

Balázs Krusper

The role of external and  
country specific factors  
in Hungarian inflation  
developments

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MAGYAR NEMZETI BANK



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**The role of external and country specific factors in Hungarian inflation developments\***

(Külső és országspecifikus tényezők szerepe a magyarországi infláció alakulásában)

Written by: Balázs Krusper\*\*

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\*\* Balázs Krusper ([krusperb@mnb.hu](mailto:krusperb@mnb.hu)).

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# Abstract

Recent literature suggests that the co-movement of inflation is rather strong across countries. We use a factor model to assess this co-movement within the EU, while we differentiate between common (EU) and regional (CEE) effects. We find that price dynamics in Western European countries share a common pattern, while CEE countries can be divided into subgroups according to their inflation history. Results indicate that the monetary policy regime is a very important source of the difference among CEE countries. This method also allows us to examine how external and country-specific components contributed to the Hungarian inflation. We find that Hungary, similar to other countries in the region, experienced a disinflation period before the EU accession. However, country specific components (e.g. VAT changes or monetary policy) also played an important role.

**JEL:** C33, E31, E42, E58.

**Keywords:** inflation dynamics, factor model.

## Összefoglalás

Az empirikus irodalom szerint az infláció együttmozgása országok között igen szoros. Ezt az együttmozgást elemezzük egy faktormodell segítségével az EU-n belül, miközben különbséget teszünk közös (EU) és regionális (KKE) hatások között. Nyugat-Európában jelentős közös mintát találunk az árak alakulásában, míg a kelet-közép-európai országok inflációs múltjuk alapján több alcsoportra oszthatók. Az eredmények azt mutatják, hogy a monetáris politikai rezsim meghatározó szerepet játszik a régiós országok közötti különbségek magyarázatában. A módszer lehetővé teszi annak vizsgálatát is, hogy külső és országspecifikus tényezők milyen mértékben járultak hozzá a magyarországi inflációhoz. Azt találjuk, hogy Magyarországon, hasonlóan más régiós országokhoz, végbement egy dezinflációs folyamat az EU-csatlakozás előtt. Ugyanakkor országspecifikus tényezők (például indirektadó-változások vagy monetáris politika) szintén fontos szerepet játszottak.

# 1 Introduction

The aim of this study is to tell a story about Hungarian inflation by analyzing external and country specific factors. The approach is based on the recent literature that examines the co-movement of different economic variables across countries. In particular, we use the data of EU-27 countries to estimate a factor model suggested by Stock and Watson (2002). It allows us to split the external components into common (EU) and regional (CEE) components. Although this method does not give a structural explanation of inflation developments (as it analyzes the correlation between different inflation time series), it still provides a useful framework to capture the contribution of external and country-specific components.

External effects are thought to play an important role as Hungary is a small open economy. The economic history of Central Eastern European countries is characterized by some common events (for example the transition to market economy or the EU accession), therefore we differentiate between European and regional effects. We find that the latter is more important in the case of Hungary.

The country-specific component captures idiosyncratic shocks that also affect inflation. We analyze some "exogenous" shocks like minimum wage hikes or VAT changes. In certain periods the results give some indications about the monetary policy stance. However, as mentioned before, our approach is not structural, therefore alternative explanations can account for the results as well.

This paper contributes to the literature by treating CEE and EU15 countries in a joint framework. Therefore in addition to telling a story about the determinants of Hungarian inflation in the past, it also allows us to analyze the different behavior of EU member countries. In addition, this exercise can be useful for analyzing the current state of the economy, especially when the effect of some common or idiosyncratic shock is not clear.

The paper is organized as follows. Section 2 summarizes the literature of international co-movement of inflation. Section 3 presents the methodology, then section 4 describes the data. Section 5 provides the results. Common factors are presented in Section 5. 1, then regional factors are presented in Section 5. 2. Section 5. 3 deals with the heterogeneity among CEE countries. Section 5. 4 describes the country-specific component. Section 5.5 examines the robustness of the results. Finally, Section 6 concludes.

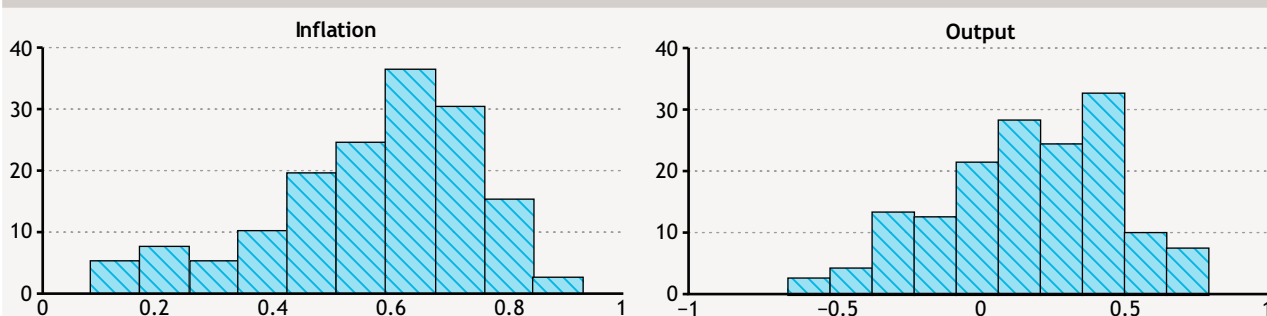


## 2 Related literature

Globalization turned economists' attention to study the co-movement of variables across countries. Interestingly, the international co-movement of inflation has not been studied extensively until recent years<sup>1</sup>, although stylized facts show that this co-movement is rather strong. Eickmeier and Moll (2009) computed all correlations between inflation time series of OECD countries and they found an average and median correlation of 0.56 and 0.61 respectively.

In fact, inflation co-movement is stronger than co-movement of real variables. Wang and Wen (2007) performed the same exercise on inflation and output time series of 18 developed countries. They found that average correlation of inflation

**Chart 1**  
Distribution of correlations between inflation and output time series



Source: Wang and Wen (2007).

time series was 0.57 while average correlation of GDP growth was only 0.18. For inflation, unlike output, they did not find any pair of time series with negative correlation.

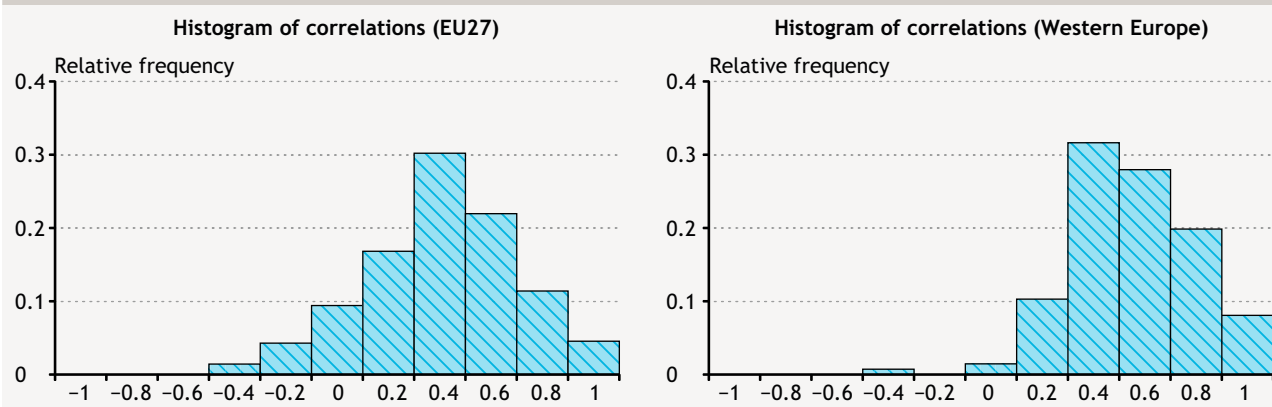
Our data set consists of EU-27 countries. The histogram of the correlations shows significant co-movement within the whole EU, but it is not as strong as among developed countries (Chart 2). The mean is 0.31, the median is 0.32 and we find a number of negative correlations. However, if we consider only the group of Western European countries (that is, we remove CEE countries from the sample), we get a higher degree of co-movement. In this case the mean and median of the correlations are 0.45 and 0.44 respectively, while we have only 3 negative correlations out of a total of 136<sup>2</sup> pairs. These findings are in line with Wang and Wen (2007) and suggest that the distinction between CEE and Western European countries is meaningful.

<sup>1</sup> For sample information regarding the studies cited in this section see Table 1.

<sup>2</sup> Pairs of countries with negative correlations: UK-Ireland, UK-Netherlands, UK-Portugal.

Chart 2

## Distribution of correlations between inflation time series of EU27 and Western European countries



Ciccarelli and Mojon (2010) emphasize that inflation is a global phenomenon. They found that a global common factor explained almost 70% of the total variance of developed countries' inflation. They argued that the high level of co-movement can be explained by common shocks hitting the global economy.

