

# The impact of real convergence on inflation in the new EU Member States<sup>1</sup>

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## **Abstract:**

The paper discusses several equilibrium-based channels through which real convergence could affect inflation and how their impact is likely to develop in the coming years. The channels that are examined in more detail are the Balassa-Samuelson effect, changes in the consumption pattern, declining energy intensity, lower macroeconomic volatility, higher credit growth and increased trade openness. In the empirical part of the paper we aim to evaluate the relevance of these channels in each of the new EU Member States (EU-10). Given the limited data availability, we used the General-to-Specific (GETS) modelling strategy starting from an unrestricted VAR model to select for each country those convergence-related variables that are associated with the above mentioned channels and that have had an impact on inflation. Productivity growth and macroeconomic volatility appear to be the most important explanatory variables followed by credit growth, openness and wage convergence. We then test the robustness of the results by using two different catching-up scenarios to see how the convergence-related variables are likely to affect inflation developments in the EU-10 in the future.

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# 1 INTRODUCTION

In the new EU Member States (EU-10)<sup>5</sup> one of the most important economic developments in the coming years is the process of real economic convergence to the euro area, i.e. their catching-up in standards of living with those of the euro area. Although remarkable progress in terms of catching-up has been made in the past, most EU-10 display GDP per capita and price levels which are still considerably below the ones of the euro area. Catching-up in income levels is usually accompanied by a rise in price levels and hence inflation. Thus, the process of real convergence in the EU-10 is expected to continue playing an important role for future inflation developments in these countries. The interdependence of real and nominal convergence becomes in particular relevant, as the EU-10 are expected to join the euro area, for which *inter alia* the Maastricht inflation criterion needs to be fulfilled in a sustainable manner. Moreover, once the EU-10 countries become part of the euro area, the nominal exchange rate will no longer be available as a potential tool to facilitate adjustments of international relative prices. From the perspective of the euro area, potentially higher inflation in the EU-10 may increase inflation differentials, which may complicate the conduct and communication of a common monetary policy within the enlarged euro area, even if the impact on the euro area inflation rate will most likely be limited due to the relatively low economic weight of most of the EU-10 in an enlarged euro area.

Against this background, there is a need for an in-depth analysis of how real convergence is currently affecting inflation in the EU-10 and how the inflationary impact of real convergence is likely to develop in the years ahead. The literature offers several possible channels through which real convergence could impact on inflation. The Balassa-Samuelson effect is certainly the most prominent one. But there are also other important real convergence-related factors that can be expected to drive inflation developments in these countries. The other channels that we examine in this paper in more detail are changes in the consumption pattern towards more non-tradable goods, a decline in the energy intensity of production, lower macroeconomic volatility, higher credit growth and greater openness. All these channels are assumed to influence the level of inflation, although not necessarily in the same direction and to a different degree across countries. Yet, an interesting question arising from this is which of these channels have a predominant role in shaping inflation developments in the each of the

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<sup>5</sup> In the paper we only look at the EU-10 10 new Member States that joined the EU in May 2004. Thus, Bulgaria and Romania are not considered in this paper, unless they are explicitly mentioned.

EU-10 countries. In this context, we carry out a general meta-analysis by using a variable selection algorithm applied to an unrestricted VAR model to select those real convergence-related factors that have influenced inflation in the EU-10 countries. In a forward looking exercise, we then test the robustness of the results by using two different catching-up scenarios, namely one in which real convergence occurs at a steady pace and another one assuming overheating, to see how the convergence-related variables are likely to affect inflation developments in the EU-10 in the future.

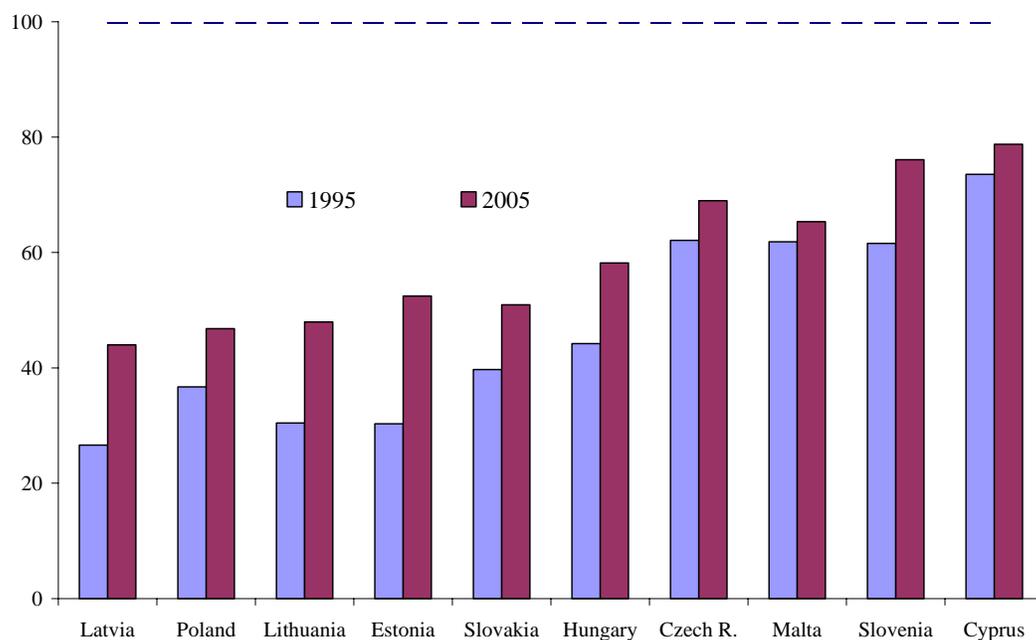
The focus of this paper is on the link between catching-up and inflation in the EU-10 countries, i.e. how the long- to medium-run process of convergence can affect inflation dynamics. As such, our study focuses on this specific aspect and it is worth delimiting its scope. We do not look at the external side of this question, namely how real convergence leads to a real appreciation. We model, though, the potential impact of imported inflation and the output gap. These two channels would capture the possible impact that nominal exchange rate changes on inflation although, it should be noted, nominal exchange rate variability has been rather low in most of the EU-10 countries. Moreover, we also abstract from possible policy reactions that inflationary pressures may trigger in these countries, in particular the impact of potential monetary policy reactions on inflation, as we are precisely interested on how real convergence may pose challenges for inflation stabilization policies. Finally, although the analysis contains a forward looking part, we do not try to answer the question how the link between real convergence and inflation would be affected after the EU-10 countries join the euro area. This would go far beyond the scope of this paper, while it might be a potential area for future research.

The paper is organised as follows. The next section contains some stylised facts on the catching-up in income and price levels in the EU-10 compared to the euro area. Section 3 provides a comprehensive overview of the most important channels through which real convergence can affect the level of inflation and how these channels are likely to develop in the years to come. Section 4 aims to evaluate the empirical relevance of the different channels in each of the EU-10 by using a VAR model and how the various convergence-related variables have affected inflation in each country. On the basis of the model, we examine in section 5 the expected impact of real convergence on inflation in the future by using a simple simulation exercise. Section 6 offers some conclusions.

## 2 REAL CONVERGENCE: STYLISTED FACTS AND PROSPECTS

In the past decade, the EU-10 made considerable progress in catching-up in income levels with those in the euro area. Between 1995 and 2005, the GDP per capita level in PPP terms in the EU-10 increased from 42% of the euro area to around 53%.<sup>6</sup> Within this period, the GDP growth rates in the EU-10 stood on average at 4.0%, compared to 2.1% in the euro area. Cyprus and Slovenia have currently the highest GDP per capita levels among the EU-10. Moreover, the progress in catching-up made so far varied largely across countries. The largest increase was experienced mainly by those countries with the lowest starting point, namely the Baltic States (Chart 1). Yet, the catching-up process was also relatively strong in Hungary and Slovenia.

**Chart 1: GDP per capita in the EU-10  
(in % of euro area average in PPP terms)**

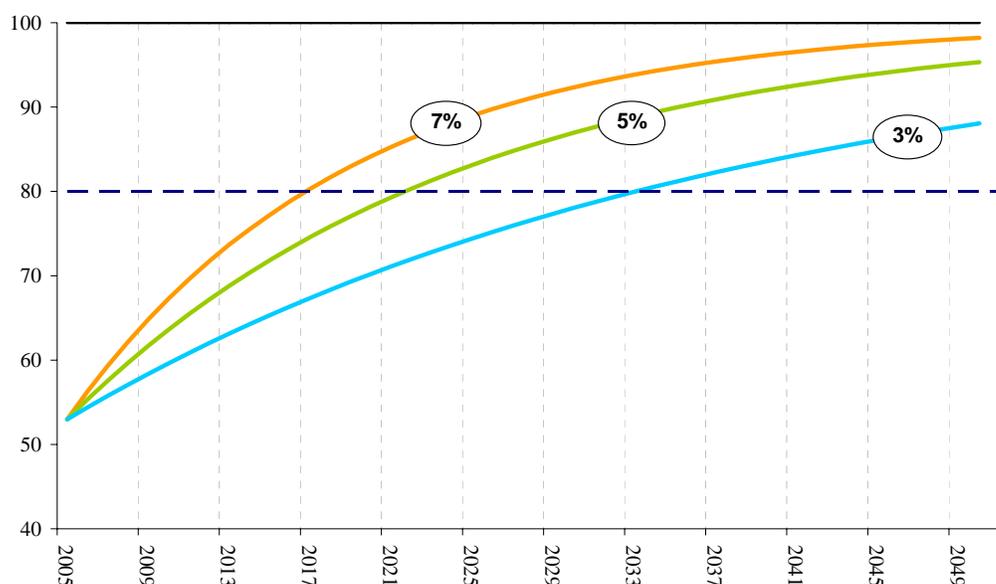


Source: Eurostat.

<sup>6</sup> Expressed in EUR exchange rates, the GDP per capita levels in the EU-10 increased on average even more during the same period, namely from 17% to 29% of the euro area average, which might partly reflect the fact that a number of countries experienced a nominal appreciation of their currencies against the euro in the past decade.

Looking ahead, real convergence is expected to gain further momentum, in particular as EU and euro area membership are assumed to add some further stimulus.<sup>7</sup> Nevertheless, real convergence is a very gradual process and will most likely be at work for the next decades. Depending on the speed by which the income gap between the EU-10 and the euro area is assumed to be reduced each year - in our example we used for demonstration purposes catching-up rates between 7% and 3%<sup>8</sup> - it will take roughly between 12 and 28 years for the EU-10 until they will have reached on average a level of more than 80% of the euro area (Chart 2).

**Chart 2: Different scenarios of catching-up in real income (GDP per capita in PPP terms, in % of euro area average)**



Source: Eurostat and ECB calculations.

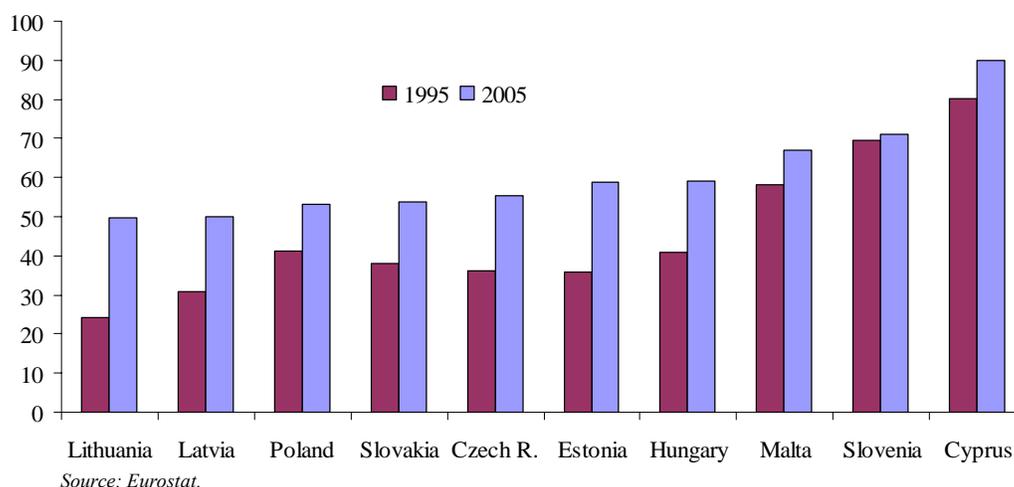
The catching-up rate indicates the speed by which the gap the GDP per capita levels between in the euro area and the EU-10 is expected to shrink each year. In this chart we used rates of 3%, 5% and 7%. The higher the catching-up rate, the faster is real convergence. By looking at the catching-up rate we implicitly assume that the GDP growth rate differentials between the EU-10 and the euro area and therefore the speed of real convergence will gradually decline over time as real convergence advances.

