6.904**
Relative prices in the country	[1]-4.323**	[1]-4.364**	[1]-4.316**	[1]-7.312**	[1]-7.368**	[1]-7.353**
Productivity differential against						
Germany	[1]-5.249**	[2]-3.391**	[2]-3.421**	[1]-7.442**	[2]-7.384**	[2]-7.439**
Trade weighted basket	[1]-5.268**	[1]-5.134**	[1]-5.185**	[1]-7.378**	[1]-7.353**	[1]-7.413**
US	[1]-5.293**	[1]-5.234**	[1]-5.295**	[1]-7.164**	[1]-7.201**	[1]-7.268**
Relative prices against						
Germany	[2]-4.245**	[2]-4.293**	[2]-4.308**	[2]-7.439**	[2]-7.511**	[2]-7.553**
Trade weighted basket	[2]-4.261**	[2]-4.308**	[2]-4.348**	[2]-7.377**	[2]-7.444**	[2]-7.508**
US	[2]-4.317**	[2]-4.357**	[2]-4.394**	[2]-7.217**	[2]-7.266**	[2]-7.332**
Real exchange rate (CPI)						
Germany	[2]-3.779*	[1]-3.709**	[1]-3.556**	[2]-5.462**	[1]-5.428**	[1]-5.241**
Trade weighted basket	[1]-3.808*	[1]-3.849**	[1]-3.837**	[1]-5.606**	[1]-5.663**	[1]-5.648**
US	[1]-5.191**	[1]-5.244**	[1]-5.149**	[1]-6.580**	[1]-5.647**	[1]-5.603**

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 17. Unit root tests in level, Slovenia

1993:01-2000:07	ADF in level			PP in level		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]-1.932[a]			[1]-2.029[a]		
Relative prices in the country	[1]-2.361	[1]-2.416[b]		[1]-3.363[a]		
Productivity differential against						
Germany	[1]-2.100[a]			[1]-2.103[a]		
Trade weighted basket	[1]-1.827	[3]-0.552	[3]2.689	[1]-1.873	[3]-0.564	[3]3.220
US	[1]-1.444	[1]-1.974[b]		[1]-1.471	[1]-2.014[b]	
Relative prices against						
Germany	[1]-2.783[a]			[1]-3.856*[a]		
Trade weighted basket	[1]-2.681	[1]-2.356[b]		[1]-3.771*[a]		
US	[1]-1.997	[1]-3.311*[b]		[1]-2.890	[1]-4.594**[b]	
Real exchange rate (CPI)						
Germany	[2]-3.057[a]			[2]-3.145[a]		
Trade weighted basket	[2]-1.937	[2]-1.692	[2]-0.689	[2]-2.067	[2]-1.177	[2]-0.431
US	[1]-1.298	[1]-0.944	[1]0.563	[1]-1.078	[1]-0.749	[1]0.758
Real exchange rate –traded goods						
Germany	[2]-2.605	[2]-2.287[b]		[2]-2.707	[2]-1.540	[2]0.036
Trade weighted basket	[2]-1.875	[2]-2.211[b]		[2]-1.814	[2]-1.699	[2]0.443
US	[1]-1.115	[1]-0.434	[1]0.916	[1]-0.864	[1]-0.262	[1]1.220

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 18. Unit root tests in first difference, Slovenia

1993:01-2000:07	ADF in PP in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]-6.263**	[1]-4.561**[b]		[1]-9.663**	[1]-9.719**[b]	
Relative prices in the country	[1]-7.089**	[1]-6.860**[b]				
Productivity differential against						
Germany	[1]-6.546**	[5]-6.574**[b]		[1]-9.204**	[5]-9.235**[b]	
Trade weighted basket	[1]-6.559**	[3]-7.166**	[3]-6.927**	[1]-9.280**	[3]-9.343**[b]	
US	[1]-6.121**	[1]-7.092**	[1]-6.881**	[1]-9.374**	[1]-9.243**	[1]-9.005**
Relative prices against						
Germany	[1]-7.1565*	[1]-7.166**	[1]-6.927**			
Trade weighted basket	[1]-7.137**	[1]-7.092**	[1]-6.881**			
US						
Real exchange rate (CPI)						
Germany	[2]-5.034**	[2]-5.125**	[2]-4.932**	[2]-4.958**	[2]-4.997**	[2]-4.984**
Trade weighted basket	[2]-4.695**	[2]-4.682**	[2]-4.656**	[2]-5.224**	[2]-5.264**	[2]-5.287**
US	[1]-6.702**	[1]-6.515**	[1]-6.498**	[1]-7.887**	[1]-7.789**	[1]-7.786**

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 19. Unit root tests in level, Slovenia