Mumtaz and Surico (2008) studied how the degree of co-movement evolved over time. They used 164 price index time series for 11 developed countries and found that the degree of co-movement increased throughout the Great Moderation while the level, the persistence and the variance of inflation decreased.

Monacelli and Sala (2009) analyzed product level price data of four countries (France, Germany, United Kingdom, United States). They found that the international factor explained 15%–30% of the total variance depending on the exact form of the price index (monthly versus annual change). They argued that "given the high level of disaggregation of our panel, this estimate is best viewed as a lower bound for the contribution of international factors to inflation dynamics" (Monacelli and Sala, 2009, pp. 101). Besides that the authors found significant relationship between the importance of international factors and trade openness.

Mody and Ohnsorge (2007) focus on the EU. They find that the common component is more important in the euro area (on average it explains two-thirds of the level of inflation) than in other EU member states. The authors identified the price convergence as an important source of country-specific component of inflation in non-euro area countries. The results of Choueiri et al. (2008) confirm the importance of common factors within the EU.

Beck et al. (2006) analyzed price developments in the euro area. The sample consists of inflation data of 70 NUTS-II regions that covers a little more than 60% of the euro area. The authors identified three common factors that explain 75% of the total variance. The first factor (that explains the highest share of the total variance) co-moves strongly with euro

Table 1

## Sample information on the cited literature

Author	Sample (cross section)	Sample period
Beck et al. (2006)	70 NUTS-II regions (2/3 of euro area)	January 1995–October 2004
Choueiri et al. (2008)	EU25	2001–2004
Ciccarelli and Mojon (2008)	22 OECD countries	1961–2007
Eickmeier and Moll (2009)	24 OECD countries	1980–2007
Mody and Ohnsorge (2007)	EU25	2001–2004
Monacelli and Sala (2009)	France, Germany, UK, USA	1991–2004
Mumtaz and Surico (2008)	11 developed countries	1961–2004
Stavrev (2009)	10 New Member States	January 1998–June 2008
Wang and Wen (2007)	18 developed countries	1977 Q1–1998 Q4

area inflation. The authors conclude that there is a common inflation pattern in the euro area. However, country-specific component also play a role, on average three-fourths of the remaining variation is explained by three country-specific factors.

Stavrev (2009) studied inflation in the 10 New Member States by analyzing product-level data. They find significant common factors that are attributed to price convergence and EU accession.

In summary, the literature confirms that inflation developments are synchronized among (especially developed) countries. This finding can be interpreted that external effects are important source of inflation variation. The contribution of this paper to this literature is to analyze the developed (EU15) and emerging (CEE) countries in a joint framework.

### 3 Methodology

In this study we follow Stock and Watson (2002). External and country-specific factors are computed by principal component analysis, where external factors are decomposed into common and regional effects. We estimate the following equation:

$$\pi_{ijt} = \lambda_{ij}f_t + \mu_{ij}g_{jt} + e_{ijt}, \quad (1)$$

where  $\pi_{ijt}$  is the standardized annual change of the consumer price index in country  $i$  and region  $j$ <sup>3</sup>,  $f_t$  is the global factor,  $g_{jt}$  is the regional factor in region  $j$  and  $e_{ijt}$  is the country-specific component. This method allows for more global or regional factors. Finally note that the parameters ( $\lambda_{ij}$  and  $\mu_{ij}$ ) may differ across countries.

Factors can be estimated consistently with a two-step procedure. In the first step common factors are obtained by the principal components of inflation time series. Then we subtract the global component by regressing the factor(s) on inflation and taking the residuals. In the second step we compute the principal components again, but using only the residual time series of CEE countries. These principal components give the regional factors. Finally by regressing the global and regional factors on the inflation time series, the resulting residuals give the country-specific component ( $e_{ijt}$ ).

A key question of this procedure is how to determine the number of principal components. The Kaiser criteria (Kaiser, 1960) suggests that we should use components only with eigenvalues higher than 1 (that is, their variance is higher than the variance of the original variables). Beck et al. (2006) determine a (clearly arbitrary) threshold: they use the fewest principal components that explain together at least 75% of the total variance. Furthermore, we should consider the decrease in the share of explained variance: if the first component explains 73% while the second one explains only 3%, we should take only the first one.

It is important to note that the principal component analysis is not a structural method; the identification is based on the orthogonality of the principal components. Hence we cannot match structural explanatory variables (such as oil price, euro area output gap and so on) with the principal components. However, we obtain *factors* that we should interpret somehow, and the explanation may help to determine the number of the factors. Explanation may also be based on the loadings that show which country's inflation co-moves closely with that particular factor. In addition, the shape of the factor may allow for some explanation as well. In Section 5, both approaches are used to interpret the results.

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<sup>3</sup> Section 5.5 shows that the results still hold if we use the monthly change of the seasonally adjusted consumer price index.

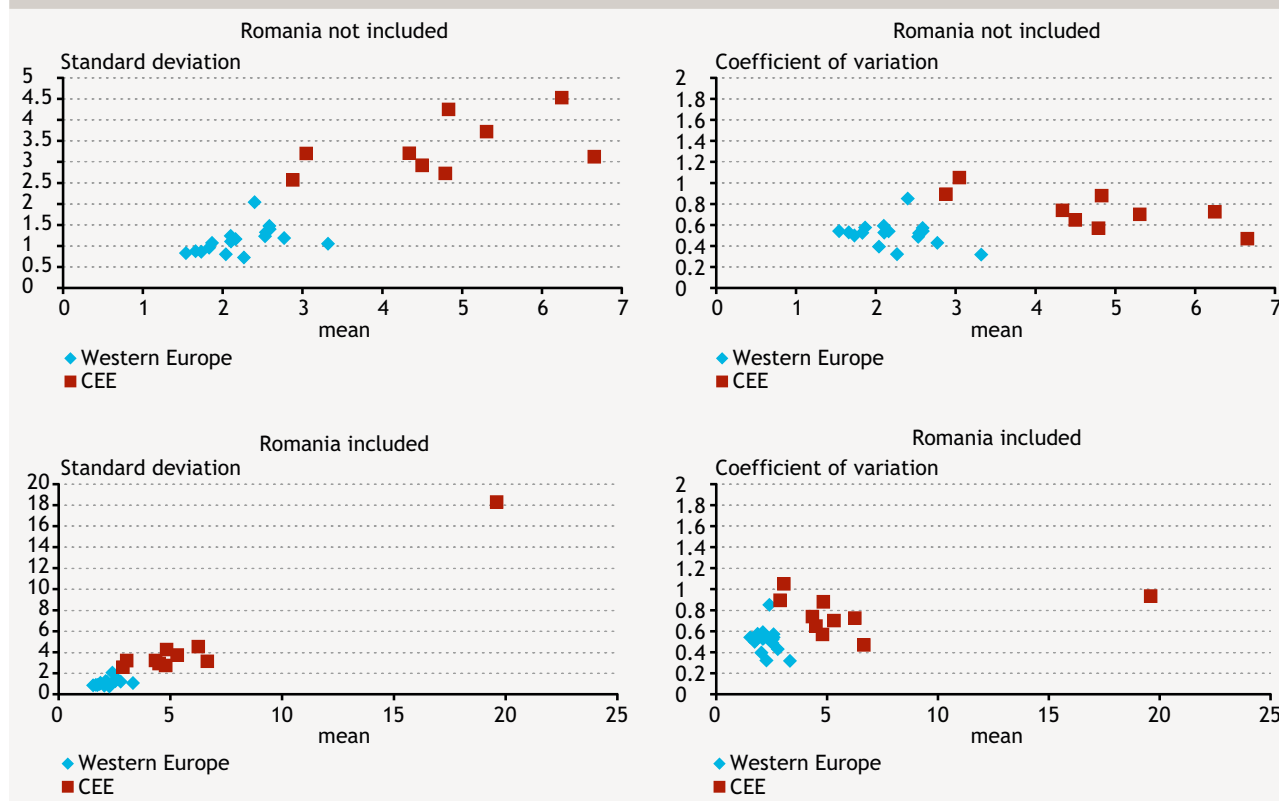
## 4 Data

The data set consists of monthly inflation data of 27 EU member states in the period of February 1998–February 2012<sup>4</sup>. Inflation is measured by the annual percentage changes of the Harmonized Index of Consumer Prices. These data are provided by Eurostat, and they are comparable across countries. The time series are plotted in the Appendix.

Within the European Union, the following countries are defined to belong to the Central Eastern European region: Hungary, Poland, Czech Republic, Slovakia, Slovenia, Estonia, Latvia, Lithuania, Bulgaria and Romania. For simplicity, the remaining part of the EU is referred to as Western Europe. In our sample period, on average CEE countries have higher and more volatile inflation. However, the coefficient of variation (standard deviation divided by the mean) is not higher than in Western Europe (Chart 3)<sup>5</sup>.