<sup>7</sup> A similar experience was made by Ireland, Portugal and Spain after they had joined the EU and later on the euro area.

<sup>8</sup> The catching-up rate indicates by how much percent the gap of the GDP per capita levels between in the euro area and the EU-10 is expected to shrink each year (see also footnote in Chart 2).

The average price level in the EU-10, calculated on the basis of the private consumption deflator, stands currently at 54% of the euro area, compared to 40% in 1995 (Chart 3).<sup>9</sup> There are, however, large differences across countries, with the Baltic States, the Czech Republic, Hungary and Slovakia experiencing the strongest pick-up in the price level (by more than 15 percentage points) during the last decade. In contrast, price level increases were rather moderate in Cyprus, Malta and Slovenia, all of which already display price levels closer to the euro area. Looking ahead, catching-up further in price levels would imply that inflation rates in the EU-10 will need to be on average above the euro area level.

**Chart 3: Price levels in the EU-10  
(private consumption deflator in % of euro area average)**



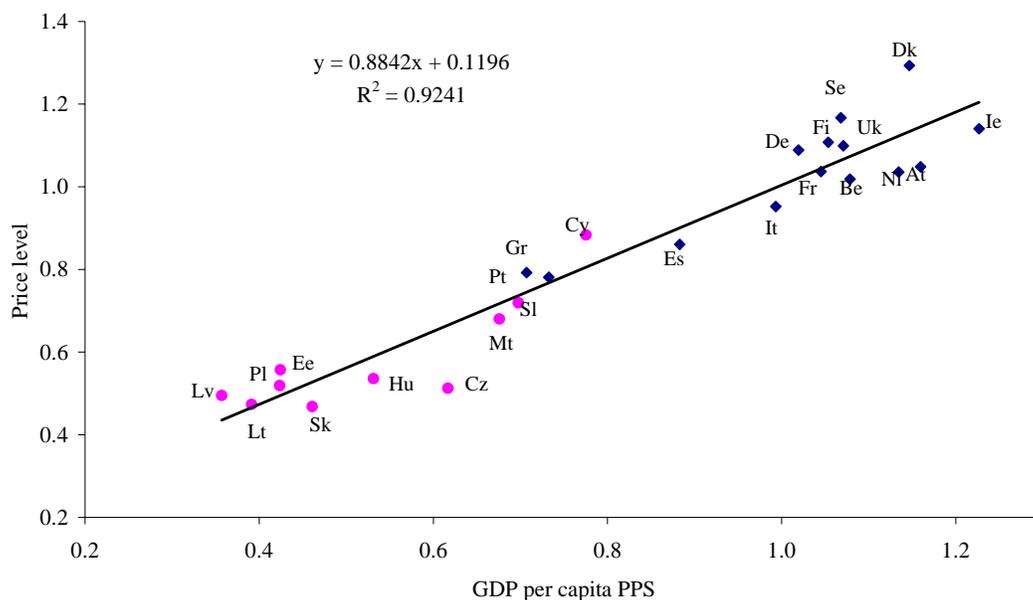
According to the literature, there is strong empirical evidence for a positive relationship between the price level and GDP per capita.<sup>10</sup> For the EU countries, we obtain an elasticity of relative price levels to relative GDP per capita levels (expressed in PPP terms) of around 0.88 for the period 2000 to 2005, i.e. a one percent increase in relative GDP per capita implies a 0.88 percent increase in the relative price level (Chart 4). Around 92% of the variation in relative price levels can be explained by changes in relative income levels and a constant. In fact, most of the countries that made large progress in real convergence during the past decade

<sup>9</sup> The private consumption deflator is measured by the ratio of private consumption expressed in EUR exchange rates and private consumption expressed in PPP terms.

<sup>10</sup> See for example Kravis and Lipsey (1988), Bergstrand (1991), Rogoff (1996). For the EU-10 see Cihak and Holub (2001), De Broeck and Slok (2001) and Herrman and Jochem (2003).

also displayed stronger increases in their relative price levels, while the Czech Republic and Slovenia show a somewhat different picture.<sup>11</sup>

**Chart 4: GDP per capita and price levels in the EU countries (average 2000-2005)**



Source: Eurostat, own calculations.

EU 25 countries excluding Luxembourg; GDP per capita and price levels in % of the euro area average. Price levels are based on the private consumption deflator.

<sup>11</sup> In the period of 1995 to 2005, the Czech Republic made only relatively little progress with real convergence, but advanced significantly in terms of price level convergence. In contrast, in Slovenia real convergence was strong, but the price level remained almost unchanged.

### **3 POTENTIAL CHANNELS OF REAL CONVERGENCE AFFECTING INFLATION**

In this section we discuss the main potential channels through which real convergence is likely to affect inflation in the EU-10. In the academic literature, reference is mainly made to the Balassa-Samuelson effect (see 3.1). But there are also other important real convergence-related factors that can be expected to drive inflation developments in these countries and which are worth to examine in more detail. Besides the productivity growth channel, we look in this chapter in particular at changes in the consumption patterns towards more non-tradable goods, the gradually declining energy intensity of production, lower macroeconomic volatility, higher credit growth and an increasing degree of external openness. All these channels can be expected to influence the level of inflation, although not necessarily in the same direction or magnitude. We also discuss in this chapter how the importance of each of these channels is likely to develop over time with real convergence progressing. While there might be also additional channels through which real convergence could impact on inflation<sup>12</sup>, we concentrate on those that can be expected to be the most relevant ones for the EU-10. Yet, the ordering of the different channels in this section does not necessarily reflect their empirical importance for the countries. In fact, given that each channel is analysed separately in this section, such a ranking of importance across channels is not possible within this framework, but will be done in the empirical part in Section 4. Finally, it should be noted that when discussing the impact of the various real convergence-related factors on inflation, we abstract from the potential impact that real convergence might have on the nominal and real exchange rate and we also do not discuss potential policy reactions.

#### **3.1 PRODUCTIVITY GROWTH AND THE BALASSA-SAMUELSON EFFECT**

According to the well-known Balassa-Samuelson (BS) effect, a catching-up economy is assumed to experience more rapid convergence of productivity levels in the tradable goods sector than in the non-tradable goods sector. Stronger productivity growth in the tradable goods sector pushes up wages in this sector. Under the assumption of perfect labour mobility

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<sup>12</sup> For example to the extent that real convergence is accompanied by substantial quality improvements of domestically produced consumer goods and services that are not properly accounted for, the inflationary impact could be overestimated. Moreover, a rise in the endowment ratio of capital to labour in the EU-10 following for example strong capital inflows, could also result in a higher price level under the assumption that the non-tradable sector is relatively more labour-intensive and the tradable sector is more capital-intensive (see Bhagwati, 1984). While this channel is similar to the Balassa-Samuelson effect (see 3.1.), most empirical studies on the Balassa-Samuelson effect assume the endowment ratio to remain constant.

across sectors, wages rise in the whole economy. As the productivity growth in the non-tradable sector is assumed to be relatively lower, higher wages in this sector translate into higher prices of non-tradable goods and hence an increase in the overall price level. This is often referred to as the internal version of the BS effect<sup>13</sup>, while the external version of the BS effect compares productivity growth differentials between the tradable and non-tradable sector and its inflationary impact across countries.<sup>14</sup> Assuming that the nominal exchange rate is determined by purchasing power parity in the tradable sector<sup>15</sup>, an increase in the price level in the catching-up economy following an increase in productivity will *ceteris paribus* result in an appreciation of the CPI-based real exchange rate in the EU-10. In this paper, however, we only focus on the internal version of the BS effect.

In contrast to the BS effect, which assumes a positive correlation between productivity growth and inflation, there are also good reasons to argue that higher productivity growth in the tradable sector can lead to a reduction in inflation. In fact, rising productivity growth in the tradable sector may imply more competition in this sector due to higher product variety and increased aggregate supply, which in turn would force firms to reduce their mark-ups.<sup>16</sup> This would impact favourably on inflation. This so-called competition effect would gain even more importance if it were accompanied by a rising degree of trade openness (see also 3.6).

While the competition effect has not yet been analysed for the EU-10,<sup>17</sup> there is ample empirical evidence in the literature for the existence of the BS effect in these countries. Yet, the estimated size of the effect varies considerably across studies, depending on the applied methodology, the respective countries, the included control variables and the sample period.<sup>18</sup>

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<sup>13</sup> The domestic version of the Balassa-Samuelson effect is often referred to as the Baumol-Bowen effect (Baumol and Bowen, 1966).

<sup>14</sup> Mihaljek and Klau (2003) argue that the internal version of the BS effect tends to overestimate the inflationary impact as it is not looking at productivity growth differentials relative to a benchmark country.

<sup>15</sup> It has been a long debate in the empirical literature, whether Purchasing Power Parity (PPP) holds or not. Burstein et al. (2003) found that PPP holds when measuring tradables prices at the dock. They argue that other measures of tradables prices, such as the retail prices, are likely to be distorted by domestic distribution costs and therefore retail prices do not reflect purely “tradables prices” any more.

<sup>16</sup> MacDonald and Ricci (2002) developed a new trade theory model and relaxed the assumption of price equalisation and perfect substitutability of tradables across countries. According to this model, higher productivity growth in the tradable sector would have two opposing effects. On the one hand, prices in the tradable sector would decline due to higher competition following larger product variety, which would force firms to reduce their mark-ups. On the other hand, wage equalisation across sectors (just as in the BS framework) implies an increase in the price of non-tradables. Assuming an expenditure bias towards domestic tradables, the negative inflationary impact would dominate the positive one.

<sup>17</sup> For some empirical evidence of the competition effect in the EU-10 see Section 4.

<sup>18</sup> For a survey of the literature see Mihaljek and Klau (2003), Breuss (2003), Coudert (2004) and European Commission (2002).

**Table 1: Selected studies on the Balassa-Samuelson effect in the EU-10**

Authors (Year)	Time and Cross-Sectional Dimension (EU-10)	Methodology	Dependent Variable	Explanatory Variable	Estimate of the BS effect*
Halpern and Wyplosz (2001)	1991-1999 CZ, EE, HU, LV, LT, PL, SK, SI (among others)	GLS	Non-tradable to tradable goods price ratio	Productivity in tradable sector, productivity in non-tradable sector	2.4 (Panel)
Egert (2002)	1993-2001 CZ, HU, PL, SK, SI	Cointegration Test, VAR	Inflation Differential (vis-à-vis DM) in non-traded goods	Relative productivity	0.2-0.6 (CZ) 2.6-3.5 (HU) 1.5-3.3 (PL) -0.2- -0.4 (SK) 0.9-1.3 (SI)
National Bank of Hungary (2002)	1993-2001 CZ, HU, PL, SK, SI	Accounting	CPI based real exchange rate	Relative productivity	1.6 (CZ) 1.9 (HU) 1.0-2.0 (SK) 0.7-1.4 (SI)
Mihajlek and Klau (2003)	1992-2001 CZ, HU, PL, SK, SI	OLS	Non-tradable to tradable goods price ratio	Domestic productivity growth differential	0.3 (CZ) 1.6 (HU) 1.4 (PL) 0.6 (SK) 0.6 (SI)
MacDonald and Wojcik (2003)	1995-2001 EE, HU, SK, SI	DOLS	Inflation Differential (vis-à-vis Austria) in non-traded goods	Relative productivity	0.5-0.6 (Panel)
Blaszkiewicz et al. (2004)	1995-2003 CZ, EE, PL, LT, SK, (among others)	Panel (FMOLS and PMG)	Non-tradable to tradable goods price ratio	Relative productivity	0.4-0.6 (Panel) 0.5-0.6 (CZ) 0.8-1.0 (EE) 0.8-0.9 (LT) 1.2-1.3 (PL)
Coricelli and Jazbec (2004)	1990-1998 CZ, EE, HU, LV, LT, PL, SK, SI (among others)	Fixed effects	Non-tradable to tradable goods price ratio	Relative productivity	0.9 (Panel)
Mihajlek and Klau (2005)	1995-2005 CZ, HU, PL, SK, SI	OLS	Non-tradable to tradable goods price ratio	Domestic productivity growth differential	0.3 (CZ) 0.2 (HU) 0.2 (PL) 0.0 (SK) 0.6 (SI)

\* Impact of productivity growth in the tradable and non-tradable sectors on the relative price of non-tradable goods, expressed in percentage points per annum (internal BS effect).