1995:04-2000:07	ADF in level			PP in level		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]-2.528[a]			[1]-2.450 [a]		
Relative prices in the country	[3]-2.614 [a]			[3]-3.669* [a]		
Productivity differential against						
Germany	[1]-3.867* [a]			[1]-3.413 [a]		
Trade weighted basket	[1]-3.899* [a]			[1]-3.443 [a]		
US	[1]-3.191	[1]-3.572** [b]		[1]-2.934	[1]-3.349* [b]	
Relative prices against						
Germany	[3]-2.980 [a]			[3]-4.150** [a]		
Trade weighted basket	[3]-2.998 [a]			[3]-4.164** [a]		
US	[3]-2.777 [a]			[3]-3.777* [a]		
Real exchange rate (CPI)						
Germany	[2]-2.545 [a]			[2]-1.969	[2]-0.868	[2]-1.192
Trade weighted basket	[2]-2.176	[2]-1.631	[2]0.118	[2]-1.761	[2]-1.437	[2]0.645
US	[2]-1.897	[2]-0.624	[2]1.922	[2]-1.879	[2]-0.545	[2]2.017
Real exchange rate –traded goods						
Germany	[3]1.648	[2]-1.723	[2]0.152	[3]-1.244	[2]-1.374	[2]0.064
Trade weighted basket	[2]-1.622	[2]-1.523	[2]0.796	[2]-1.049	[2]-0.852	[2]0.992
US	[1]-1.409	[1]-0.102	[1]1.926	[1]-1.302	[1]0.011	[1]2.160

Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 20. Unit root tests in first difference, Slovenia

1995:04-2000:07	ADF in first difference			PP in first difference		
	Constant and trend	Constant	None	Constant and trend	Constant	None
Productivity in the country	[1]-5.315**	[1]-5.422**[b]		[1]-8.196**	[1]-8.226**[b]	
Relative prices in the country	[3]-4.936**	[3]-4.819**[b]		[3]-3.669* [a]		
Productivity differential against						
Germany				[1]-7.939**	[1]-7.818**[b]	
Trade weighted basket				[1]-8.040**	[1]-7.906**[b]	
US						
Relative prices against						
Germany	[3]-4.824**	[3]-4.902**	[3]-4.734**			
Trade weighted basket	[3]-4.876**	[3]-4.926**	[3]-4.843**			
US	[3]-5.127**	[3]-4.796**	[3]-4.719**			
Real exchange rate (CPI)						
Germany	[2]-3.164	[2]-3.232*	[2]-3.137**	[2]-5.207**	[2]-5.256**	[2]-5.221**
Trade weighted basket	[2]-3.674*	[2]-3.705**	[2]-3.739**	[2]-5.246**	[2]-5.288**	[2]-5.333**
US	[2]-5.182**	[2]-5.217**	[2]-4.785**	[2]-7.622**	[2]-7.674**[b]	

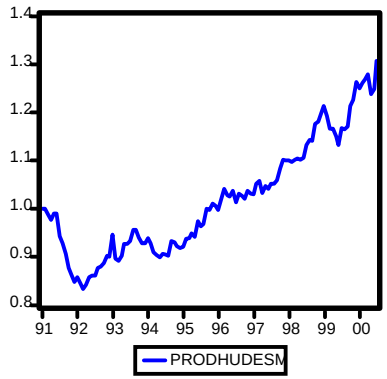
Note. H_0 : the data process contains a unit root, critical values are provided by MacKinnon(1991),
Lags based upon the Bayesian Information Criterion (BIC) in brackets, H_0 is rejected at the 5% significance level,
** H_0 is rejected at the 1% significance level, [a] denotes significant constant and trend in the model at 5% significance,
[b] denotes the constant is significant in the model at the 5% significance level

Table 21. Trade pattern and settlement of trade, 1999 (in %)

Czech Republic			**Hungary**		
	Exports	**Imports**		**Exports**	**Imports**
EU	69.2	64.5	EU	76.1	65.1
EFTA	1.4	1.8	EFTA	1.4	1.8
CEFTA	16.1	11.2	CEFTA	8.0	7.9
CIS	2.9	6.1	CIS	2.4	6.4
US	2.5	4.1	US	5.2	3.5
Other	3.2	4.3	Other	0.6	6.0
EU currencies	**75.3**		**EU currencies**	**76.2**	
USD	**18.4**		**USD**	**16.0**	
Slovakia			**Slovenia**		
	Exports	**Imports**		**Exports**	**Imports**
EU	59.5	51.7		66.4	68.9
EFTA	1.9	1.5		1.3	2.2
CEFTA	29.7	23.4		7.2	8.4
CIS	2.3	13.3		2.1	1.9
US	1.4	2.6		3	5
Other	2.1	1.6		15.2	5.7
EU currencies	**70.6**		**EU currencies**	**83.8**	
USD	**24.9**		**USD**	**9.9**	
Poland	Settlement of trade				
	Exports	**Imports**			
USD	36.2	32.1			
EUR	42.0	39.0			
EU currencies	11.6	18.2			
EU currencies	**55.4**				
USD	**34.15**				