The principal component analysis is usually performed on standardized data (that is, we subtract the mean and divide by the standard deviation). While the mean of the time series is entirely irrelevant (the principal components are computed from the covariance matrix), dividing by the standard deviation affects the results. If we do not rescale the data then countries with higher variance will tend to have higher loadings. As in our case, there is a positive correlation between the

**Chart 3**  
**Mean and standard deviation of inflation in EU-27 member states**  
(February 1998–February 2012)



<sup>4</sup> The first month of 1998 was dropped because Bulgaria experienced 3-digit hyperinflation.

<sup>5</sup> The average and the standard deviation of Romanian inflation is an outlier, thus the scatter plots are reported both when the sample includes and does not include Romania.

mean and the standard deviation (see Chart 3). This offers an opportunity to take into account indirectly the difference between average levels of inflation.

Unfortunately the difference of the standard deviations is large enough to completely drive the results. Therefore the data are standardized and we emphasize that this paper analyzes only the dynamics of inflation in different countries.

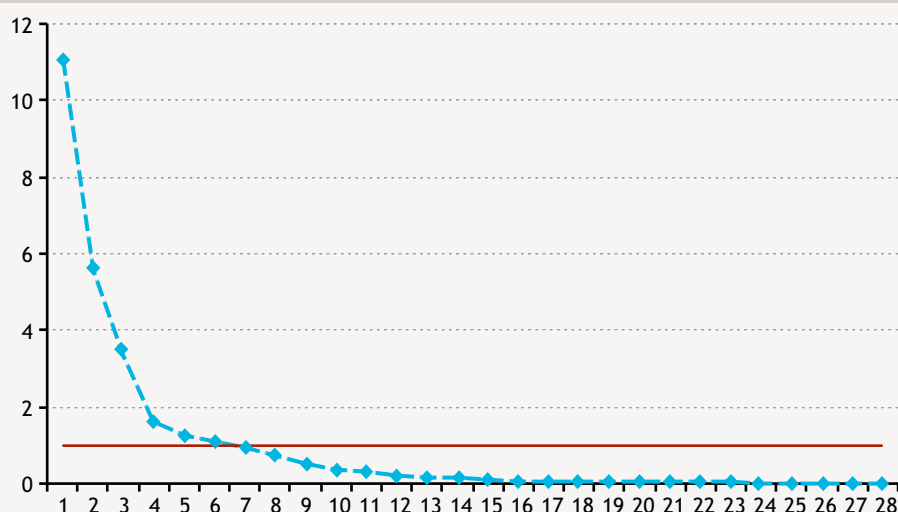
# 5 Results

## 5.1 EU-WIDE COMMON FACTOR

In the first step we compute the common factors. As the sample consists of EU member states, common factors can be interpreted as some common trend in the EU. As Hungary is integrated deeply into the EU, both in the goods and financial markets, the EU-wide common factors serve an appropriate proxy for “global” or “external” price developments.

The scree plot of the principal components shows that the first three components explain 40%, 20% and 12% of the total variance respectively (Chart 4). The sum of the variance explained by these three components is 72%.

**Chart 4**  
**Scree Plot (ordered eigenvalues) for the common EU factors**

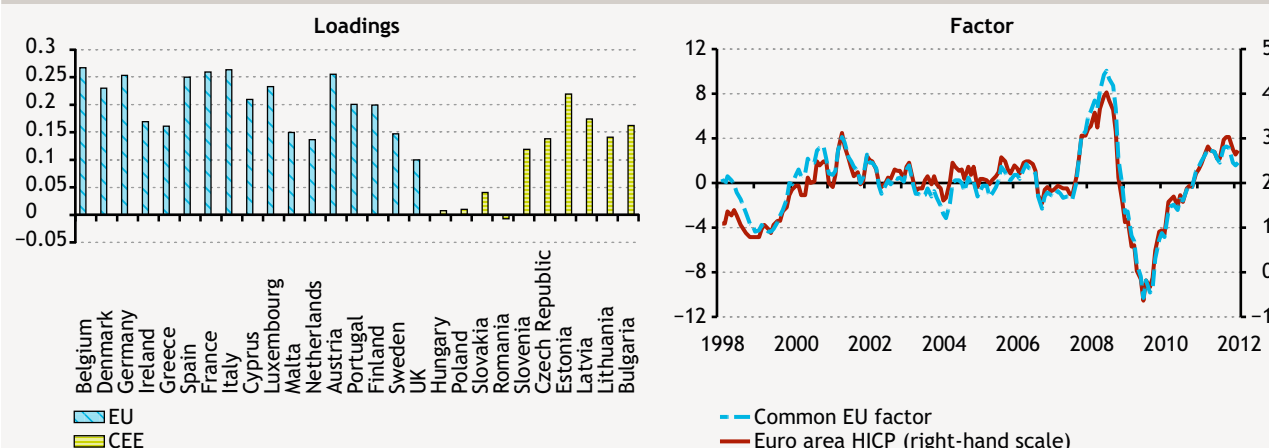


The loadings of the principal components are shown in Chart 5. The first one is highly correlated with the Western European countries and especially with some core euro area countries such as Italy, Germany and France.

In Central Eastern Europe the loadings show a mixed pattern. Inflation in countries with fixed exchange rate or currency board (Estonia, Latvia, Lithuania and Bulgaria) co-moves strongly with Western European inflation. This is also true for Slovenia and the Czech Republic. In the sense that they have loadings of a similar size, these two countries are as close to the euro area as Sweden, which is another highly integrated country with independent monetary policy and flexible exchange rate. Other CEE countries (Hungary, Poland, Romania, Slovakia) have small loadings.

As the first common factor correlates with most of the euro area countries, it is not surprising that this factor co-moves with the euro area HICP. It declines at the end of the 90's in the European recession, and fluctuates around 0 (that is around its historical average) thereafter. It clearly picks up in 2007–2008 as the global commodity price shock appears in euro area consumer prices and then falls to historical low levels due to the recession in the financial crisis. However, since 2010 it is on the rise again and it clearly exceeds its historical average in 2011.

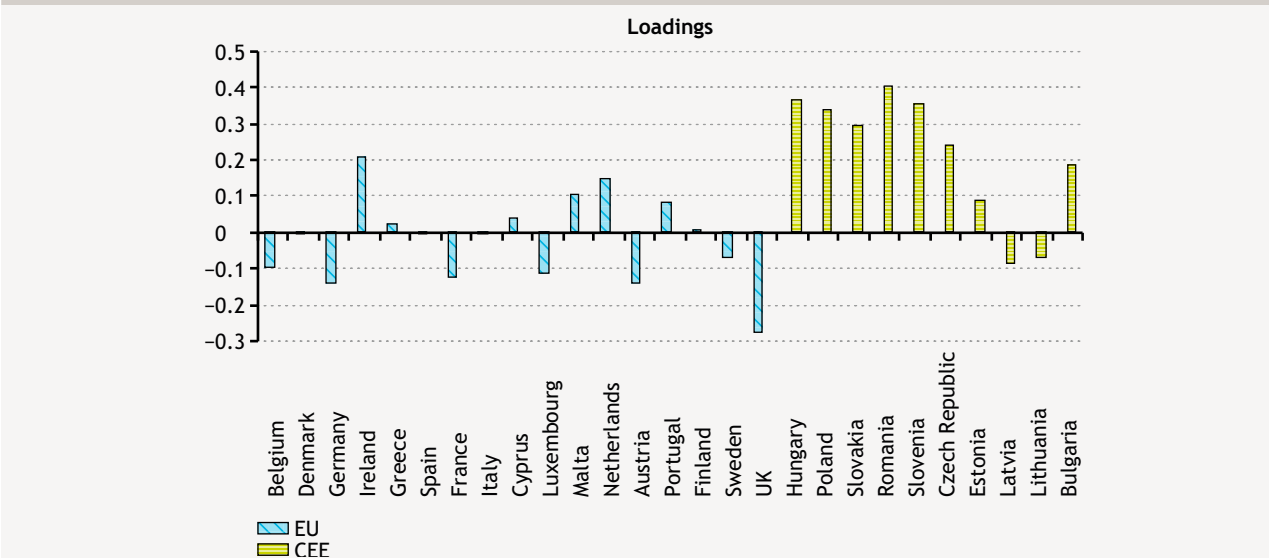
**Chart 5**  
The first common factor and its loadings



This finding is in line with empirical results that detect a strong common pattern in inflation dynamics within the euro area (Beck et al., 2006; Mody and Ohnsorge, 2007; Choueiri et al., 2008).