According to some of the latest studies for the EU-10, estimates of the internal version of the BS effect, i.e. the impact of higher productivity growth in the tradable sector on the relative price of non-tradable goods, range widely between close to zero and around 3 percentage points per annum (Table 1). The estimated BS effect is usually lower with panel analysis than with time series analysis. In most studies the panel estimates are clearly below 1 percentage point per annum. Country-specific estimates of the BS effect vary widely across countries. Yet, when looking at Table 1, there seems to be a pattern across countries. For the Czech Republic, Slovenia, and Slovakia the estimated BS effect is relatively low in most studies (on average between 0 and 2 percentage points per annum), while the BS effect seems to play a relatively larger role in Hungary and Poland (on average the effect is estimated to be in the range of 1 and 3.5 percentage points per annum).

The Balassa-Samuelson effect has been often criticised for its underlying assumptions. This relates in particular to the assumption of perfect labour mobility across sectors, the argument of rather low productivity growth in the service sector<sup>19</sup> and the law of one price in the tradable sector.<sup>20</sup> From an empirical point of view, the data on job flows as well as relative wage developments do not support the assumption of perfect labour mobility in the EU-10. There is, however, evidence of productivity growth in the tradable sector being higher than in the non-tradable sector in most EU-10, although it is worth noting that the estimates of the BS effect could be distorted due to difficulties in distinguishing between tradable and non-tradable goods.<sup>21</sup> Also frequent changes in administered prices could disfigure the actual size of the BS effect, as they mainly relate to the sector of non-tradable goods and services and thereby lead to relative price changes.<sup>22</sup> In the EU-10, most administered prices have been gradually increased closer towards cost recovery levels<sup>23</sup>, which can partly explain the higher

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<sup>19</sup> Technological advances can be expected to strongly improve productivity in many service sectors such as banking and insurance (Rogoff, 1996).

<sup>20</sup> According to Maier (2004) the price level of tradable goods in the EU-10 is well below the one of the euro area. The expected convergence of tradable goods prices would result in higher inflation by on average 1.5 to 3.5 percentage points per annum.

<sup>21</sup> Many items that are usually considered as tradable goods also contain a non-tradable component (Arratibel et al, 2002).

<sup>22</sup> MacDonald and Wojcik (2003) found that when including regulated prices in the analysis, the BS effect becomes statistically insignificant.

<sup>23</sup> This relates in particular to energy-related items, while the recent deregulation of the telecommunication sector in a number of countries led to a sharp decline in telecommunication prices.

inflation rate in the service sector in the past years, in particular as the share of administered prices in the consumer basket appears to be relatively high in most of these countries.<sup>24</sup>

With real convergence advancing, how will the Balassa-Samuelson effect develop in the coming years? While it is obvious that the BS effect will disappear once the process of real convergence is concluded, the short- to medium-term prospects for the BS effect are less clear. Some rough indication can be derived from the empirical studies listed in Table 1, which suggest that the estimated size of the BS effect is on average lower in those studies that focus on a later period, in which the GDP per capita levels are already somewhat higher. However, the relationship between the BS effect and real convergence might not be linear, as suggested by the opposing arguments below:

- The main argument suggesting that the BS effect is likely to gain further importance with real convergence advancing, is the assumption that the share of non-tradable goods is likely to increase in the consumer price basket (for further details see Section 3.2.). A higher weight of non-tradable goods would *ceteris paribus* imply a higher leverage of the BS effect which would result in higher overall inflation.
- On the other hand, it can be argued that the BS effect might become less important due to faster productivity growth in the non-tradable sector, which would result in a gradually declining productivity growth differential in the tradable relative to the non-tradable sector. Anecdotic evidence suggests that FDI inflows are increasingly oriented towards the non-tradable sector (namely the banking, insurance and IT sector), which can be assumed to contribute to stronger productivity growth in this sector. For the distribution sector in the EU-10 there is in fact already empirical evidence that substantial FDI inflows led to strong productivity growth in this sector and changes in relative prices.<sup>25</sup>
- In addition, further needed structural reforms in the non-tradable sector are likely to lead to higher productivity growth in this sector and as a consequence of higher competition to a reduced mark-up and smaller relative price changes.<sup>26</sup> Labour market reforms aimed at improving wage differentiation across sectors are likely to diminish

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<sup>24</sup> In 2006, the weight of administered prices in the consumer basket ranges from 7.6% in Malta to almost 24% in Slovakia (ECB, 2006).

<sup>25</sup> See MacDonald and Ricci (2001); MacDonald and Wojcik (2003).

<sup>26</sup> While some progress has been already made with respect to product market reforms, further steps are envisaged in the coming years according to the most recent National Reform Programmes of the EU-10.

the BS effect, while measures to increase labour mobility would per se have the opposite effect.

While the productivity channel described above reflects an equilibrium adjustment process of relative prices, real convergence might be also accompanied by developments which are not equilibrium-based. In particular, it is possible that in the context of the catching-up process pressures emerge to converge wage levels at a non-sustainable pace.<sup>27</sup> It could be even argued that the risk of wage growth exceeding productivity growth might increase with the EU-10 eventually becoming part of an enlarged euro area. This relates to the so-called “demonstration effect”, which assumes that with a common currency wage levels become more comparable across countries so that trade unions might aim to more strongly equalise wage levels upwards across the member countries.<sup>28</sup> However, for the current euro area countries there is no strong empirical evidence supporting this hypothesis<sup>29</sup> and for the EU-10 the risk of unsustainable wage level convergence might be further limited as collective bargaining seems to be weak in most of these countries.<sup>30</sup>

### **3.2 CHANGES IN THE CONSUMPTION PATTERN**

While the Balassa-Samuelson effect is a supply side phenomenon, real convergence can affect inflation also through the demand side. This relates mainly to changes in the consumption pattern, as it can be expected that with higher wealth the demand for non-tradable goods and services will increase relative to tradable goods. This phenomenon is known as the Linder hypothesis (Linder, 1961).<sup>31</sup> With respect to its inflationary impact, an increase in the consumption of non-tradable goods is assumed to result in a higher overall price level and from a dynamic perspective a rise in inflation, by first, higher prices of non-tradable goods at least in the short run, and second, a gradually increasing weight of non-tradable goods in the consumer price basket. With respect to the first aspect, a higher income level is expected to result in higher absolute and relative demand for non-tradable goods.<sup>32</sup> Under the assumption

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<sup>27</sup> A similar experience was made for example in East Germany after the re-unification.

<sup>28</sup> See Demertzis and Hallet (1995) and Jackman (1997).

<sup>29</sup> See Mora et al. (2005).

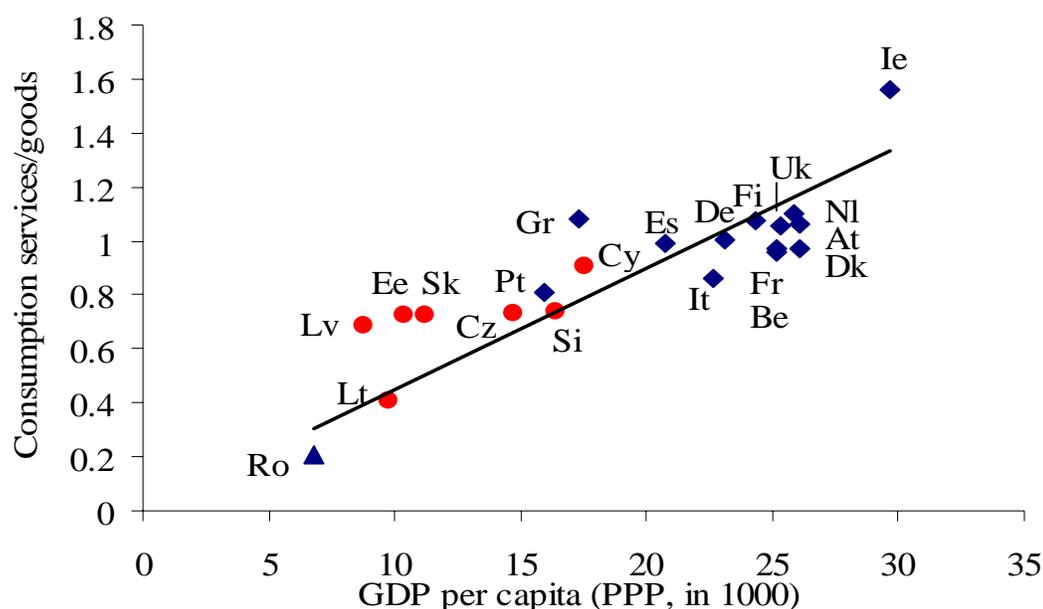
<sup>30</sup> See Arratibel et al. (2006).

<sup>31</sup> See also Bergstrand (1991). The impact of the Linder effect on inflation can be shown by the following equation:  $p = \alpha p^T + (1 - \alpha) p^{NT}$ , with the overall price level  $p$  being a weighted average of the prices for tradable (T) and non-tradable (NT) goods.

<sup>32</sup> Consumer tastes are assumed to be non-homothetic with income elasticity of demand for services being greater than 1 and for tradable goods less than 1 (Bergstrand, 1991). Services are often luxuries in consumption, while tradable goods include to a large extent necessities in the consumption basket, such as food.

of inelastic supply in the short-run, this is expected to lead to higher price increases of non-tradable goods.<sup>33</sup> Several empirical studies confirm a positive relationship between the consumption of non-tradable goods and relative prices.<sup>34</sup> With respect to the second aspect, an increasing weight of non-tradable goods in the HICP consumption basket would effect overall inflation to the extent that relative inflation of non-tradable goods is high. In addition, a higher HICP weight of non-tradable goods is likely to amplify the inflationary impact of the Balassa-Samuelson effect (see 3.1.).

**Chart 5: Consumption of services relative to goods and GDP per capita (PPP)**



Sources: Eurostat and own calculations.  
 Services and goods are taken as a proxy for tradables and non-tradables. The definition of the consumption of goods and services follows the definition of the HICP breakdown. The relative consumption ratios are calculated for all EU countries (excluding Luxembourg) plus Romania for which all 39 HICP sub-groups are available. Hungary, Malta and Poland are not included. Data refers to 2003 except for Greece (2002).

Looking at the EU-10, there seems to be some empirical support for the Linder hypothesis. Chart 5 shows a positive relationship between real GDP per capita and the consumption of

<sup>33</sup> See for example Evans (1985) for a theoretical model that explains an increase in the price level due to short run capacity constraints in the input factors.  
<sup>34</sup> This is for example shown by Bergstrand (1991) in a cross-country study for OECD countries and by Rawdanowicz (2006) for the EU-10. De Gregorio et al. (1994) find evidence for the demand and supply side effects determining relative inflation. Yet, in the long run the impact of demand side factors appears to become less important, while the importance of supply side factors seems to increase.

services relative to goods in 2003 for 22 European countries.<sup>35</sup> The higher the countries' GDP per capita level, the more people seem to consume services relative to tradable goods.<sup>36</sup>

In line with progress towards real convergence the consumption pattern in the EU-10 can be assumed to gradually converge towards the one in the euro area countries. When estimating the income elasticity of the relative consumption of services to goods in individual consumption for 22 European countries for the period 1996 to 2003, the relationship appears to be highly significant at the one percent level (Table 2). An increase in GDP per capita by one percent increases the relative consumption of services to goods in individual consumption by about 0.45 percent.<sup>37</sup> The relationship, however, might not be linear, as an increase of one percent in the GDP per capita of a richer country might lead to a lower increase in the consumption ratio of services to goods as in a poorer country. Therefore, it might be more appropriate to assume non-linearity when estimating the elasticity. Results accounting for non-linearity are reported in the third row of Table 2, with the estimate of the income elasticity being around 0.32.<sup>38</sup>

**Table 2: Per capita income elasticity of relative consumption of services to goods**

	1996	1997	1998	1999	2000	2001	Panel
<i>Linear</i> <sup>1</sup>	0.65(0.00)	0.61 (0.00)	0.54 (0.00)	0.48 (0.00)	0.45 (0.00)	0.49 (0.00)	0.45 (0.00)
R <sup>2</sup>	0.84	0.84	0.80	0.76	0.71	0.69	0.61
<i>Nonlinear</i> <sup>2</sup>	0.42 (0.00)	0.41 (0.00)	0.28 (0.00)	0.42 (0.00)	0.36 (0.00)	0.38 (0.00)	0.32 (0.00)
R <sup>2</sup>	0.82	0.81	0.76	0.58	0.73	0.68	0.62

*The dependent variable is the relative consumption of services to goods in individual consumption. P-values in parentheses, constants are included but not reported. The panel number is a pooled estimate with panel corrected standard errors. EU countries (excluding Luxembourg) plus Romania. No data available for Hungary, Malta and Poland.*

*1 All in logs.*

*2 Estimates of a semi-logarithmic transformation (lin-log). Only GDP per capita are in logs.*

<sup>35</sup> Consumption data is based on the position "individual consumption expenditure" of the national accounts, which are only available until 2003 for all EU-10. The definition of goods and services follows the definition of the HICP goods/services breakdown.