Source: IMF Country Reports for the Czech Republic, Hungary, Slovakia, Slovenia, and National Bank of Poland

Hungary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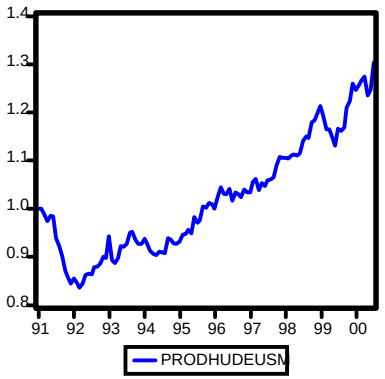
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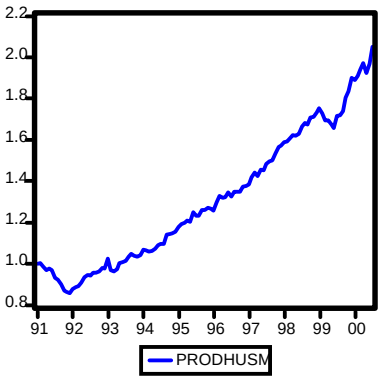
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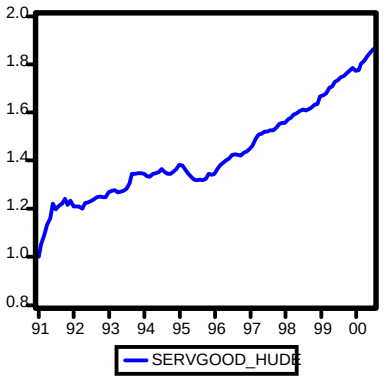
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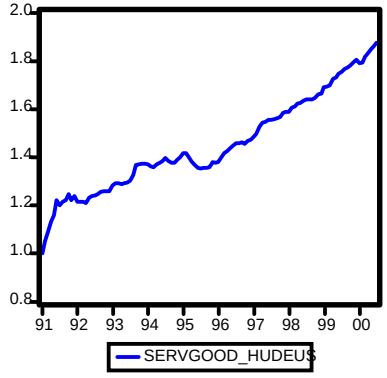
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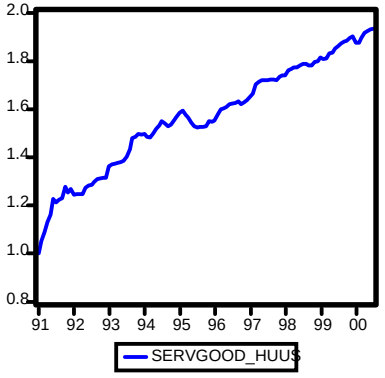
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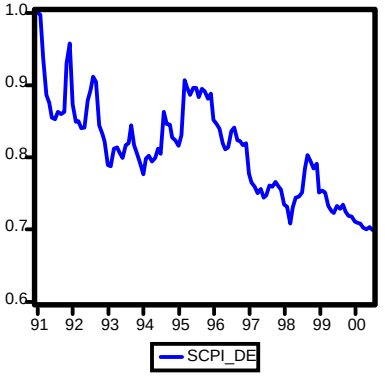
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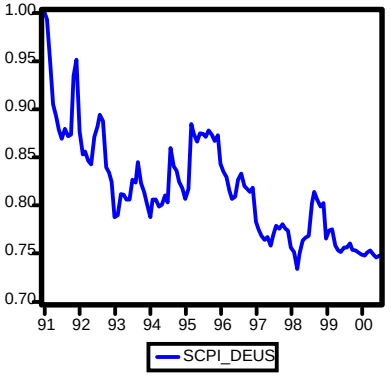
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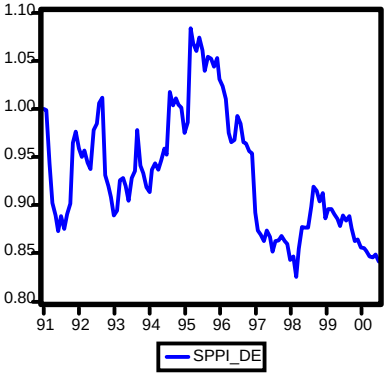
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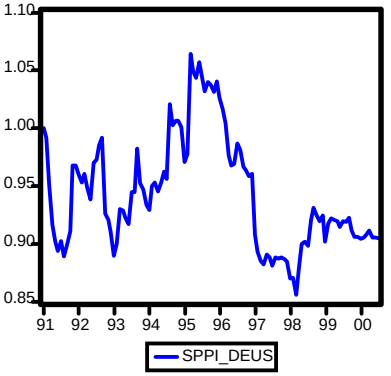
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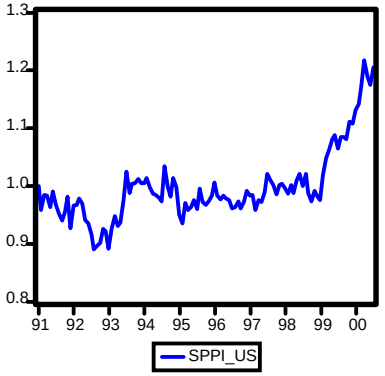
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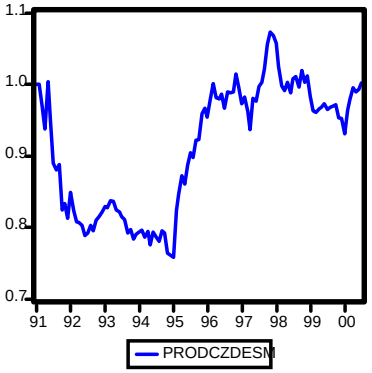