The loadings of the second factor (Chart 6) show that it captures some common pattern of the CEE countries that have flexible exchange rate (or had had flexible exchange rate for a long period). Thus we use only the first common principal component to identify the global factor ( $f_t$  in Equation 1) and we proceed by analyzing the regional co-movements with obtaining the regional factors. Another strategy would be to use the second common factor as the regional factor. Section 5.5 shows that it would lead to the same results.

**Chart 6**  
Loadings of the second common factor

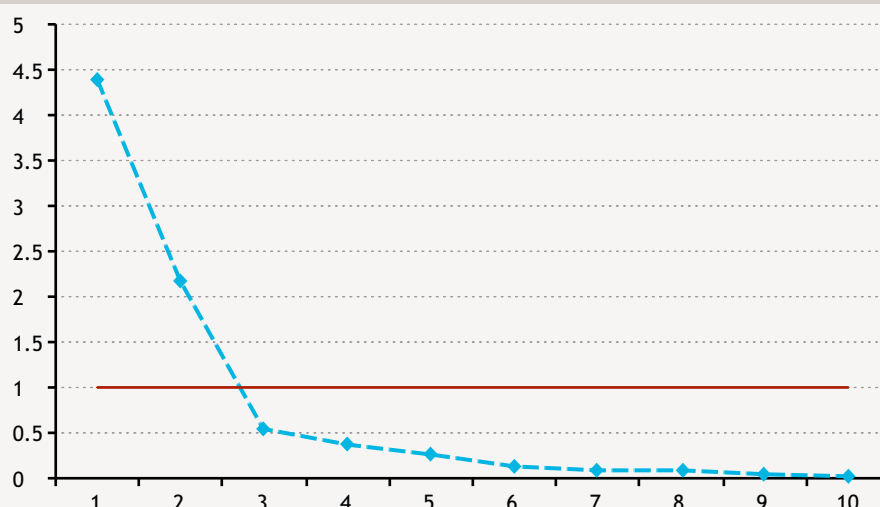


## 5.2 REGIONAL FACTORS

After extracting the effect of the common EU factor, we calculate the principal components of the ten remaining time series again. The scree plot of the principal components (Chart 7) shows that the first two components are significant, they explain 54% and 27% of the total variance respectively. The sum of the variance explained by these two components slightly exceeds 80%.



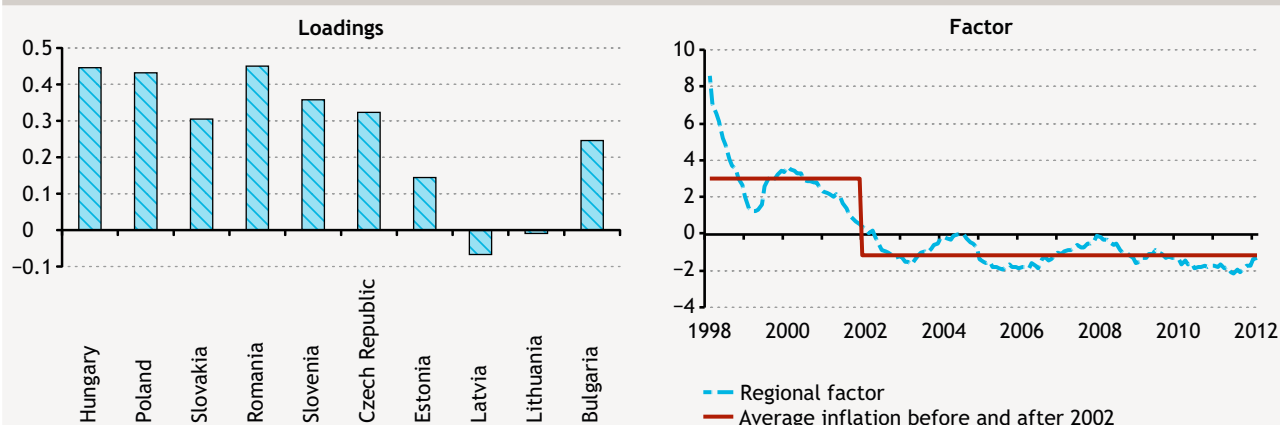
**Chart 7**  
Scree Plot (ordered eigenvalues) for the regional factors



The loadings of the common factor showed that CEE countries are not homogenous. The first regional factor confirms this (Chart 8) as it correlates less with fixed exchange rate countries (Estonia, Latvia, Lithuania and Bulgaria). This factor captures the disinflation process that took place in some of the CEE countries in the first half of the sample. It also shows that the disinflationary trend ended in the beginning of the 2000's. The regional factor clearly picks up in 2004 which can be a result of the EU accession, as several countries in the region changed their VAT rates.

When we consider the results, it is important to keep in mind that this analysis has absolutely nothing to say about the level of inflation. The fact that this factor did not decrease further does not mean that countries with a high loading reached price stability and do not need further reduction in inflation. This factor only indicates that strong disinflation was one of the common features of these CEE countries after the first period of transition from socialism to market economy.

**Chart 8**  
The first regional factor and its loadings

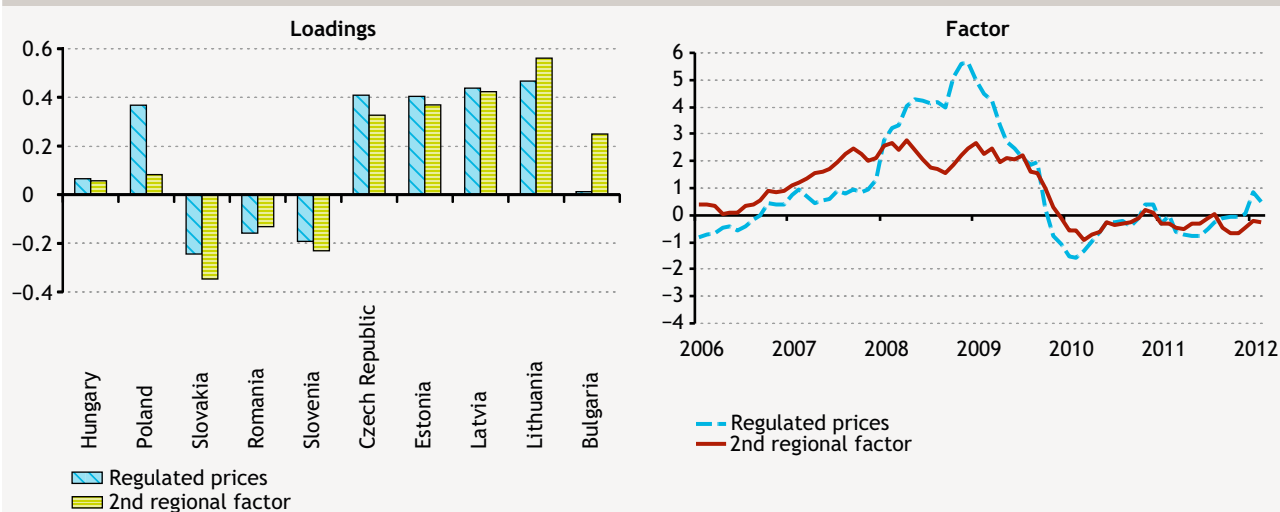


*Note: The red line is the average of the standardized inflation in the 6 CEE countries with higher loadings (Hungary, Poland, Slovakia, Romania, Slovenia and the Czech Republic) in two periods (February 1998–December 2001 and January 2002–February 2012). The resulting values are then divided by the average of the loadings in order to get the same scale as the factor itself.*

According to the scree plot (Chart 7), the second principal component is significant as well. This factor shows that countries with positive loadings experienced somewhat higher inflation in the period 2007–2009 than previously. In fact, this factor captures the effect of some regulated price developments in some of the countries. Chart 9 compares the loadings and

Chart 9

## Principal components of regulated prices and the second regional factor



the path of this factor with the first principal component of the annual changes of regulated prices in the CEE countries<sup>6</sup>. Both the loadings and the path of the principal components show that the second regional factor is strongly connected to the regulated price developments.