<sup>36</sup> The phenomenon of rising consumption weights of non-tradable goods was also observed for some of the "old" EU countries within the period 1980-2003. See also ECB (2003).

<sup>37</sup> The estimate of the panel analysis shows that the income elasticity of consumption of services relative to goods is 0.56 across countries and across the six years.

<sup>38</sup> The results are also in line with an earlier study by Podkaminer (1998), who estimates income elasticities of different groups of goods in transition countries. He finds that the income elasticity of demand for services such as gross rent, medical care, recreation and education is the highest.

Looking at the consumption patterns of the EU-10 in more detail, it appears that the consumption patterns in most EU-10 are still very different compared to Germany, which we have chosen as the benchmark country. The difference in the consumption pattern between the respective EU-10 and Germany can be measured by constructing a deviation coefficient.<sup>39</sup> This coefficient calculates the difference of consumption expenditures on various groups of goods in comparison to the reference country.<sup>40</sup> The deviation coefficient is particularly high in Lithuania, i.e. the consumption pattern in Lithuania seems to differ substantially from the one of Germany. In contrast, the consumption pattern of Slovenia seems to be rather similar (Chart 6). This points to a positive relationship between the income gap and the deviation coefficient, i.e. the more similar the GDP per capita level of the country is with the benchmark country, the more similar seems to be the consumption pattern. However, it should be borne in mind that country-specific tastes can also influence the consumption pattern irrespective of the GDP per capita level.

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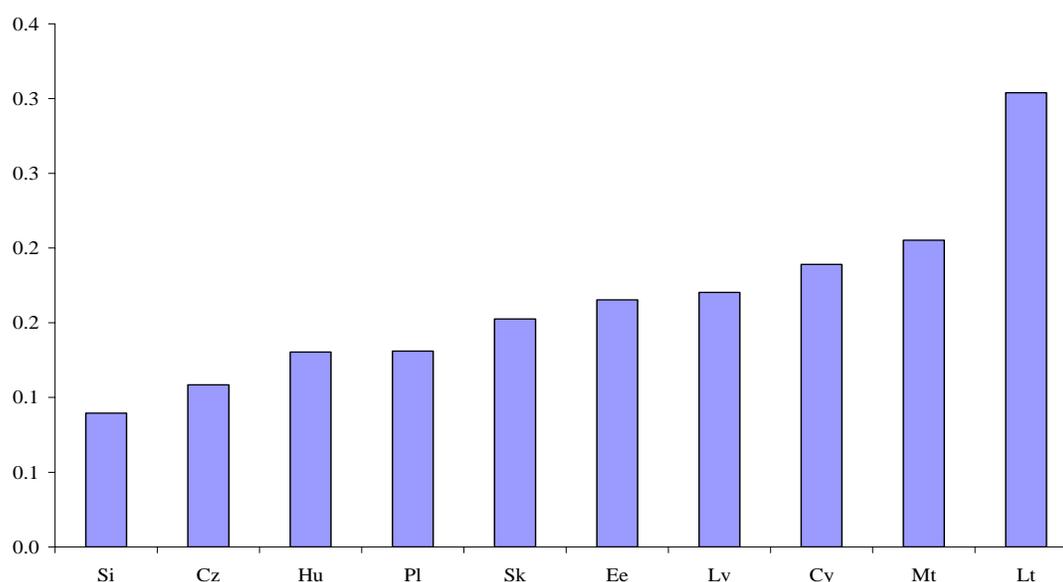
<sup>39</sup> The deviation coefficient is based on Cihak and Holub (2001) and is calculated as follows:

$$\rho_i = \sqrt{\frac{1}{n} \sum_j e_{ij} (e_{ij} - e_{dej})^2}$$

where  $e_{ij}$  is the share of item  $j$  in country  $i$  in overall individual consumption expenditure and  $e_{dej}$  represents the same figure for the benchmark country. This coefficient can be interpreted as a difference in the consumption pattern compared to the benchmark country. A low coefficient indicates that a country has a similar pattern, while a high coefficient represents a very different pattern compared to the benchmark country.

<sup>40</sup> The exercise was done for the 12 main HICP groups: 1. Food and non-alcoholic beverages; 2. Alcoholic beverages, tobacco and narcotics; 3. Clothing and footwear; 4. Housing, water, electricity and other fuels; 5. Furnishings, households equipment and routine maintenance of the house; 6. Health (private consumption); 7. Transport; 8. Communications; 9. Recreation and culture; 10. Education (private consumption); 11. Restaurants and hotels; 12. Miscellaneous goods and services. Slightly different results for the deviation coefficients can be obtained when using the 39 HICP sub-groups. However these data are not available for Hungary, Malta and Poland, so that we only report the results on the basis of the 12 main HICP groups.

**Chart 6: Deviation coefficient in the EU-10 relative to Germany (2001)**



*Source: Eurostat and own calculations.*

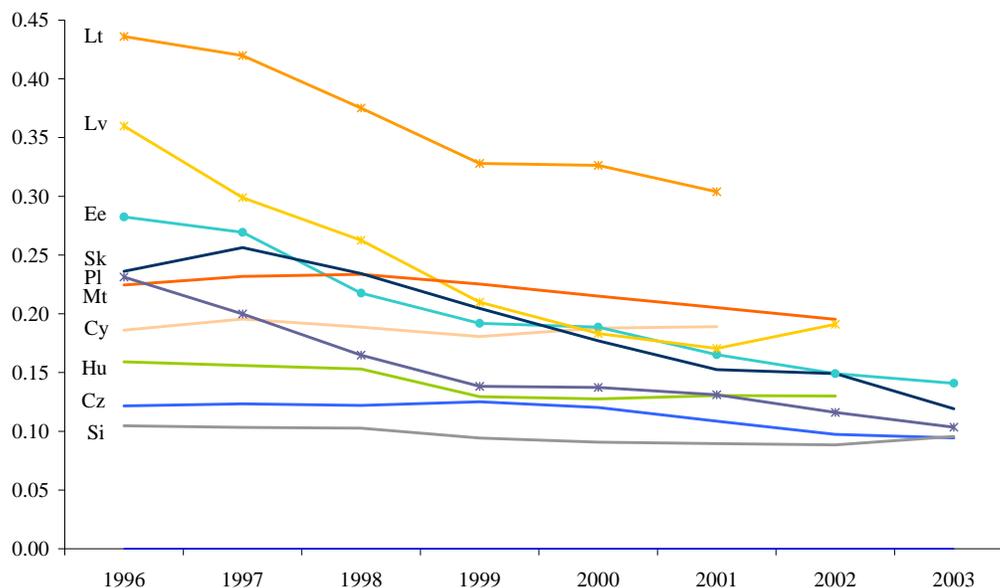
*The deviation coefficient calculates the difference of consumption expenditures on various groups of goods in comparison to the reference country. A low coefficient indicates a rather similar pattern with the reference country. For further information see also footnote 30. For all EU-10 the most recent data available are from 2001.*

As regards the development of the deviation coefficient over time, the coefficient declined mainly in those countries with a very low GDP per capita level, such as Latvia and Lithuania, while it remained broadly constant in countries with a GDP per capita level that is already closer to Germany, such as Cyprus, Malta and Slovenia (Chart 7). Under the assumption that a declining deviation coefficient reflects a rising share of non-tradable goods in a country's consumption basket, this would imply - in line with the arguments mentioned above - an increase in inflation. Thus, with respect to the EU-10 at least part of the underlying inflationary pressures in the low-income countries could in principle be related to changes in their consumption pattern towards more non-tradable goods.

Looking ahead, adjustments of the consumption pattern are likely to continue mainly in those EU-10 with a comparatively low GDP per capita level, such as Latvia, Lithuania, Poland, and Estonia. This might result in higher inflation in these countries. Such inflationary pressures are, however, likely to decline over time with real convergence progressing, due to a gradually declining income elasticity of the relative consumption of services to goods. Likewise, the consumption patterns are expected to remain broadly stable over the medium term in countries

such as Cyprus, Malta, and Slovenia, which already display a GDP per capita level close to the euro area.

**Chart 7: Development of the deviation coefficients over time in the EU-10 (1996-2003)**



Source: Eurostat and own calculations.

The deviation coefficient calculates the difference of consumption expenditures on various groups of goods in comparison to a reference country, here Germany. A low coefficient indicates a rather similar pattern with the reference country. For Cyprus and Lithuania data are only available until 2001.

### 3.3 DECLINE IN ENERGY INTENSITY

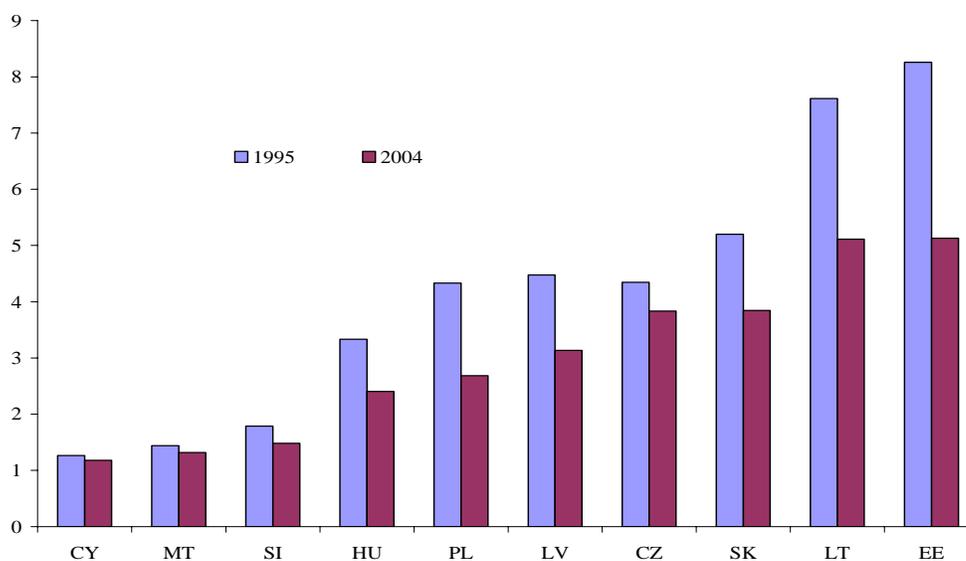
Real convergence might affect inflation also through changes in energy consumption. With real convergence progressing, the countries' total energy consumption usually increases. However, energy intensity, defined as the ratio of energy consumption to GDP, is likely to converge towards the lower levels usually observed in more mature economies.<sup>41</sup> A gradual decline in energy consumption can be mainly explained by two factors. First, with real convergence progressing energy might be used more efficiently, as more advanced economies can better afford to implement energy-saving technologies in the production process, transportation and for private consumption. Second, energy intensity might also decline due to

<sup>41</sup> Energy consumption, however, is also affected by country-specific factors such as the climate, the need for long-distance transport or the reliance on heavy industry.

changes in the production structure in a catching-up environment, namely from the industrial sector towards the less energy-intensive service sector.

With respect to the EU-10, energy intensity is considerably higher compared to the euro area countries. While in the euro area around 201 tonnes of oil equivalent were needed in 2004 to produce one unit of real GDP, for the same amount of production 2.4 times more energy would be needed in Hungary and 5.1 times more in Lithuania. Yet, energy intensity declined noticeably in most EU-10. Between 1995 and 2004, it fell by on average 24%, while energy intensity in the euro area went down by only 9% (Chart 8).<sup>42</sup> The decline in energy intensity was particularly strong in Estonia and Lithuania.

**Chart 8: Changes in relative energy intensity in the EU-10**



Source: Eurostat.

The chart shows energy intensity in the EU-10 in relation to energy intensity in the euro area in 1995 and 2004. Energy intensity is measured as the ratio of gross inland energy consumption, expressed in tonnes of oil equivalent, to real GDP.