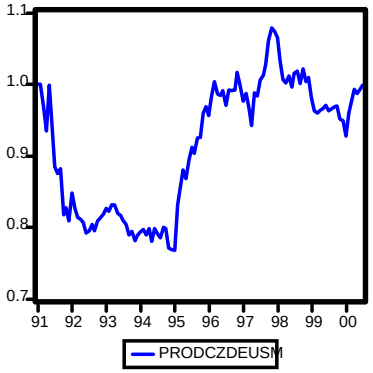

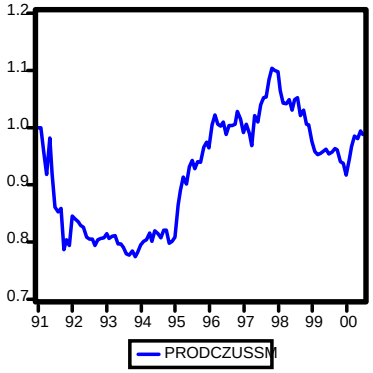

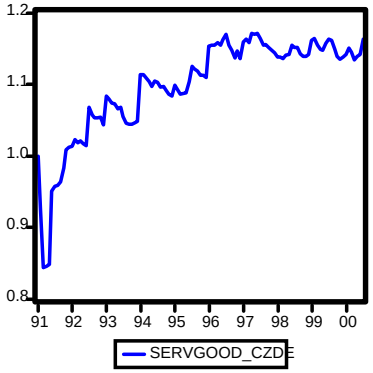

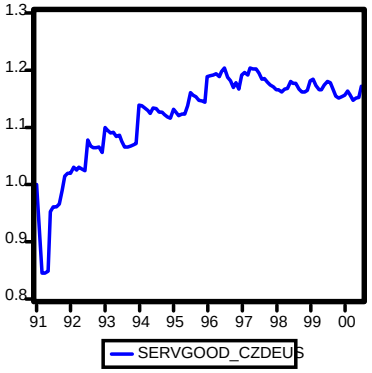

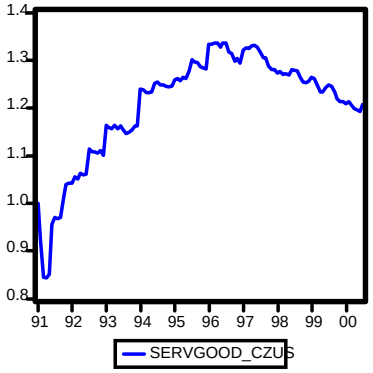

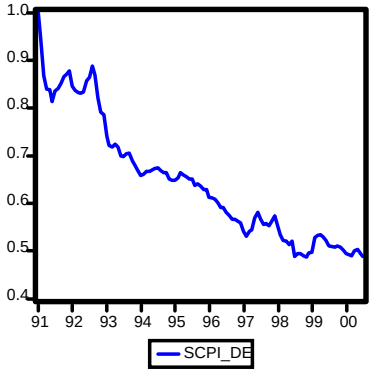

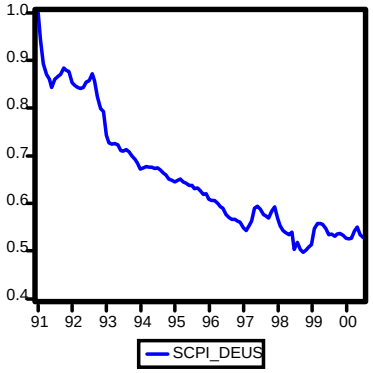

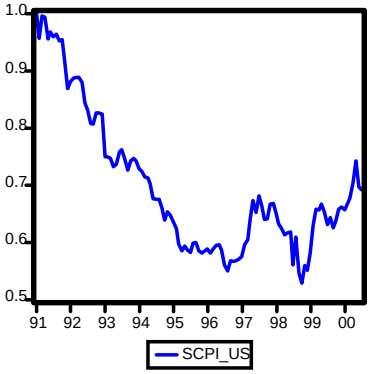

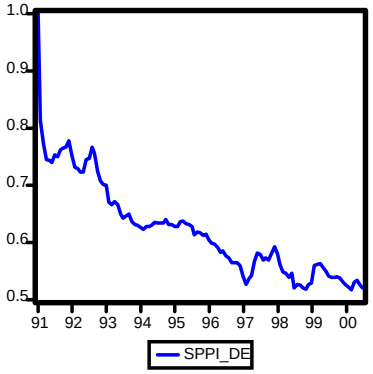

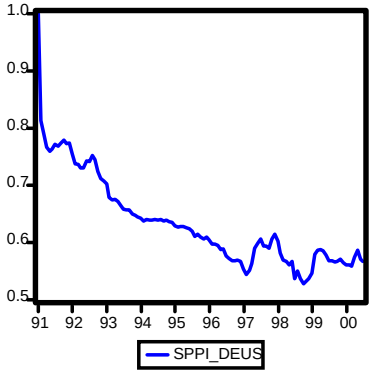

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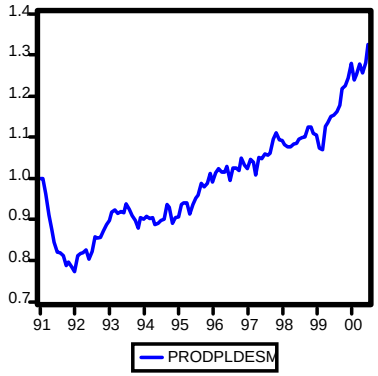
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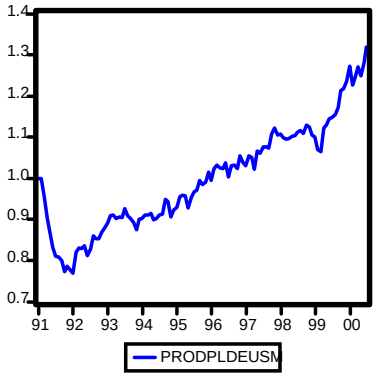
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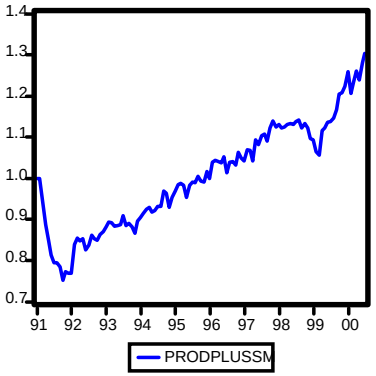
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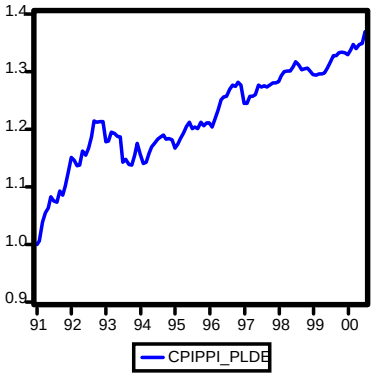