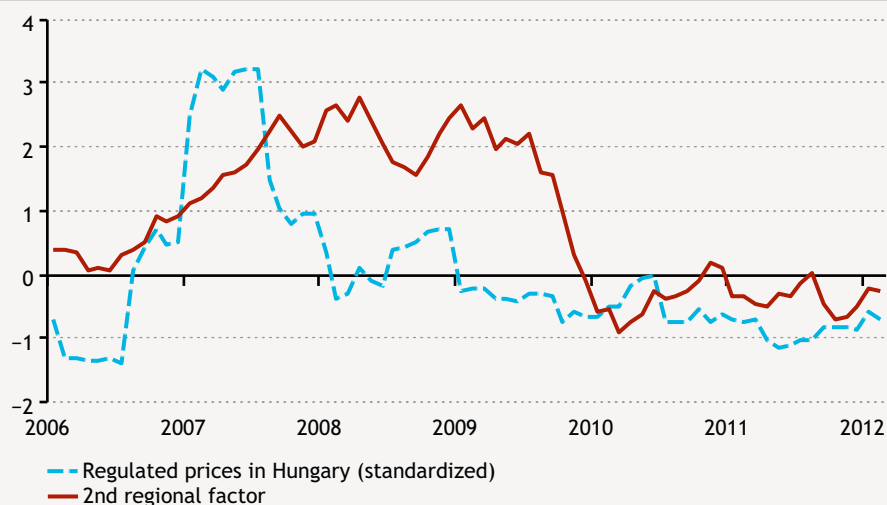
Should we use the second regional factor then? We can argue that in the socialist regime regulated prices were lower than market prices in CEE countries; therefore we should observe that they converge to market prices after the transition. Synchronized regulated price developments can also be linked to the EU accession process. However, these facts cannot explain why regulated price developments should be synchronized in the second half of the 2000's, and why we observe higher regulated inflation in this period.

The fact that we observe significant differences across the loadings within the region (note that Slovakia, Slovenia and Romania have negative loadings) also suggests that we should not use label this factor as a common regional factor.

Chart 10

## Regulated prices in Hungary and the second regional factor

(2006–2012)



<sup>6</sup> This principal component is obtained by using the HICP Administered Price indices from Eurostat. These data are available only from 2002.

It is also worth analyzing the path of Hungarian regulated prices and the second regional factor (Chart 10). We can observe huge regulated price increases during fiscal adjustment in 2007, but thereafter regulated price inflation was not higher than its historical average<sup>7</sup>. While inflation in other CEE countries was indeed high because of regulated price developments, it is clearly not the case in Hungary.

In summary there is no sound economic reason for synchronized regulated price movements in the region. In addition, using the second regional factor and labeling it as regulated price factor is misleading, especially in the case of Hungary. In 2008 Hungarian inflation was high in contrast to its historical average due to some reason(s) other than regulated price developments. In Section 5.4 we consider some possible explanations.

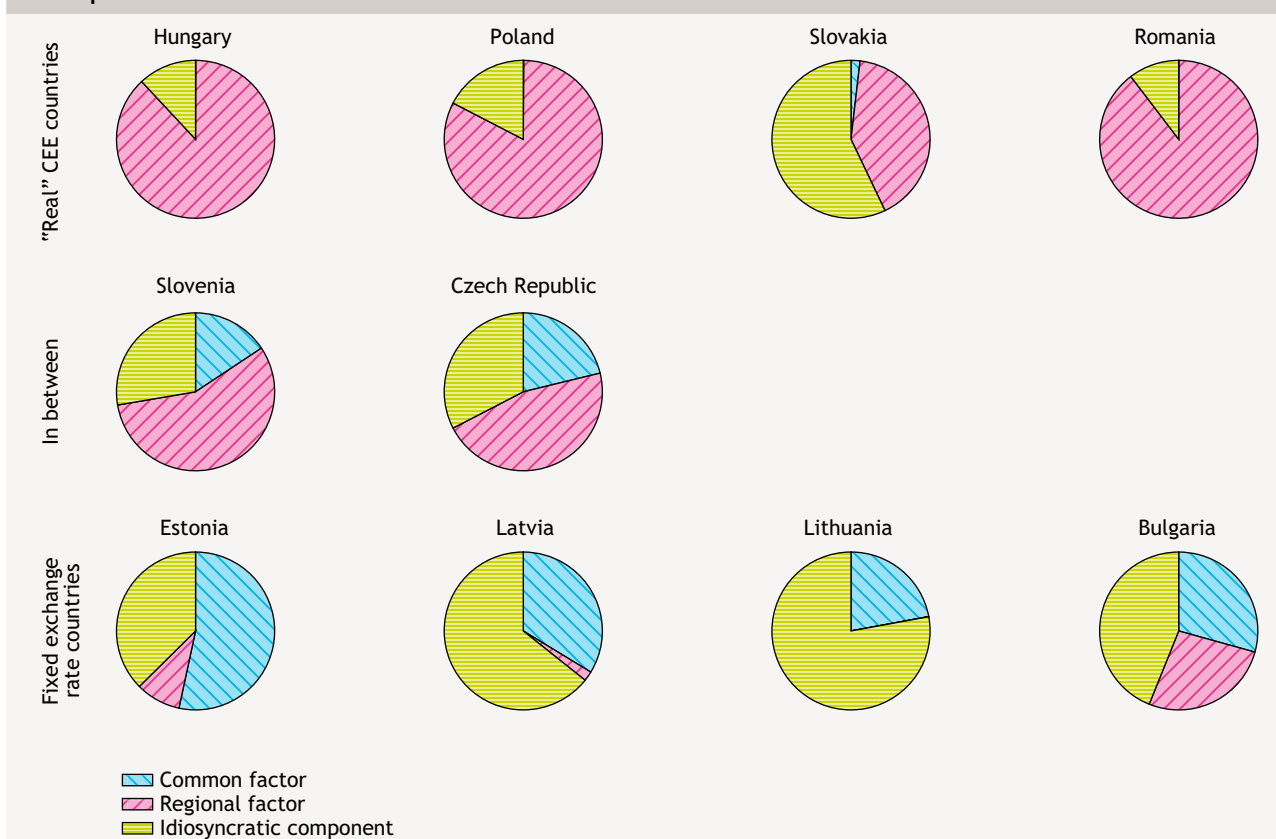
### 5.3 ASSESSING THE HETEROGENEITY OF CEE COUNTRIES

The analysis of common and regional factors shows that CEE countries differ from each other. In order to create more homogenous subgroups, the variance of every country's inflation is decomposed into parts explained by common, regional and country specific components. According to Chart 11 three subgroups emerge.

The first group consists of Hungary, Poland, Slovakia and Romania, we label them as "real" CEE countries. The regional factor has a dominant effect while the common EU factor is negligible.

On the other hand, fixed exchange rate countries (Estonia, Latvia, Lithuania and Bulgaria) have entirely the opposite pattern. Developments in euro area inflation are the most important external effect, while the contribution of the regional factor is limited.

**Chart 11**  
**Decomposition of variance**



<sup>7</sup> Notice that the time series of administered prices are standardized here, therefore the zero level is equal to the historical average.

Slovenia and the Czech Republic can be found between these two groups: while the common component has a significant contribution to the total variance, the regional factor is still the most important source of variation. According to price developments these countries are as close to the euro area as Sweden, which is a country that is also highly integrated into the EU, but maintains its own monetary policy<sup>8</sup>. However, as several other CEE countries, they experienced a significant disinflation in the first part of the sample which is captured by the regional factor.

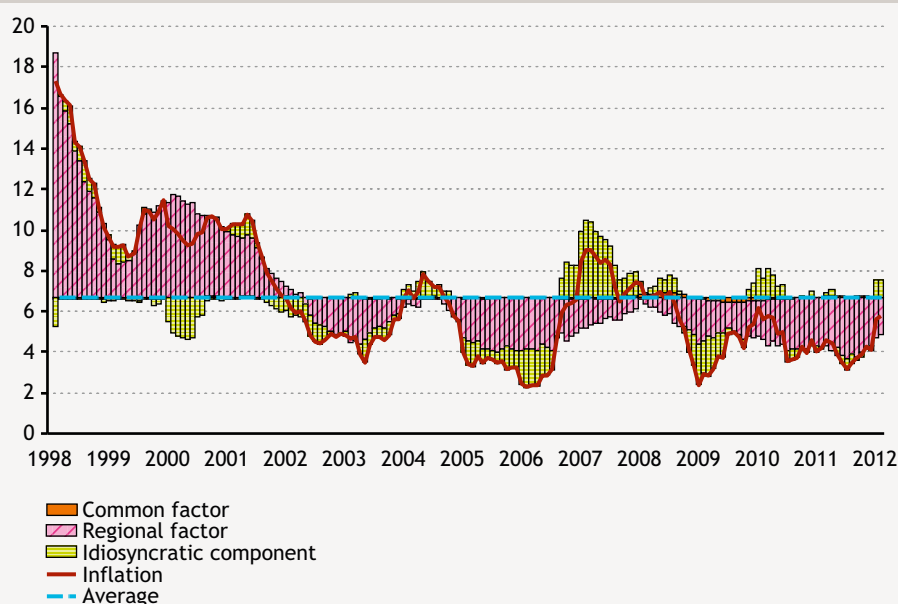
## 5.4 COUNTRY-SPECIFIC COMPONENT

After common and regional factors ( $f_t$  and  $g_{jt}$ ) are determined, the error term of a simple OLS regression gives us the country specific component ( $e_{ijt}$ ):

$$\pi_{ijt} = \hat{\lambda}_{ij} f_t + \hat{\mu}_{ij} g_{jt} + \hat{e}_{ijt} \quad (2)$$

The decomposition of the Hungarian inflation into common, regional and country specific components is shown in Chart 12. In line with the factors and the loadings attached to them, the decomposition shows that the effect of the euro area price developments is relatively minor, while Hungary, as other CEE countries, experienced a sharp disinflation in the first period of the sample.