<sup>42</sup> According to the EBRD (2001), the decline in energy intensity in Central and Eastern Europe in the early years of transition was mainly attributed to a decline in private consumption, as energy prices were increased towards cost-recovery levels. Energy intensity also dropped in the industry sector as companies were restructuring, replacing their capital stock and closing inefficient production facilities. In contrast, structural shifts away from the industrial sector were slow within this period and therefore contributed only marginally to the overall reduction in energy intensity.

Lower energy intensity, in turn, can have a favourable impact on inflation, at least if, as in the past, energy price inflation continues to exceed overall HICP inflation.<sup>43</sup> The main arguments for energy prices remaining higher in the future are first, an continuous shortage in energy resources in view of increasing world demand for energy, and second, further structural reforms in the energy sector in the EU-10, which would bring energy prices even closer towards their cost-recovery levels.<sup>44</sup> Under this assumption, a decline in energy intensity on the production side – either due to a higher share of the service sector and/or more energy-saving technologies in the industrial sector – might then lead to lower inflation through a drop in production costs. Assuming a sufficiently high degree of competition, lower costs would be passed on to consumers, thereby having an easing impact on consumer price inflation.<sup>45</sup> In addition, a decline in energy intensity in private consumption might result in lower weights of the energy-related items in the HICP basket (such as transport, water, electricity, gas and fuels). Currently, the HICP basket weights of energy-related items in the EU-10 are well above the ones of the euro area, with the exception of Malta (Chart 9).<sup>46</sup> A lower weight of energy-related items is likely to have a dampening effect on inflation, as long as energy prices remain above overall HICP inflation.<sup>47</sup>

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<sup>43</sup> In the past, the energy-related HICP items were among the most inflationary ones in the EU-10 (Arratibel et al., 2002). Besides oil price developments, this can be mainly explained by structural reforms and deregulation in the energy sector, which had been heavily subsidised before transition. Since then energy prices have been gradually lifted closer towards cost-recovery levels.

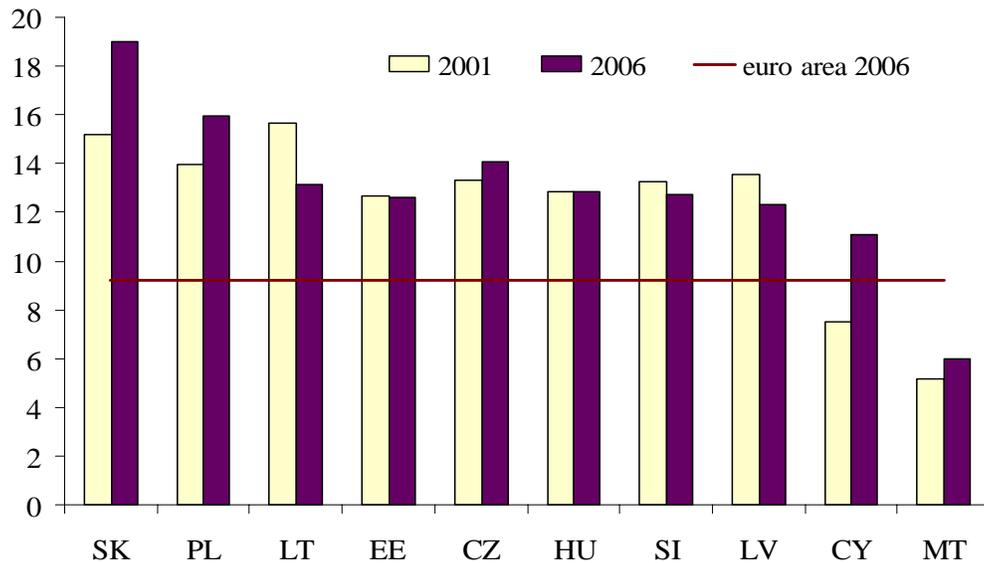
<sup>44</sup> In fact, in some countries energy prices seem to be still administered at a level below cost recovery (e.g. oil prices in the Baltic States and gas prices in Slovakia).

<sup>45</sup> Due to differences in product market competition and labour market flexibility across countries, however, the EU-10 seem to react quite differently to common energy price shocks (IMF, 2005).

<sup>46</sup> The energy weights are, however, also partly affected by the cyclical position of the respective countries, which might explain why the weights increased in some of the countries since the past five years.

<sup>47</sup> The impact of lower energy intensity on the HICP weight is expected to compensate the impact of higher energy consumption per person.

**Chart 9: Weights of energy-related items  
(in percent of overall HICP basket per country, 2001 and 2006)**



Source: Eurostat.

Looking ahead, with real convergence progressing energy intensity is likely to converge towards the level in the euro area, although country-specific factors will remain. Under the assumption of energy price rises remaining above average inflation in the coming years, the reduction of energy intensity due to real convergence would have a dampening impact on inflation. The downward impact of a decline in energy intensity on inflation might be particularly high in Estonia and Lithuania, while in Cyprus and Malta energy intensity is already very similar to the one of the euro area. It should be also noted that the relevance of the energy-intensity channel will diminish over time.

### 3.4 REDUCED MACROECONOMIC VOLATILITY

Real convergence is likely to contribute to a lower degree of macroeconomic volatility in the EU-10. This can be largely explained by the fact that most of the EU-10 underwent a major transformation process from planned to market economies. With the adjustment process being largely completed by now, there seems to be less need for a far-reaching restructuring of the economies and also the frequency and depth of structural changes have gradually declined in these countries. Moreover, the EU-10 are expected to have increasingly better access to international capital markets, whereas in the past higher uncertainties might have exposed them to a larger extent to changes in investor sentiments. Consequently, more advanced

economies are likely to face lower amplitudes of their business cycles, which might also contribute to lower inflation volatility. Moreover, inflation volatility is likely to decline as the weights of the most volatile HICP items in the consumer basket, such as food, which are currently considerably higher compared to the euro area, will fall due to changes in the consumption pattern (see 3.2.). Overall, it can be argued that a lower degree of macroeconomic volatility can be expected to have a favourable impact on anchoring inflation expectations and therefore achieving price stability,<sup>48</sup> as it would help to improve the signalling mechanism of prices. In addition, it would also facilitate for agents in an economy to formulate pricing strategies, reduce contracting costs and the costs of borrowing.<sup>49</sup>

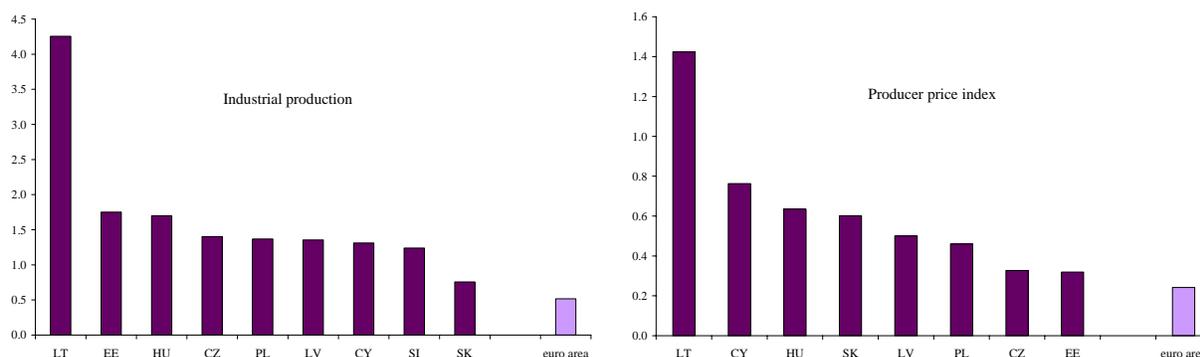
In the EU-10 the degree of macroeconomic volatility appears to be still considerably higher than in the euro area (Chart 10a and 10b). We looked at two different measures of macroeconomic volatility, namely the standard deviation of industrial production and of the producer price index. With both measures Lithuania stands out as being particularly volatile. It should be noted, however, that to some extent the higher degree of volatility in the EU-10 compared to the euro area can be also explained by the fact that most of the EU-10 are small and open economies, which are usually more exposed to shocks.

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<sup>48</sup> While in the academic literature reference is mostly made to the causality going from inflation to inflation volatility due to higher uncertainty about monetary policy (see for example Ball, 1992; Holland, 1993; Ahmed et al., 2002), it is also plausible to argue for a reverse causality, namely that lower inflation volatility can have a dampening impact on inflation. Some authors argue that higher inflation volatility causes higher inflation due to increasing incentives for policy-makers to create inflation surprises to stimulate output growth (see for example Cukierman and Meltzer, 1992; Devereux, 1989). There is empirical evidence for causalities in both directions (Jiang, 2004). In addition, some studies show that a high degree of inflation volatility might have a negative impact on output and investment (Judson and Orphanides, 1996; Blanchard and Simon, 2001). A decline in inflation volatility could thus facilitate the process of real convergence.

<sup>49</sup> Easterly et al. (2000) present evidence for developing countries that less volatility in growth rates of output is associated with less inflation. For empirical evidence see the review of the literature in Ewing and Seyfried (2003).

**Chart 10a and 10b: Macroeconomic volatility in the EU-10 and the euro area (1998-2005)**



Source: Eurostat.

Macroeconomic volatility is measured by the standard deviation of industrial production (10a) and the producer price index (10b). The charts show the averages of the quarterly standard deviations of monthly data between 1998 and 2005 for each country. Data for industrial production are seasonal and working-day adjusted; no data is available for Malta and for Cyprus only from 1999 onwards. For PPI no data is available for Malta and Slovenia and for Cyprus and Slovakia only since 2000 and 2003, respectively.

Looking ahead, real convergence can be assumed to have a dampening impact on macroeconomic volatility in the EU-10. Thus, by helping to anchor inflation expectations real convergence is likely to contribute to lower inflation. The main reasons underpinning this argument are first, some of the factors that have been responsible for rather high business cycle amplitudes in the EU-10 in the past, such as the need for restructuring the economy and the imperfect access to capital markets, might improve with real convergence progressing. Second, the weights of the most volatile HICP components in the consumer baskets are likely to converge closer to those of the euro area due to changes in the consumption pattern. Moreover, the prices of some items might become less volatile, as countries with higher per capita levels usually experience less frequent changes in administered prices and indirect taxes, which have been a source of inflation volatility in the EU-10.

### 3.5 HIGHER CREDIT GROWTH

Real convergence usually comes along with higher credit growth. According to the “financial deepening argument”, credit growth increases more rapidly than output during the catching-up phase of an economy,<sup>50</sup> as improved financial conditions of the private sector in form of higher expected income and profits allow for higher levels of indebtedness. Moreover, firms

<sup>50</sup> See e.g. King and Levine (1993).

may want to maintain the ratio between internal and external capital as the economy grows. At the same time, banks are usually more willing to lend to the private sector in an economic upturn.<sup>51</sup>

The impact of higher credit growth on inflation is ambiguous, depending on a number of factors, namely the equilibrium level of the stock of credit which is determined by fundamentals such as the level of economic development and the sectoral composition of credit growth.<sup>52</sup> On the one hand, it can be argued that higher credit growth limits the effect of demand pressures on inflation, as economic agents have less liquidity constraints to finance investments, which would subsequently result in higher output. Thus, under these circumstances rising credit growth would have a dampening impact on inflation.<sup>53</sup> On the other hand, however, credit growth far beyond what would be in line with economic fundamentals, can be expected to trigger financial bubbles and strong demand pressures due to rising consumption, which would subsequently result in higher inflation rates. In addition, the inflationary impact of credit growth also depends on the sectoral composition of credits to the private sector and the underlying dynamics. Strong growth in loans to the household sector is expected to foster demand and inflationary pressures, in particular if it is mainly used for consumption and if the share of household credits is particularly high compared to credits to the corporate sector. Moreover, in the long run risks to price stability might also emerge in case of strong growth in mortgage credits to the extent that this triggers a boom in housing prices.

With respect to the EU-10, credit growth in the private sector has been strong in a number of countries, especially in the Baltic States. Moreover, there seems to be evidence of a positive relationship between economic development and the level of credit in the EU-10 (Chart 11).<sup>54</sup> So far, however, there is only little evidence that the past credit growth has caused inflationary pressures in the EU-10, which might also reflect that most countries had a very low starting

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<sup>51</sup> See Kiss et al (2006).