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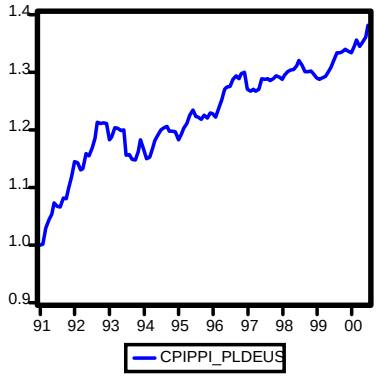
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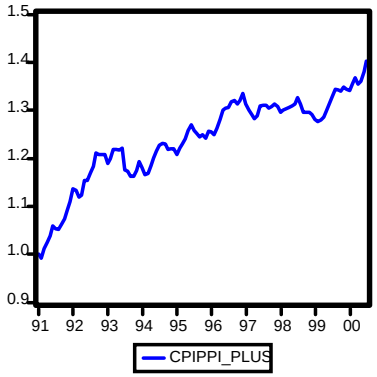
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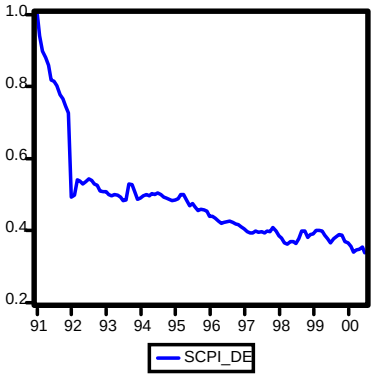
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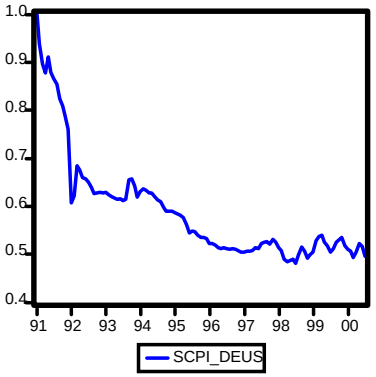
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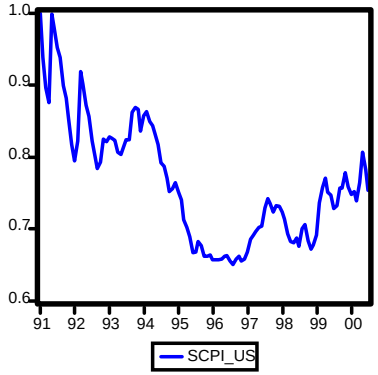
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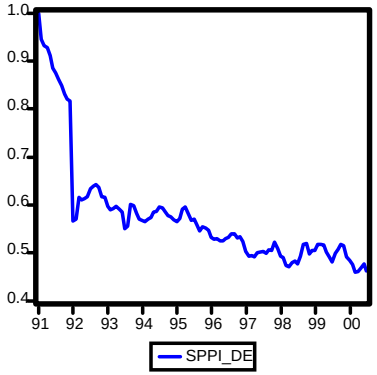
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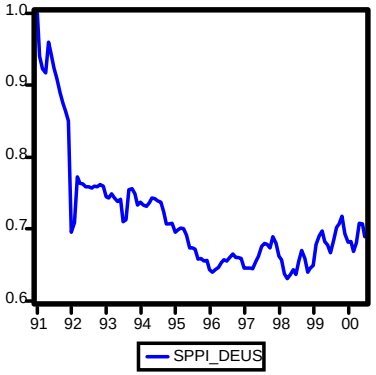
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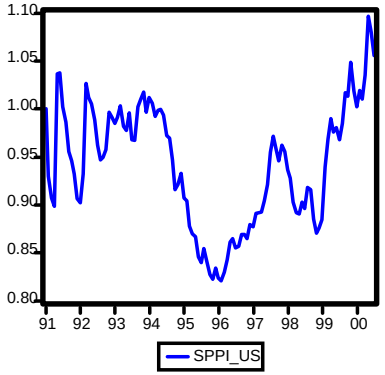