**Chart 12**  
**Decomposition of Hungarian inflation**



The country specific component is expected to reflect idiosyncratic shocks affecting Hungarian price developments. Indeed, Hungary experienced a plenty of such events. In 2001 the crawling peg was abandoned and the exchange rate was allowed to fluctuate within a  $\pm 15\%$  band. Also in that year Hungary adopted an inflation targeting regime. After 2001 monetary policy became tighter and the exchange rate appreciated significantly. This is reflected in the country-specific component which is mainly negative until 2004.

In this period the country-specific component is positive only for a short period in 2001, when the minimum wage was increased by 57%. Although this was followed by another 25% increase of the minimum wage in 2002, it does not appear in the country-specific component. This observation is consistent with the results of Jakab and Kaponya (2010). They

<sup>8</sup> This is also true for Norway, if we extend the sample.

**Table 2**  
**Changes in VAT rates in Hungary**  
 (1998–2006)

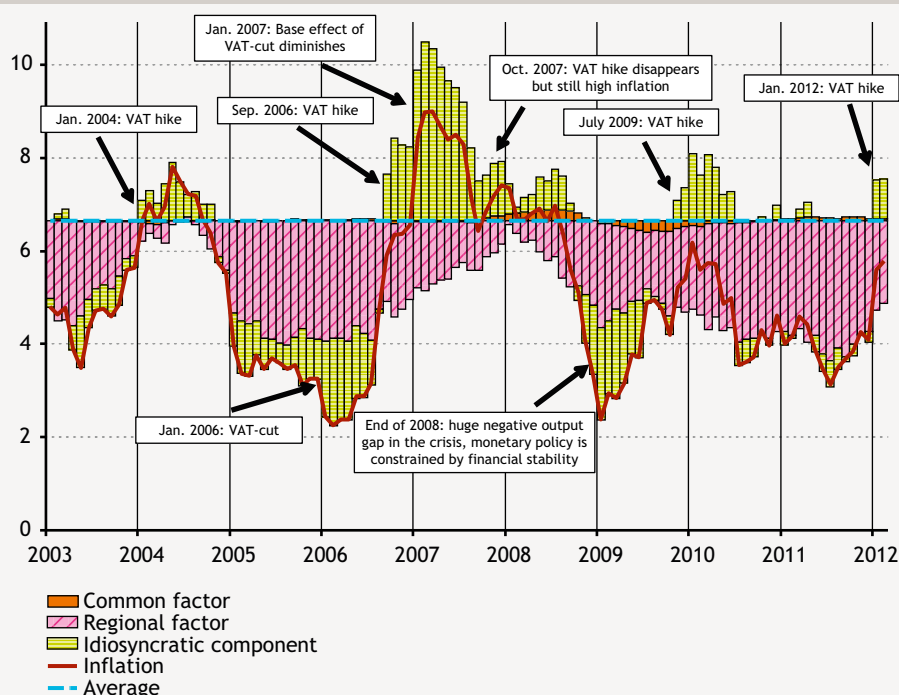
	Upper	Middle	Lower
–December 2003	25%	12%	0%
January 2004–December 2005	25%	15%	5%
January 2006–August 2006	20%	15%	5%
September 2006–June 2009	20%	20%	5%
July 2009–December 2011	25%	18%	5%
January 2012–	27%	18%	5%

estimated a SVAR model and found that labor supply shocks (that capture minimum wage hikes) raised core inflation in 2001, but they had no effect thereafter.

In the second half of the sample Hungarian inflation was hit by several shocks. Hungary experienced frequent VAT changes (see Table 2)<sup>9</sup>, a global commodity price shock in 2007 and then the severe recession caused by the financial crisis. It is worth to have a closer look at this period (Chart 13).

The first VAT change was a relatively small hike in January 2004 that is reflected in the positive country-specific component throughout 2004 (or approximately zero in the last two months) before and after negative episodes. Note that inflation is measured by the annual change of the HICP, therefore a one-off shock like a VAT hike persists for 12 month. In these years monetary policy was tighter than on average (reflected in the high ex post real interest rate), hence after the effect of VAT hike dissipated, the country-specific component turned negative again. As several CEE countries increased their VAT rate because of the EU accession, this effect is partly captured by the first regional factor.

**Chart 13**  
**Decomposition of Hungarian inflation**  
 (2003–2012)



<sup>9</sup> Gábel and Reiff (2010) discussed the effect of VAT changes on Hungarian price developments.

The government then decided to cut the VAT rate before the election in 2006. The effect is clearly seen in 2006 January. However, lower VAT rates were not maintained for a long period, as the government had to increase them after the election in order to adjust the budget balance. Thus a two-step increase emerges in the country-specific component (remember these figures are linked to the annual change of the price index): in September 2006 when higher VAT rates became effective and in January 2007 when the base effect of the previous VAT cut diminished.

These two subsequent VAT changes in 2006 were roughly the same in magnitude, but they had an opposite sign. Actually the rise in the country-specific component is much higher due to VAT hike than the decrease due to VAT cut<sup>10</sup>. This result is in line with Karádi and Reiff (2010), who found “symmetric changes in the value added tax (VAT) rates with highly asymmetric inflation effects”.

The decomposition clearly suggests that headline inflation was mainly driven by fiscal measures in these years. It also confirms that high headline inflation is explained by the VAT hike until the end of 2007. However, headline inflation remained at a high level after September 2007, despite the effect of the VAT hike dissipated.

The high inflation can be partly attributed to global factors, namely the sharp increase in commodity prices. Although the results suggest that the global commodity price shock played an important role in Hungarian price developments, it definitely does not account for the whole story.

How can we explain this? Why did the country-specific component remain high after the effect of VAT had dissipated? One possible explanation is accommodative monetary policy. Although the policy rate was raised by 200 basis points in the second half of 2006, inflation increased much quicker, which resulted in a negative ex post real interest rate.

Communication of the Monetary Policy Council also indicates that monetary policy did not want to counteract the effect of subsequent cost push shocks. After the interest rate decision on 27 August 2007, for example, the press release stated that “consistent with earlier practice, the Monetary Council does not wish to respond to – largely temporary – price fluctuations triggered by short-lived supply shocks”.<sup>11</sup>

Accommodative monetary policy accompanied by an inflation rate consistently above the target for a long period could have led to an expectation bias. By analyzing survey data Gábrriel (2010) found that expected inflation usually co-moves strongly with headline inflation. In line with this, expected inflation rose sharply in 2007 and remained stable at a high level for a while, even after headline inflation decreased considerably. In addition to that, Gábrriel (2010) claims that “in Hungary changes in the VAT rate are also important sources of the variability in expectations and may explain why monetary policy was relatively less successful in anchoring expectations.”

However, accommodative monetary policy is not the only explanation. The relationship between the euro area and Hungarian inflation can change over time. The impact of the former on the latter can be different when the shock affects mainly energy and food prices than in other periods. However, the coefficients do not vary over time, therefore the model cannot account for this change. If this is the case, then the contribution of global factors are underestimated in that period.

At the end of 2008 the financial crisis hit the global economy which caused a significant drop in the euro area inflation. The common factor decreased to historically low levels just after the global commodity price shock. However the significant drop in Hungarian headline inflation cannot be explained purely by the common factor; the country-specific component also played a role.

Hungary fell into a more severe recession than the euro area. The output gap became negative, which would have implied a significant monetary easing, but monetary policy was constrained by financial stability considerations. Briefly, the private sector had been accumulating a large stock of foreign currency (especially Swiss franc and euro) denominated debt.

<sup>10</sup> The effect of VAT changes is simply measured by the absolute value of the changes in the country specific component in the appropriate month, that is:  $|(change from August 2006 to September 2006) + (change from December 2006 to January 2007)| > |change from December 2005 to January 2006|$ .

<sup>11</sup> [http://english.mnb.hu/Monetaris\\_politika/decision-making/mnben\\_monet\\_kozlem/press\\_releases\\_2007/mnben\\_mtkozl\\_20070827\\_nochange](http://english.mnb.hu/Monetaris_politika/decision-making/mnben_monet_kozlem/press_releases_2007/mnben_mtkozl_20070827_nochange)

Moreover the banking system financed these credits with short-term sources. A sudden and large depreciation would have endangered the banking system both from a liquidity and solvency perspective.