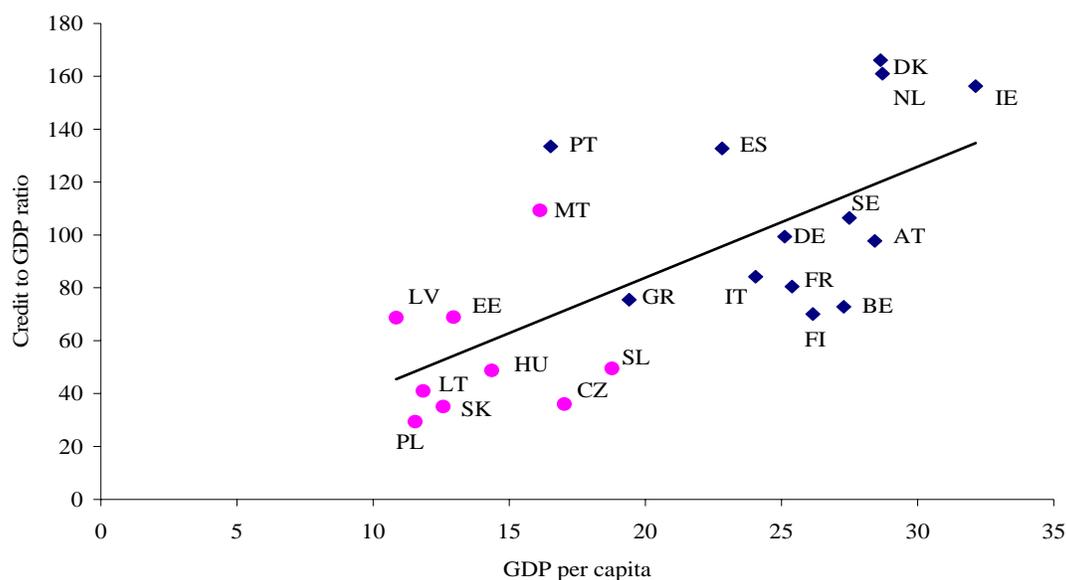
<sup>52</sup> See e.g. Égert et al (2006).

<sup>53</sup> See Blinder (1987) and McCallum (1991). Calza and Sousa (2005) find that the positive impact of credit growth on inflation is asymmetric in the euro area: starting under the high credit growth regime, they find that a real credit shock is followed by a positive deviation of inflation from the baseline but this is never statistically significant. However, when the economy starts under a low credit growth regime the response of inflation to the credit shock is larger in absolute terms and statistically significant in the short-term.

<sup>54</sup> Cottarelli et al. (2005) present empirical evidence for the positive relationship between per capita income and financial deepening in the EU-10. Backé and Zumer (2005) argue that credit growth in the EU-10 has been fostered especially by economic growth, higher income and profit expectations and the liberalization of the financial system.

point in terms of financial depth. Only for the Baltic countries there is some indication that the strong growth in credit in recent years may have started to contribute to price dynamics.<sup>55</sup> In fact, some empirical analysis shows that in Estonia and Latvia the credit-to-GDP ratio has already exceeded their equilibrium levels determined by the level of economic development, while credit growth seems to be already close to equilibrium in Hungary and Slovenia.<sup>56</sup> Yet, inflationary pressures arising from credit growth depend also largely on the sectoral composition of credit growth and their relative importance. Growth in consumer credit has been particularly strong in the Baltic countries and Hungary (above 60% in 2005), while among these countries only in Estonia and Latvia credits to the household sector seem to have played an important role compared to total credits to the private sector.

**Chart 11: Credit to the private sector and real convergence in EU countries (2005)**



Source: Eurostat and BSI.  
GDP per capita in PPP terms. EU countries excluding Cyprus, Luxembourg and the United Kingdom.

Looking further ahead, credit growth in the EU-10 is likely to remain high and in some countries to increase even further as the degree of financial deepening is expected to gradually converge closer to that of more mature economies with real convergence advancing. Stronger credit growth can be expected to cause some inflationary pressures in the EU-10 in the

<sup>55</sup> See Terrones and Mendoza (2004) and Backé and Zumer (2005).

<sup>56</sup> See Égert et al. (2006).

coming years, in particular if the countries' credit-to-GDP ratios will exceed their equilibrium levels and if most of the credit expansion relates to consumer credits.

### **3.6 GREATER OPENNESS**

Real convergence might lead through more specialisation and productivity expansion to a higher degree of trade openness, as firms are likely to become more export-intensive with a higher share of import penetration.<sup>57</sup> This in turn would affect the pass-through of international prices, which could influence inflation developments in the EU-10.

Greater openness can have an effect on inflation in both directions. On the one hand, greater openness might generate higher inflation, to the extent that the prices of tradable goods catch up with international ones through the law of one price.<sup>58</sup> Moreover, the structure of imported goods might change over time, as with real convergence countries are likely to import goods of higher quality. This in turn could imply higher prices for tradable goods. On the other hand, however, there are several arguments to assume that higher openness will have a dampening effect on inflation.<sup>59</sup> First, higher trade integration contributes to higher competition in domestic markets and could trigger the relocation of production of many internationally traded goods to countries with a comparative advantage, which would impact favourably on their relative prices.<sup>60</sup> Second, the incentive for policy makers to create surprise inflation might be lower in more open economies, particularly as the ability to temporarily stimulate domestic output are likely to be smaller because of the smaller share of non-tradable goods in consumption and the induced exchange rate depreciation.<sup>61</sup>

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<sup>57</sup> The causality can be also the other way around, namely that increased openness leads to more real convergence, especially if countries share a single currency, as predicted by the literature on endogeneity of the OCA criteria (see de Grauwe and Mongelli (2005) for a recent survey).

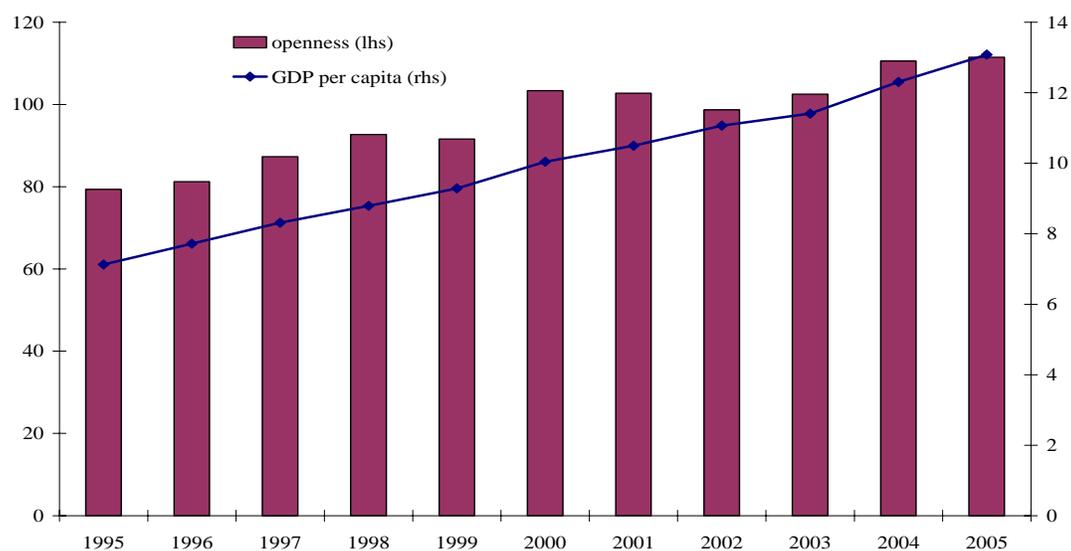
<sup>58</sup> See Kravis and Lipsey (1988) and Maier (2004).

<sup>59</sup> See Helbling et al. (2006) for a survey. For empirical evidence for a positive relationship between openness and inflation, see Sachsida et al. (2003), Gruben and McLeod (2004).

<sup>60</sup> The increased exposure to international competition could shift the Phillips Curve inwards, as discussed in Temple (2002).

<sup>61</sup> See Romer (1993) and Terra (1998). The argument of Lane (1997) on the smaller share of non-tradable goods in consumption seems to be, however, in contrast to the argument in chapter 3.2, which assumes that the share of tradables in the consumption basket will decline with real convergence.

**Chart 12: Real convergence and openness in the EU-10 (1995-2005)**



Source: Eurostat.

Openness is measured as exports plus imports as a percentage of GDP (weighted average); real convergence is measured as GDP per capita (in PPP terms, in 1000).

With respect to the EU-10, the direction in which openness is affecting inflation, hinges to a large extent on the country-specific circumstances, such as the price level of tradable goods, the underlying monetary policy regime and the scope for further trade integration. Looking ahead, it should be borne in mind that the degree of openness is already rather high in the EU-10 as a whole, standing in 2005 on a weighted average of around 111% compared to 78% in the euro area (Chart 12). Therefore, it can be assumed that the future impact of real convergence on openness is likely to be rather small, although joining a common currency area might have some further impetus on openness due to lower exchange rate risks and transaction costs.<sup>62</sup>

### 3.7 SUMMARY OF POTENTIAL CHANNELS

From a theoretical point of view real convergence can affect inflation through various channels. Table 3 summarises the main channels presented in this section, which are all assumed to have an impact on inflation in the EU-10, although not necessarily in the same direction. In the second column of the table the underlying transmission mechanism of each of the channels are presented. For three of the analysed channels, namely productivity growth

<sup>62</sup> See for example Frankel and Rose (1998), Buitier (2004).

differentials, credit growth and openness, the impact on inflation is ambiguous, as these channels can work through alternative transmission mechanism. The third column of the table indicates how the various channels are likely to affect inflation in the EU-10, i.e. whether the respective channels are likely to have an upward or a downward effect on inflation. Some information on how the role of the respective channels is expected to develop in the future is provided in the fourth column. The last column contains the corresponding real convergence-related variables, through which the impact of real convergence on inflation can be measured and which will be used in the subsequent empirical part.

**Table 3: Summary table of the main potential channels**

<i>Potential channel</i>	<i>Transmission mechanism</i>	<i>Impact of the channel on inflation*</i>	<i>Future role of the channel</i>	<i>Indicator used in Section 4 and 5</i>
<b>Productivity growth differentials (domestic)</b>	Balassa-Samuelson effect	+	A rising share of non-tradable goods would increase the impact of the BS effect, while higher productivity growth in the non-tradable sector would suggest the opposite	Productivity growth
	Higher competition leads to declining mark-ups	-		
<b>Wage level convergence (non-equilibrium)</b>	Wage pressures	+	Euro adoption could provide further impetus	Real wage growth
<b>Changes in consumption pattern</b>	Demand pressures and higher share of non-tradable goods in the consumer basket	+	Gradually declining importance	Relative consumption of non-tradable goods**
<b>Decline in energy intensity</b>	Higher efficiency in consumption and production	-	Gradually declining importance	Real oil price growth*** (proxy for energy intensity)
<b>Lower macroeconomic volatility</b>	Less uncertainty, better anchoring of inflation expectations	-	Gradually declining importance	Standard deviation of industrial production and producer price index (macroeconomic volatility)
<b>Higher credit growth</b>	Demand pressures	+	Depends on sectoral composition of credit growth	Real credit growth
	Lower liquidity constraints to finance investments	-		
<b>Greater openness</b>	Price convergence	+	Degree of openness is already high	Exports and imports as a share of GDP (openness)
	Reduced policy incentives to inflate, higher competition	-		

\* A positive sign indicates an increase in inflation while a negative sign indicates a decline in inflation.

\*\* The variable is not available on a quarterly basis; thus, this channel is not included in the empirical analysis in Section 4 and 5.

\*\*\* No quarterly data available for energy intensity; therefore we used real oil price growth as a proxy in the empirical analysis.