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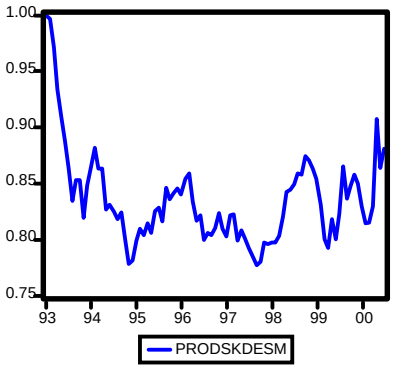
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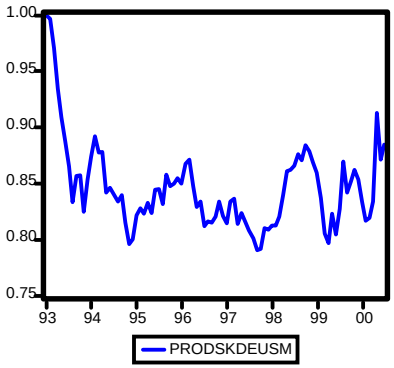
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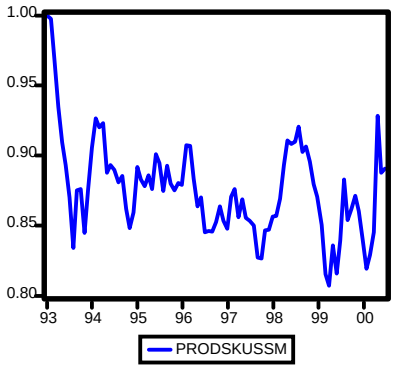
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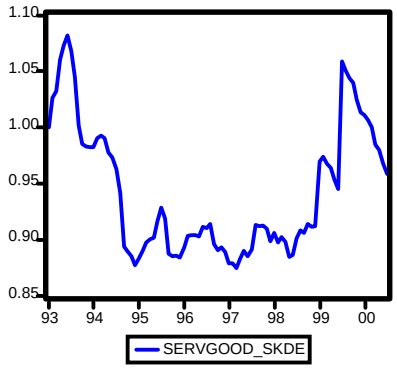
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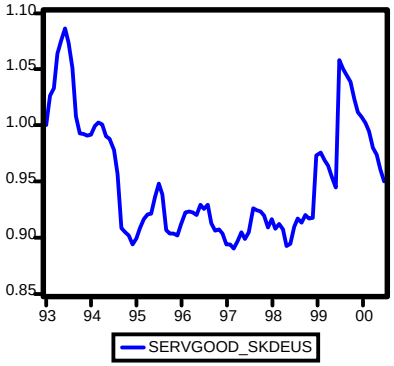
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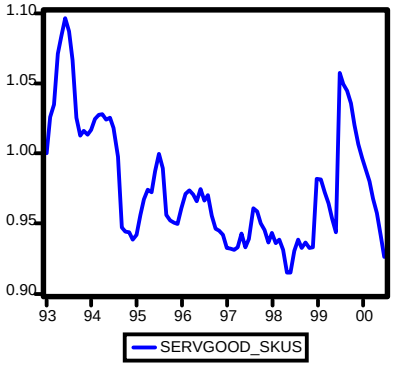
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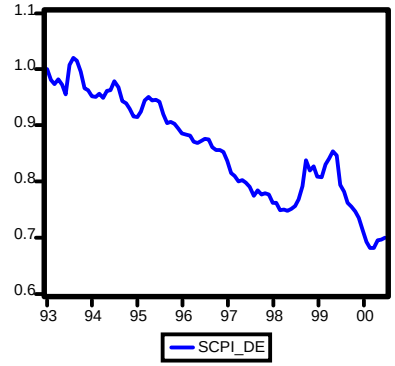
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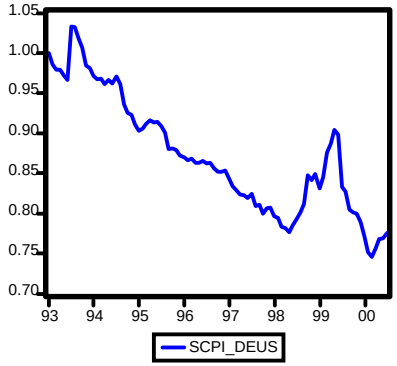