This dilemma became apparent for the public in October 2008 when the Central Bank of Hungary increased the policy rate by 300 basis points in a non-scheduled meeting to prevent the exchange rate from further depreciation. In the subsequent period, MPC always emphasized that inflation and growth outlook would have called for a considerable monetary easing while financial stability considerations implied a more cautious policy. Tighter monetary policy stance then led to a rising real interest rate. The negative country-specific component may reflect the negative output gap and constrained monetary policy.

The country-specific component picked up in July 2009, because the government increased the VAT in order to reduce public deficit. This held the country-specific component in the positive range for the subsequent 12 months<sup>12</sup>. Finally, the VAT was raised again in the first month of 2012.

## 5.5 ROBUSTNESS OF THE RESULTS

In this section we show that the result do not change if we use another measure of inflation, perform the analysis on data before and after the financial crisis and if we use the second common principal component as the CEE factor.

In this analysis inflation was measured by the annual rate of change of the consumer price index, because this index naturally contains a seasonal adjustment and is usually used to talk about inflation (for example, the central banks' inflation target is defined in this index). To check whether the results are robust to this choice, we repeated the analysis with seasonally adjusted monthly changes<sup>13</sup>. The main results are not sensitive to this choice, Chart 15 and 16 in the Appendix show that both the common and the regional factor have the same interpretation and similar loadings.

The financial crisis might have introduced a structural break into the inflation series. If this is the case, the degree of co-movement is overestimated. When we estimate the model using a sample before the crisis (February 1998–August 2008), the main results do not change (see Chart 17–18 in the Appendix). However, the interpretation of the loadings of the CEE countries is not as clear as before.

The strong correlation between the first common factor and euro area inflation still remains if the model is estimated on the sample after the crisis (September 2008–February 2012, see Chart 19 in the Appendix). Based in the post-crisis period, Slovakia has a large positive loading with the common factor which indicates that after adopting the euro in 2009, Slovakian inflation dynamics became synchronized with the euro area.

In the analysis the CEE factor was estimated by the first regional component. We can also use the second common component, as the loadings suggest that it endogenously picks up some common patterns of the CEE countries. Chart 20 in the Appendix shows that the results are robust to this choice, the CEE factors we obtain in two different ways are almost identical.

<sup>12</sup> Except in October 2009 when idiosyncratic effects on the pricing of new cars and flight tickets caused a significant, but temporary, drop in the price index.

<sup>13</sup> First we seasonally adjusted the level of the HICP by X12 and then computed the monthly rate of change.

## 6 Conclusion

In this paper we examined the external and country-specific components of Hungarian inflation dynamics. These components and their contributions to domestic inflation variation were estimated by analyzing the co-movement among inflation time series of EU-27 countries.

Our contribution to the literature is to analyze common and regional-specific effects in a joint framework. This also allows us to divide CEE countries into subgroups.

In the first group (Hungary, Poland, Slovakia and Romania), the regional factor is the dominant effect while the common EU factor is negligible. On the contrary, in countries that maintain fixed exchange rate regimes (Estonia, Latvia, Lithuania and Bulgaria) we find exactly the opposite pattern: euro area inflation variation is the most important external effect, while the contribution of the regional factor is almost zero. Slovenia and the Czech Republic belong to the third subgroup, where both common and regional factor have significant contribution. According to price developments, these countries are as close to the euro area as Sweden, a country that is also highly integrated into the EU, but maintains its own monetary policy.

In the sample, idiosyncratic shocks were an important source of variation in the Hungarian inflation. These shocks are captured by the country-specific component. We analyzed the effect of minimum wage hikes and VAT changes. Our results also give some indications about monetary policy stance. The path of the country-specific component suggests that accommodative monetary policy may have contributed to the persistently high inflation in 2008. On the other hand, the central bank could not loosen policy enough during the financial crisis because of financial stability considerations, which may have led to smaller inflation in that period.

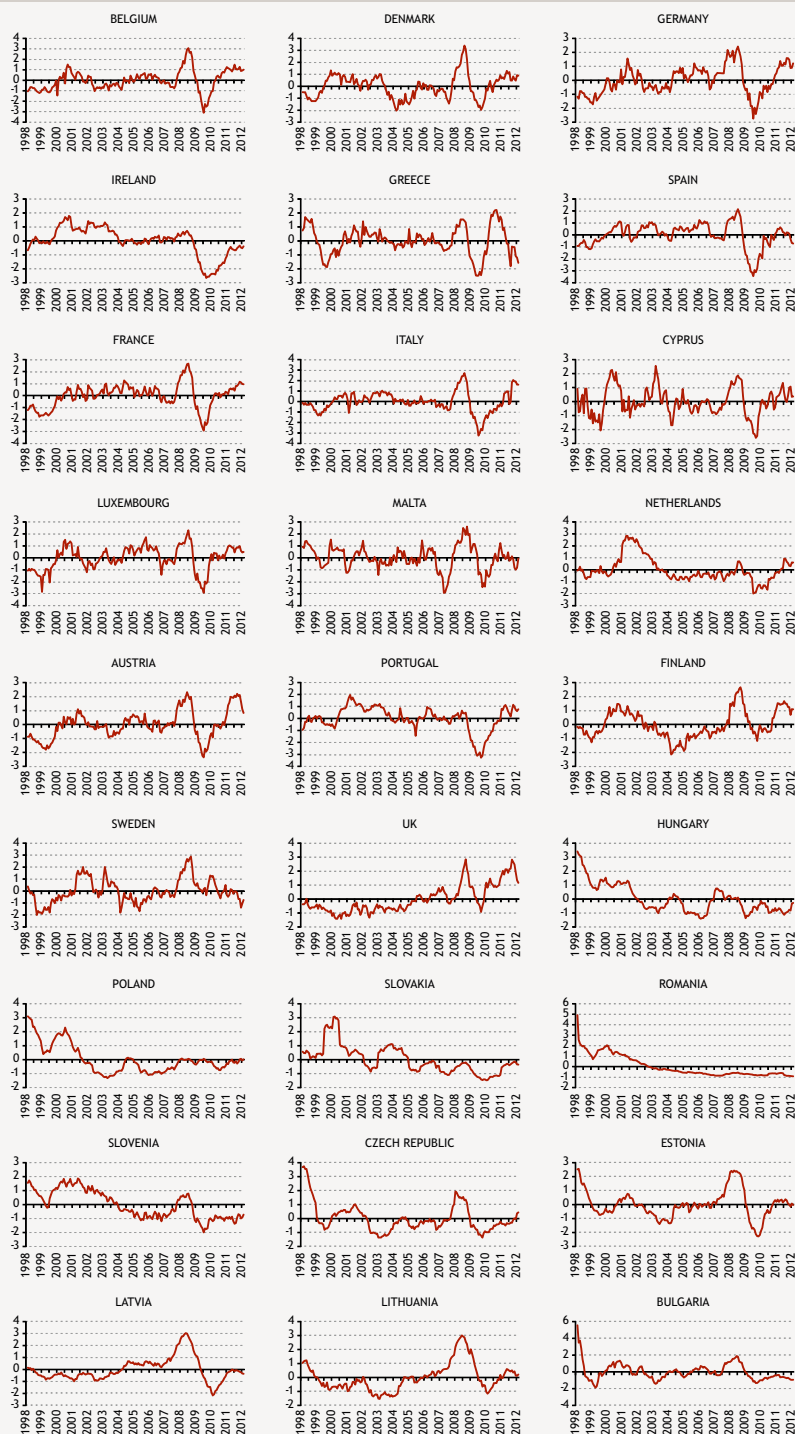


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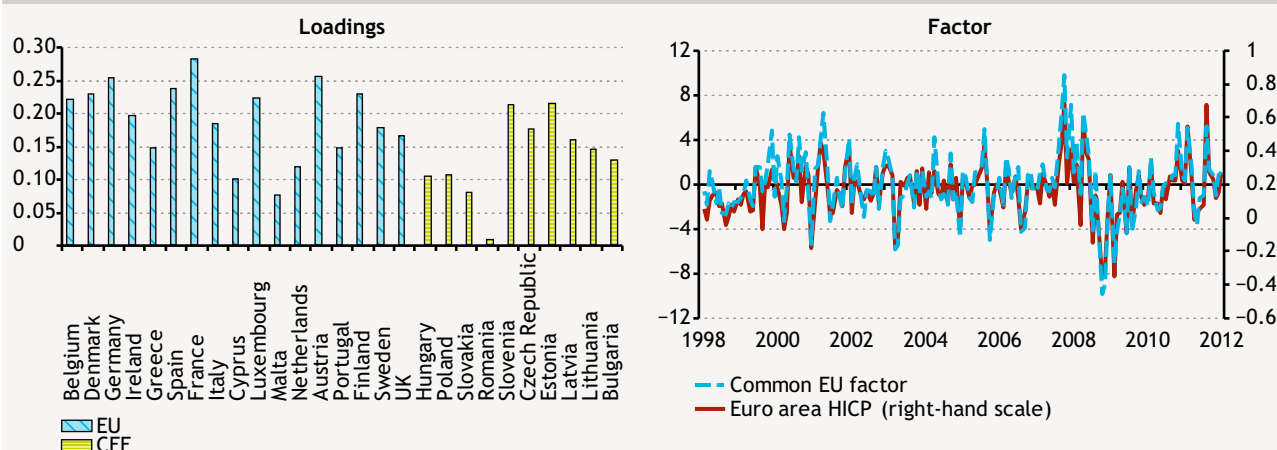
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# 8 Appendix