## **4 MAIN FACTORS DRIVING INFLATION DEVELOPMENTS IN THE NEW MEMBER STATES**

The driving factors of inflation are usually analysed separately, as was done in Section 3. It is difficult to evaluate which factors related to the convergence process have a predominant role in shaping the observed developments in inflation in EU-10. There is, hence, a need for a more general meta-analysis of how convergence-related factors drive inflation. For this reason, we carried out an empirical analysis to examine the relevance of different real convergence-related variables in explaining inflation developments in the EU-10 for the period since 1995.<sup>63</sup> This is, to our knowledge, the first study to make a systematic analysis of this question. Given the wide scope of the study, it should be thought of as a first approach at generating some general empirical regularities that help us understanding how real convergence has affected inflation in EU-10. The analysis was conducted by using time series evidence for each EU-10 separately with a set of available macroeconomic variables related to the real convergence process. These variables included productivity growth, real wage growth, openness, real oil price growth,<sup>64</sup> macroeconomic volatility and real credit growth. With the exception of changes in the consumption pattern, where no data was available on a quarterly basis, we use most of the variables highlighted in the previous section. We added two control variables to the model, namely the output gap and import price inflation, to ensure that the real convergence-related factors are not capturing other channels unrelated to convergence.<sup>65</sup> The output gap is introduced to control for business cycle fluctuations affecting inflation. Import price inflation captures factors impacting on inflation through the exogenous changes in international markets. We did not include exchange rate changes as this variable can affect inflation through two channels. The first one is by directly impacting aggregate demand and hence the output gap as it affects the demand for net exports. The second channel is the impact of the pass-through into domestic prices which is already captured in import prices and therefore redundant. As we already control for the impacts of

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<sup>63</sup> The sample period is 1995:1 to 2004:4 on a quarterly basis.

<sup>64</sup> Real oil price growth was used as a proxy for energy intensity for which no quarterly data was available.

<sup>65</sup> Given the difficulties in measuring the output gap we used two different measures, first the simple difference between GDP (log) and the HP-filtered GDP and second the Baxter and King band-pass filter, and carried out the estimates with the one that showed up to be more significant.

the output gap and import prices we do not include the exchange rate and thus avoid possible multicollinearity problems.<sup>66</sup>

The model does not include direct policy measures such as money supply, interest rates or fiscal variables. The focus of the exercise is on how important real convergence-related variables can affect inflation and hence are likely to put pressure on policy makers aiming to achieve a low and stable inflation rate. If we believe that inflation can ultimately be controlled by monetary policy, policy variables would mask the underlying effect of convergence-related variables and it would be difficult to identify how these convergence forces are affecting inflation. In essence, the model presented here attempts at unveiling how the long-run process of convergence affects short-run inflation. This is the challenge for monetary policy as it is likely that short-run inflation targeting would have to take into account the potential impact coming from the long- to medium-run catch-up process.

Other important aspects related to the process of catching-up and economic transformation that can affect inflation developments in the EU-10 are institutional factors such as the degree of (de)regulation in labour and product markets, fiscal consolidation and financial market characteristics. Several of these aspects have been thoroughly analysed in Angeloni et al. (2005). These are very slow changing variables for which we do not have reliable time series indicators on a quarterly basis. Differences in these structural and institutional characteristics, however, can be regarded as country-specific characteristics that will have an important role to play in determining which variables enter the data generating process (DGP) of inflation. As we will see later on, the heterogeneity in the results obtained from our empirical analysis goes along the lines of this argument.

Given the potential interdependence between these variables, the analysis has to be carried out using a system approach rather than a single equation. However, the short time span of data available for EU-10 makes the estimation of a full Vector Autoregressive (VAR) system

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<sup>66</sup> There is an additional reason not to introduce the nominal exchange rate in the regressions. Although catch up can affect the real exchange rate through both inflation and the nominal exchange rate, in many of the countries under study the exchange rate was subject to a high degree of intervention that limited strongly its variability. Several countries such as the Baltic States have hard pegs even in the form of a currency board. For others, some form of soft peg was practiced for good part of the sample period. De Grauwe and Schabl (2004) show that even for *de jure* flexible arrangements, the degree of variation of the nominal exchange rate was small with a few exceptions for some countries and periods. This creates problems in two ways. First, the introduction of quasi-fixed variables in the VAR can generate important econometric problems. Second, the information content of nominal exchange rates for inflation would be very limited in these cases, as most of the impact of foreign exchange market pressure would not be reflected in this variable.

problematic. One solution would be to treat all countries together within a panel. However, this assumes a high degree of homogeneity across countries, which, as we shall see later, is strongly rejected by our results. For these reasons we used a model reduction algorithm that automatically selects the variables and lags that enter the inflation DGP. The variables that appeared to be relevant were selected for each country by applying the GETS selection algorithm starting from an unrestricted VAR model.<sup>67</sup> The Appendix contains a detailed explanation of the methodology used for those interested in the technical details. The recursive structure of the VAR is less problematic in this case, as model reduction also decreases the potential number of VAR orderings for each country. The GETS algorithm is ideal in contexts in which data availability is limited, and it is of direct use to our purpose of selecting the most relevant variables driving inflation in EU-10. It has to be noted, though, that the aim is not to identify a fully structured VAR for inflation, but to analyze which variables and lags enter significantly the inflation equation. The quality of the model is assessed in terms of its fit, misspecification tests, structural stability, sample stability and economic interpretability. The model is later on used to analyse the expected changes in inflation following real convergence within a simple simulation exercise.<sup>68</sup>

As regards the results of the analysis, all channels discussed in Section 3, for which suitable data was available to include them in the analysis appear to be relevant for explaining inflation in the EU-10 as a whole, although at a varying degree. Productivity growth and the measure of macroeconomic volatility appear most often as an explanatory variable for the EU-10 (Table 4). Real credit growth, openness and real wage growth also appear quite often. Somewhat surprisingly, import price inflation and real oil price growth seem to have only a limited effect.

Furthermore, the analysis finds that oil price growth, import price inflation, macroeconomic volatility and real wage growth always have an upward impact on inflation, which is in line with expectations. Also real credit growth has an upward effect on inflation in some countries, except for the case of Slovakia. Productivity growth shows either a positive or a negative impact on inflation, depending on the relative strength of the two opposite effects, namely the

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<sup>67</sup> See Hendry and Krolzig (2005), Hoover and Perez (2004), Doyle and Nyberg (1999) and Christofersen and Wescott (1999).

<sup>68</sup> Notice that, since all the variables in the model are in rates of growth (except for openness), this is a stationary VAR, consistent with the aim at unveiling how convergence affects short-run inflation dynamics. Openness was found to be stationary in most cases, but when it was found to be I(1), it was introduced in first differences.

BS effects on the one hand and the reduced mark-up due to higher competition on the other hand.<sup>69</sup> For openness the study finds that it usually increases inflation due to the price catch-up effect, except for Hungary where it has a dampening effect. In the latter case, the potential price catch-up effect, which is quantitatively relatively small, may be compensated by the possible downward impact on inflation through higher competition.<sup>70</sup>

**Table 4: Inflationary impact by variable after dynamic adjustment\***

	<i>Upward impact on inflation</i>	<i>Downward impact on inflation</i>
<b><i>Productivity growth</i></b>	Malta Slovakia Slovenia	Czech Republic Hungary Latvia Lithuania
<b><i>Volatility</i></b>	Czech Republic Estonia Hungary Latvia Lithuania Slovenia	
<b><i>Real credit growth</i></b>	Czech Republic Estonia Poland	Slovakia
<b><i>Openness</i></b>	Malta Poland Slovakia Lithuania	Hungary
<b><i>Real wage growth</i></b>	Czech Republic Latvia Poland	
<b><i>Output gap</i></b>	Czech Republic Hungary Lithuania Poland	
<b><i>Import price inflation</i></b>	Czech Republic Estonia Slovenia	
<b><i>Real oil price growth</i></b>	Malta Slovakia	

\* A positive sign indicates an increase in inflation while a negative sign indicates a decline in inflation.

<sup>69</sup> In most cases when productivity appears to have a positive impact on inflation the algorithm did not select the wage variable, which indicates that productivity may be capturing both the BS and mark-up effects. Moreover, MacDonald and Ricci (2002) argue that once we control for wages, productivity appear to have a negative impact on inflation due to the reduced mark-up following higher competition.

<sup>70</sup> The output gap is found to be an important determinant of inflation in Poland, Hungary and Czech Republic in Golinelli and Orsi (2001).

The empirical results suggest that the driving forces of inflation seem to differ quite substantially across countries.<sup>71</sup> Interestingly the selected variables do not always seem to follow a pattern related to the GDP per capita levels of the EU-10. Hence, it can be assumed that other issues such as economic policies and structural reforms also seem to matter. It should be borne in mind, however, that the results might exaggerate the degree of heterogeneity among the EU-10 due to very different data quality across countries.

Table 5 shows the variables that have been identified as being relevant for inflation for each country. Most of the selected variables are also Granger-causal, that is, their past values contain information about current inflation. This distinction may be useful for policy purposes as Granger-causal variables can be considered as leading indicators.

Table 5 also contains an indication of the reliability of the results for each country. This is a subjective composite based on several criteria. The criteria used to analyse the reliability of the results were:

- Diagnostic tests including autocorrelation, normality and heteroskedasticity.
- Tests for over-identifying restrictions of the VAR.
- Recursive Chow tests for stability.
- Forecast stability tests.
- Sensitivity to a change in the recursive order.
- Data availability and economic interpretability of the results.

According to these criteria, the model seemed to work well in most cases, with the reliability being classified as high or medium-high. For Hungary and Slovenia the reliability of the results was considered as medium, while there are no cases for which the reliability of the results was considered low.<sup>72</sup>

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<sup>71</sup> Our results confirm the general findings in this literature that point to country specific variables as main determinants of inflation without a clear pattern. See Golinelli and Orsi (2001). Backé et al (2002) identify productivity, wage dynamics and price deregulation as main driving forces of future inflation.

<sup>72</sup> A full set of results including these criteria and the impulse-response functions is available on request.

**Table 5: Selected variables for each country and reliability of results**

	<i>Selected variable</i>	<i>Selected Granger-causal variables</i>	<i>Reliability of results<sup>1</sup></i>
<b>Czech Republic</b>	import price inflation volatility productivity growth real wage growth real credit growth	import price inflation volatility real wage growth real credit growth	high
<b>Estonia</b>	import price inflation real wage growth real credit growth volatility	import price inflation real wage growth real credit growth volatility	high
<b>Hungary</b>	openness volatility productivity growth	openness volatility productivity growth	medium
<b>Latvia</b>	productivity growth real wage growth output gap volatility	productivity growth real wage growth output gap	medium-high
<b>Lithuania</b>	openness volatility productivity output gap	Openness Productivity Output gap	medium-high
<b>Malta</b>	real oil price growth openness productivity growth real credit growth	real oil price growth openness productivity growth real credit growth	medium-high
<b>Poland</b>	real wage growth real credit growth output gap openness <sup>2</sup>	real wage growth real credit growth output gap	medium-high
<b>Slovakia</b>	real oil price growth openness productivity growth real credit growth output gap	real oil price growth openness output gap	high
<b>Slovenia</b>	import price inflation productivity growth volatility	import price inflation productivity growth volatility	medium

<sup>1</sup> Qualitative measure on the econometric performance and economic interpretability of the results, which is based on several criteria such as reliability of regressors, diagnostic tests, tests for over-identifying restrictions, test for forecast parameter constancy, sensitivity to changes in SVAR ordering, data availability and economic interpretability of the results.

<sup>2</sup> First difference of the variable.

## 5 HOW COULD REAL CONVERGENCE CONTRIBUTE TO INFLATION IN THE FUTURE?

The model estimated and reported in Section 4 can be used to analyse the potential contribution of real convergence on inflation in the EU-10 in the future. The contribution of convergence can be examined under a wide variety of scenarios depending on what is the expected evolution of the variables entering the inflation DGP. For this purpose we will work with two distinct cases of interest, namely, one in which convergence occurs at a steady pace and another in which there could be overheating together with catching-up.

We first analyse the fit of the model during the last two years of the sample 1995-2004 by comparing the fitted and actual inflation rates in-sample. We then obtain the inflation rate that would have prevailed if some of the real convergence-related variables are changed to some postulated values under the two different scenarios. We then compare the inflation rate obtained under this simulated case with the fitted values from the model so as to abstract from estimation errors. The difference between the two would be the contribution of each different convergence scenario to inflation. It is important to note that this is not an inflation forecast but rather should be viewed as an indication of the potential impact of real convergence on inflation abstracting from other changes that could occur in the economy at the same time.

As mentioned before, the range of scenarios can be very large, but here we focus on two that can exemplify different possible developments in the EU-10. The two convergence scenarios are set as follows:

Scenario 1: growth slowdown, wages grow in line with productivity, credit growth decreases and macroeconomic volatility is dampened:

- Productivity growth is 3% (average value in the last two years was 5.5%).
- Real wages grow at 3% in line with productivity (average value in the last two years was 6.5%).
- Credit grows at 5% (average of last two years was 9%).
- Macroeconomic volatility is 130% of the euro area average standard deviation of industrial production or PPI volatility (average of last two years: 190%).