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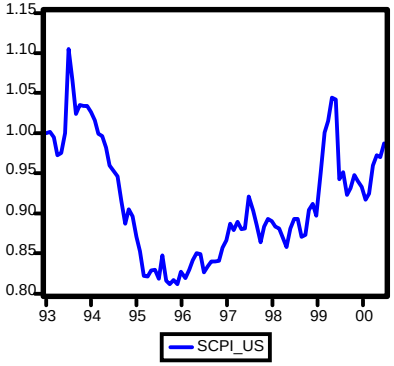
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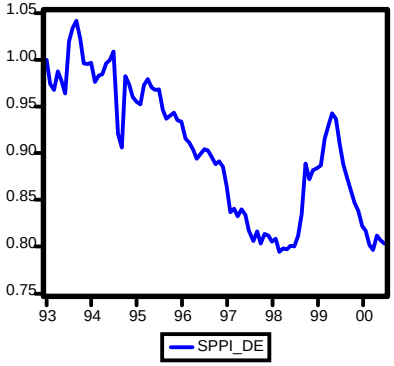
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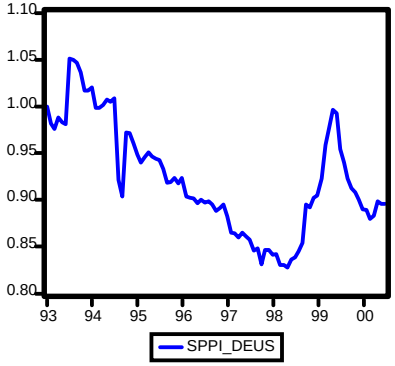
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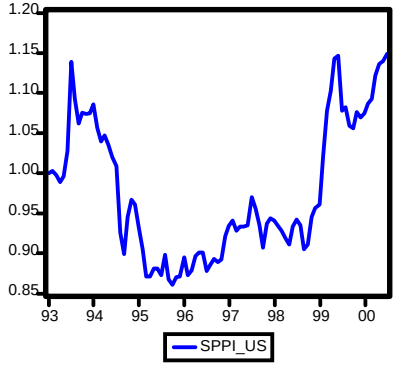
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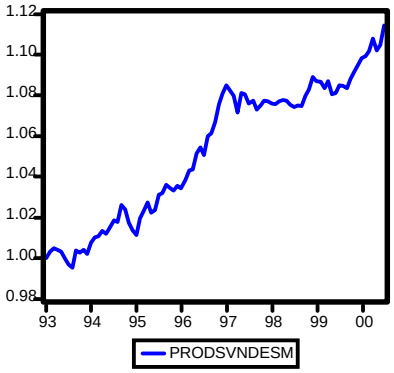
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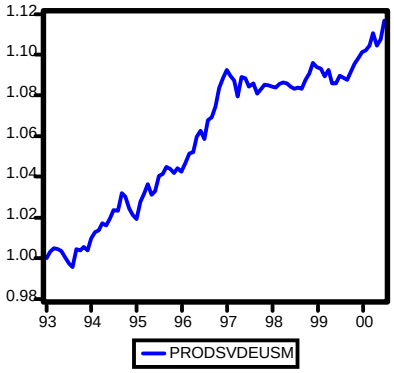
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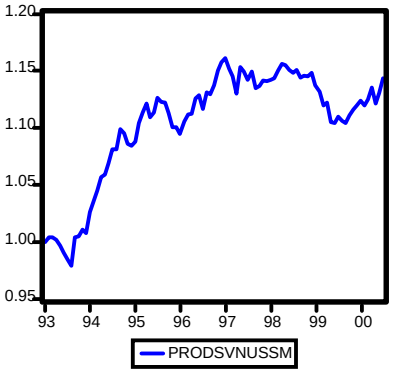
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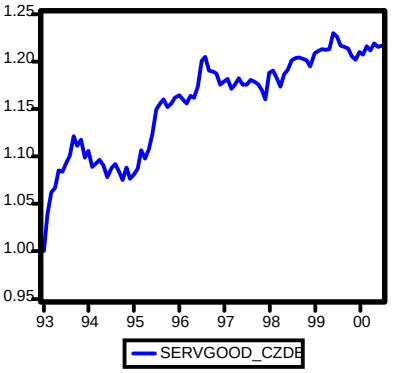
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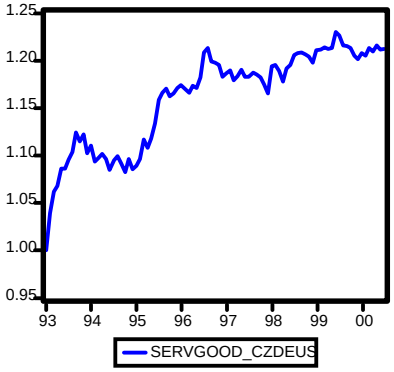
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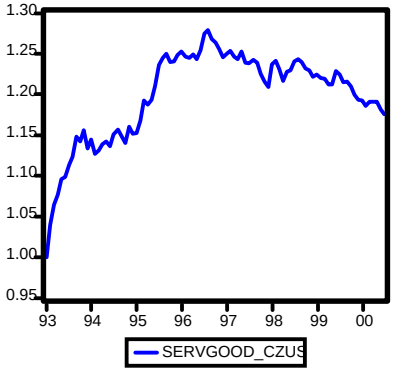
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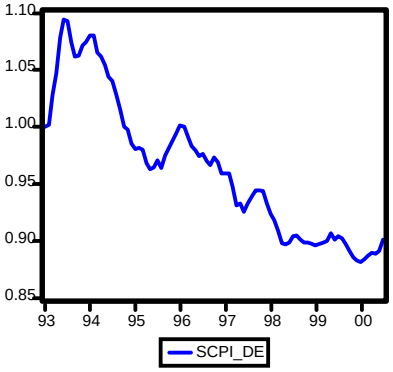
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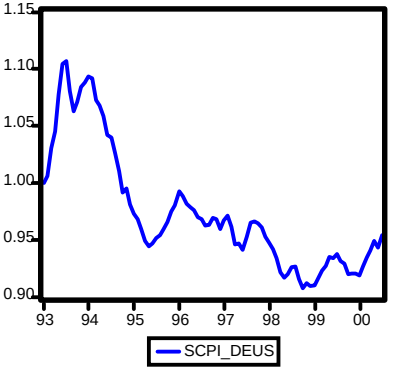
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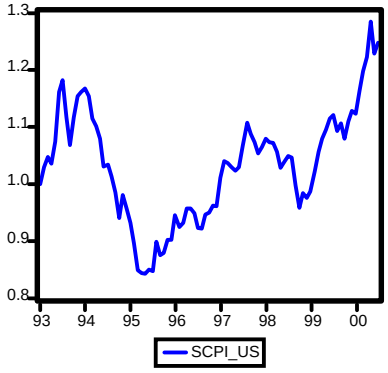
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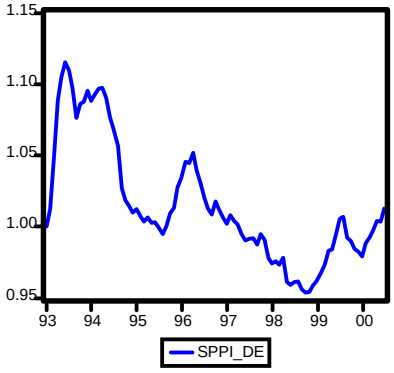
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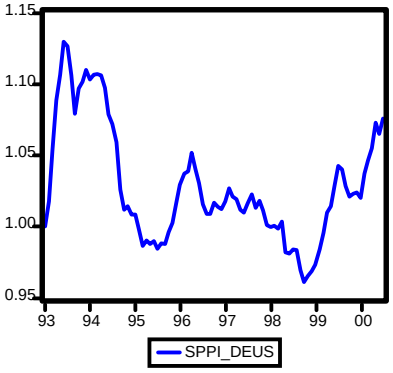
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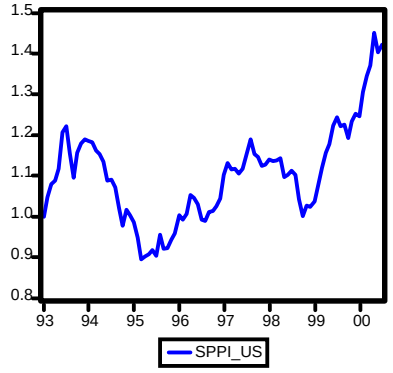
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