Scenario 2: faster productivity growth, wage inflation, credit expansion and no reduction in macroeconomic volatility:

- - Productivity growth is 5%.
- - Real wages grow at 6.5%.
- - Credit grows at 11%.

**Table 6: Actual, fitted and simulated values of inflation**

	<b>Actual</b>	<b>Fitted</b>	<b>Sim 1</b>	<b>Sim 2</b>	<b>Actual-Fitted</b>	<b>Sim1-Fitted</b>	<b>Sim 2-Fitted</b>
Czech Rep	1.551	2.351	-0.329	0.380	0.801	-2.680	-1.971
Estonia	2.697	3.855	2.635	3.032	1.158	-1.220	-0.823
Hungary	5.584	6.710	5.494	6.054	1.126	-1.216	-0.656
Latvia	5.241	3.280	3.854	3.630	-1.960	0.574	0.350
Lithuania	0.862	1.511	0.109	0.062	0.650	-1.402	-1.450
Poland	1.729	2.297	4.348	7.460	0.568	2.051	5.163
Slovakia	7.361	9.184	7.628	8.453	1.823	-1.556	-0.731
Slovenia	4.290	5.475	5.447	5.858	1.185	-0.028	0.383
<b>Weighted average</b>	<b>2.993</b>	<b>3.782</b>	<b>3.759</b>	<b>5.398</b>	<b>0.789</b>	<b>-0.023</b>	<b>1.616</b>

*Note: The first column shows the average HICP inflation rate in the last two years of the sample 1995:1 to 2004:4. The second column shows the fitted values for inflation from the static solution of the model. The next two columns show the values of inflation under the two scenarios. The rest of the columns show the difference between the actual and fitted values (the error) and the difference between the simulated values and the fitted values. The last row shows the weighted average values of inflation.*

The results reported in Table 6 show that the model fit is relatively good. Notice also that the model has been estimated for the full sample for which it is best suited. As inflation has decreased substantially in the majority of cases, the model tends to overestimate inflation by around 0.8 percentage point for the last two years. This is especially the case for Slovakia and Slovenia, but these two countries have had substantially higher inflation levels compared to the EU-10 average in the last two years of the sample. In Estonia, inflation is overestimated by about 43%, while in Latvia inflation is underestimated by around 36%.

Looking at the simulated values of inflation we can see that, on average, the contribution of the first real convergence scenario to inflation would be marginally negative. Indeed, this is

the case for all the countries in the sample except for Latvia and Poland. In the latter case, real wage growth had been negative in the last two years of the sample. This means that, as real wages grow in line with productivity this is expected to increase temporarily inflationary pressures coming from the labour market. For the rest of the countries, the impact of this steady catch-up scenario would be a decrease in inflation, although the degree of the impact varies widely between countries. For the second scenario average weighted inflation would increase by 1.6 percentage points. Note, however, that this increase is most pronounced for Poland for the same reasons commented before. For the rest of the countries, even under this overheating scenario the contribution of real convergence to inflation might be slightly negative. One of the reasons for this result is that productivity is assumed to grow fast, which for some countries has a strongly downward impact on inflation as in the Czech Republic, Lithuania and Hungary.

The general conclusion of this simple exercise is that the impact of real convergence on inflation will depend on to what extent real convergence is accompanied by other factors such as labour market policies that refrain wage inflation, more stable output (inflation), and a good regulation of the financial sector leading to reasonable levels of credit expansion to allow for economic growth. The contribution of real convergence to inflation is not homogeneous across economies and does not appear to have an unequivocal direction.

## 6 CONCLUSIONS

The paper discusses the impact of real convergence on inflation in the EU-10 and how this is likely to develop in the coming years. Several channels are analysed in detail, through which real convergence could affect inflation. These potential channels are the Balassa-Samuelson effect, changes in the consumption pattern, a decline in energy intensity, lower macroeconomic volatility, higher credit growth and greater openness. The paper tries to evaluate the empirical relevance of these channels in the EU-10 by selecting for each country those set of convergence-related variables that are associated with the potential channels and that have had an impact on inflation. The expected impact of real convergence on inflation in the future is then examined by using a simple simulation analysis.

A number of conclusions can be drawn from the analysis. First, the model shows that all convergence-related variables seem to be relevant for explaining past inflation developments in the EU-10 as a whole. Productivity growth and macroeconomic volatility appear to be the most important explanatory variables followed by credit growth, openness and wage convergence.

Second, the current level of real convergence is assumed to have at present an upward effect on inflation, but its overall magnitude is highly uncertain, in particular given the fact that not all channels point in the same direction. Among the selected variables macroeconomic volatility, real wage growth, the output gap, import prices and oil prices are assumed to have an upward impact on inflation in the EU-10 countries, while productivity growth, credit growth and openness seem to affect inflation in both directions.

Third, the results suggest that the relative importance of the convergence-related variables for inflation seems to largely differ across countries. Besides their different starting positions, the high degree of heterogeneity across countries might reflect differences in the conducted macroeconomic policies, in the underlying monetary and exchange rate regimes as well as in the importance of structural rigidities in the respective countries. Consequently, the risk of second-round effects stemming from the inflationary impact of real convergence can be expected to vary considerably across the EU-10.

Fourth, the inflationary impact of real convergence is expected to decline over time. The Balassa-Samuelson effect is assumed to diminish with relatively stronger productivity growth in the non-tradable sector, which is partly supported by FDI inflows into this sector. As

regards the changes in the consumption pattern, the inflationary impact is expected to decline as the consumption patterns of the EU-10 converge closer to those of the euro area. Also the potentially dampening impact of lower energy intensity on inflation is likely to gradually loose speed, with the production structures converging more towards those in the euro area. Furthermore, macroeconomic volatility might gradually approach the degree observed in the euro area, while the inflationary impact of credit growth will depend on changes in the sectoral composition of credit. The importance of openness for explaining future inflation developments is likely to fade, given that the EU-10 have already reached a very high degree of openness.

Some policy recommendations can be drawn from the analysis. As the analysis shows, it can be assumed that the process of real convergence will continue to affect inflation developments in the EU-10. Whether this would trigger any second-round effects which could bring inflation developments far beyond a sustainable level, hinges to a large extent on the conduct of macroeconomic policy and structural rigidities. In fact, it seems to be crucial for policy makers to follow a policy directed towards macroeconomic stabilisation to avoid excessive domestic demand. Likewise, it is important that the catching-up process is accompanied by structural reforms to further improve the supply-side conditions, enhance competition and reduce existing bottlenecks. With respect to euro adoption it appears advisable that the EU-10 join the euro area only if the inflationary impact of real convergence is sufficiently limited with relatively low costs of the adjustment process, so that those policy instruments that remain available for euro area members, in particular fiscal policies and structural policies, are sufficient to prevent unsustainable price developments to emerge. Thus, the findings on the inflationary impact of real convergence underline the importance to focus on sustainable real convergence.

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# APPENDIX

## METHODOLOGY: GTS MODEL SELECTION IN A VAR CONTEXT

As the aim of the study is to select which real convergence-related variables have information content about inflation developments in new EU Member States (EU-10), a rigorous way of doing this is by making use of the Gets algorithm of Hendry and Krolzig (2004).<sup>73</sup> In our context, we need to work within a system rather than a single equation approach due to the interdependencies between the variables involved. We will hence use a Gets model selection for a VAR consisting of the  $n$  variables involved. Previous studies for central eastern European countries such as the one by Doyle and Nyberg (1999) and Christofersen and Wescott (1999) find that a-theoretical VARs do well in terms of inflation forecasting. In our case, as will be shown below, we will use a “partially a-theoretical VAR”, as we need to use very minimal theory restrictions to carry out our model reduction.<sup>74</sup>

The Gets algorithm specifies an initial General Unrestricted Model (GUM) which is the baseline model. Then we have to specify the variable selection significance level and the model selection criteria, which can include specification tests and information criteria such as the Swartz Information Criteria. From here the algorithm searches using a multiple-path between each feasible initial variable deletion. The model selection continues until we have a well-specified model for each initial path where all variables are significant. Once all paths have been explored, all terminal models are tested against each other and their union until a *final* model is selected. One can further examine the stability of the resulting model by analysing the significance of the variables for two overlapping samples.

In the case of VAR models, we follow Brüggemann et al (2002) and Krolzig (2003) who discuss the properties of model selection algorithms for VAR models. One of the conclusions of this literature is that equation-by-equation reduction methods such as Gets are inefficient for reduced form VARs if there is no independence between the different equations in the system. Hence, the advisable thing to do is to propose a Structural VAR (SVAR) instead. In our context, a recursive SVAR that requires very little theory restrictions is the logical choice. These SVARs impose restrictions on the *contemporaneous causality* of the variables

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<sup>73</sup> See also Hoover and Perez (2004).

<sup>74</sup> The general findings in this literature point to country specific variables as main determinants of inflation without a clear pattern. See Golinelli and Orsi (2001). Backé et al (2002) identify productivity, wage dynamics and price deregulation as main driving forces of future inflation.

involved, and hence require a VAR ordering. However, as we will see below, given that our interest focuses on inflation only, one can obtain a subset SVAR (S-SVAR) corresponding to the variables that enter the inflation DGP, which reduces considerably the structural restrictions on contemporaneous causality and allows us to check the robustness of the model to these restrictions much more easily.

Suppose we start with a system that includes *inf*, *gap*,  $\Delta pr$ ,  $\Delta w$ ,  $\Delta cr$ ,  $\Delta oil$ , *op* and *vol*.<sup>75</sup> We will assume that all the variables potentially have a contemporaneous impact on inflation, but that the impact of inflation on all of them is delayed. Then *inf* would be the last variable of the *contemporaneous causal ordering*.<sup>76</sup> A possible ordering could be:

$\Delta oil \rightarrow op \rightarrow vol \rightarrow \Delta pr \rightarrow \Delta w \rightarrow \Delta cr \rightarrow gap \rightarrow inf$

That is,  $\Delta oil$  has contemporaneous impacts on all variables, but *op* does not impact immediately on the first difference of oil prices;  $\Delta oil$  and *op* have an immediate impact on *vol*, but *vol* can only have delayed impacts on  $\Delta oil$  and *op* and so on. There are several ways of justifying these restrictions. However, the important thing to notice is that if we end up with a *specific* final model for inflation that includes, for instance, only *gap*,  $\Delta w$  and *vol*, then the ordering of these 4 variables is far less restrictive and requires less theoretical justification than the larger GUM.

A relevant issue is that with these contemporaneous restrictions of the SVAR, the Gets algorithm is efficient on an equation by equation basis. Hence, the procedure we will follow for our analysis will consist of:

1. Specify a GUM for inflation with all variables and a (limited) lag augmentation in which we include contemporaneous variables (i.e. the variable at time *t* and at time *t* - 1, *t*-2,...). We restrict the VAR to a maximum of 3 lags for each variable given the short time-series available.
2. Obtain the specific model for inflation using the Gets algorithm.

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<sup>75</sup> *inf* stands for inflation, *gap* for the output gap, *pr* for productivity growth, *w* for real wage growth, *cr* for real credit growth, *oil* for real oil price growth, *op* for openness and *vol* for macroeconomic volatility.

<sup>76</sup> Note that this does not rule out that inflation can have a causal impact on the other variables, just that this causal impact is delayed at least one period.

3. Once we know the variables entering the specific DGP for inflation, we impose a VAR ordering and start from 1 again for all these variables but bearing in mind the recursive restrictions of the VAR.
4. This will yield a specific S-SVAR (SS-SVAR) model that will not only be exactly identified but also over-identified as it will restrict several insignificant lags to be zero. Hence, we will have a system in which the number of parameters to estimate will be the minimum possible.
5. From the SS-SVAR we can already assess Granger-causality, i.e. if past values of any variable contain information about current inflation. This is the information content criterion that is very relevant for policy making. Note that, in this case, if a variable enters the inflation DGP with any lag, then it is automatically Granger-causal as it is necessarily significant.
6. Then we can analyse the short and long-run impact of the variables selected.
7. We carry out impulse response analysis to examine the dynamic impact of a shock on each variable on inflation. Given that the VAR is identified we can treat these shocks as orthogonal (i.e. they are not a mixture of different shocks and hence we can identify and isolate their effect).
8. We can carry out stability analysis to check if the results are or not valid for the whole sample or have suffered from large swings that render them of little use.

Steps 1 to 8 will yield all the relevant information we are interested on: a) which real convergence-related variables are relevant in explaining inflation; b) what is the sign of their impact; c) is there statistical information content in them; d) how does inflation react to changes in these variables; e) is this impact stable.