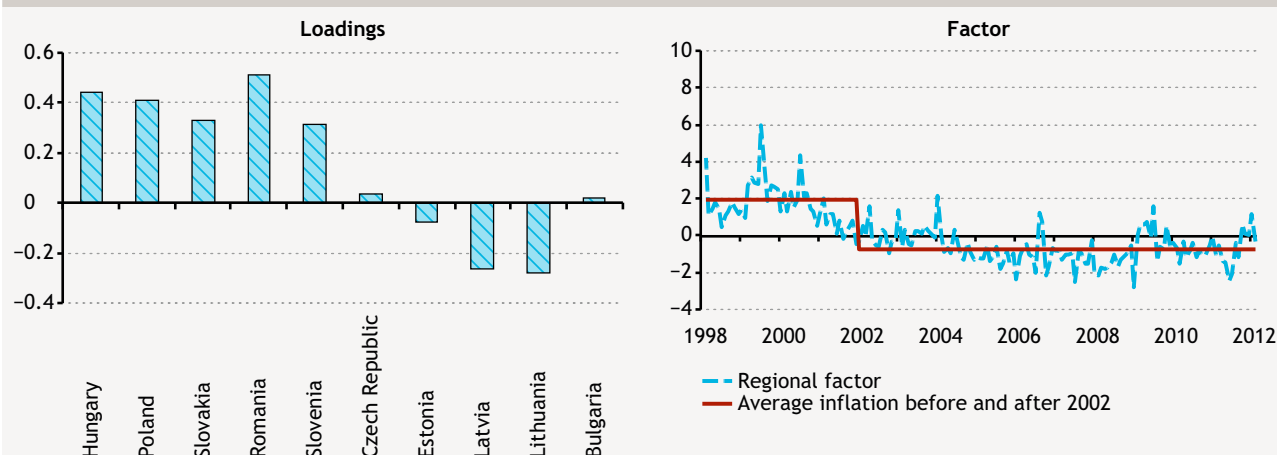
**Chart 14**  
**Inflation of EU 27 member states**



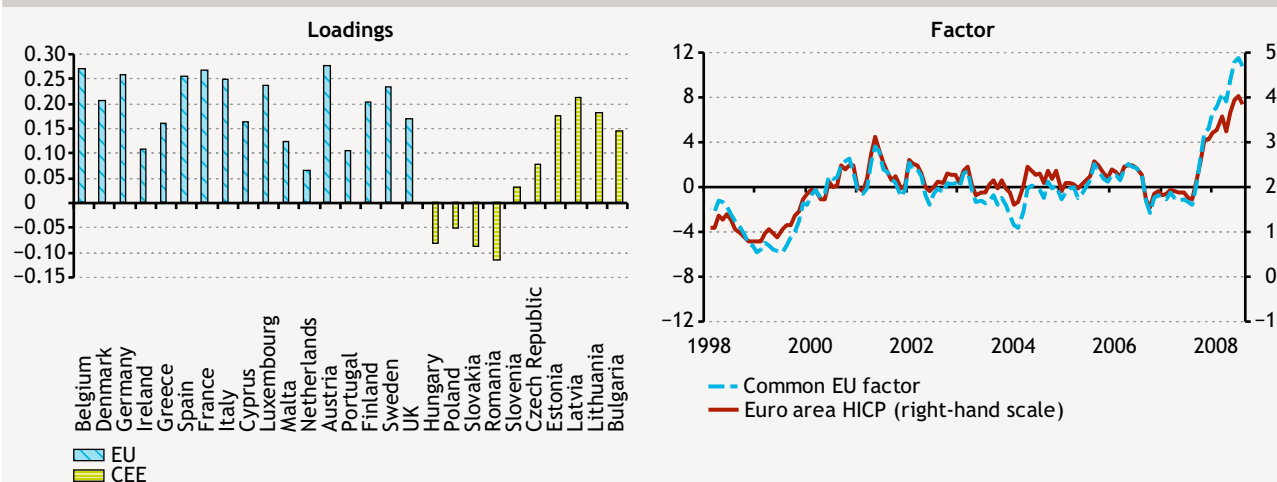
**Chart 15**  
Common factor with monthly changes



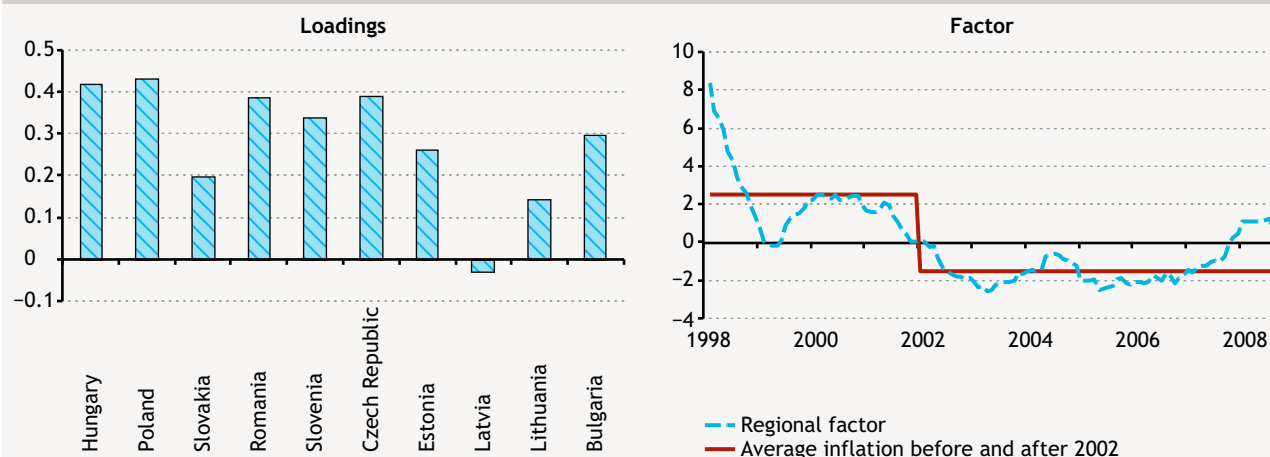
**Chart 16**  
Regional factor with monthly changes



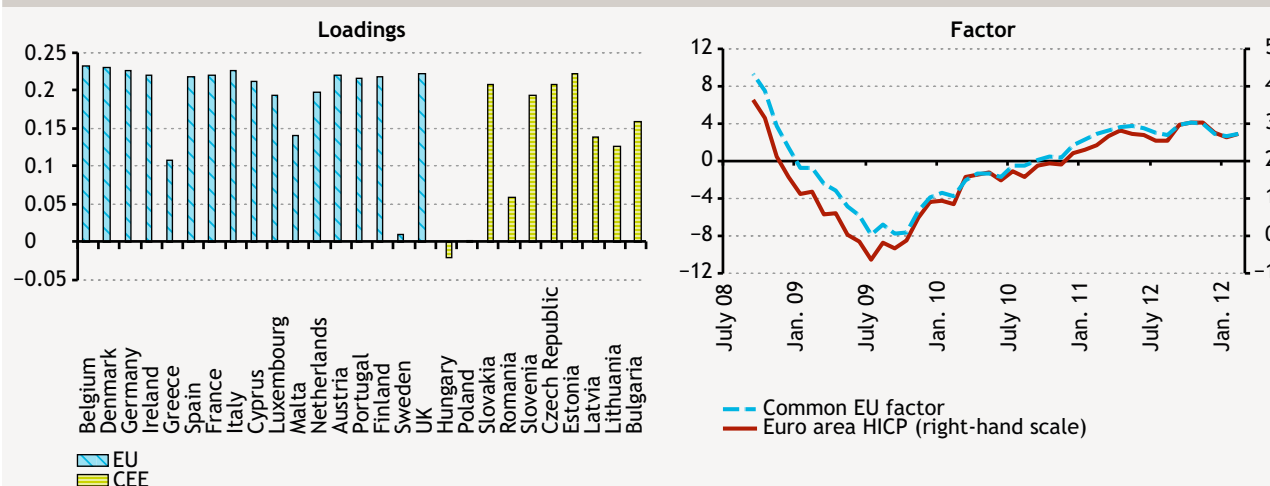
**Chart 17**  
Common factor before the crisis



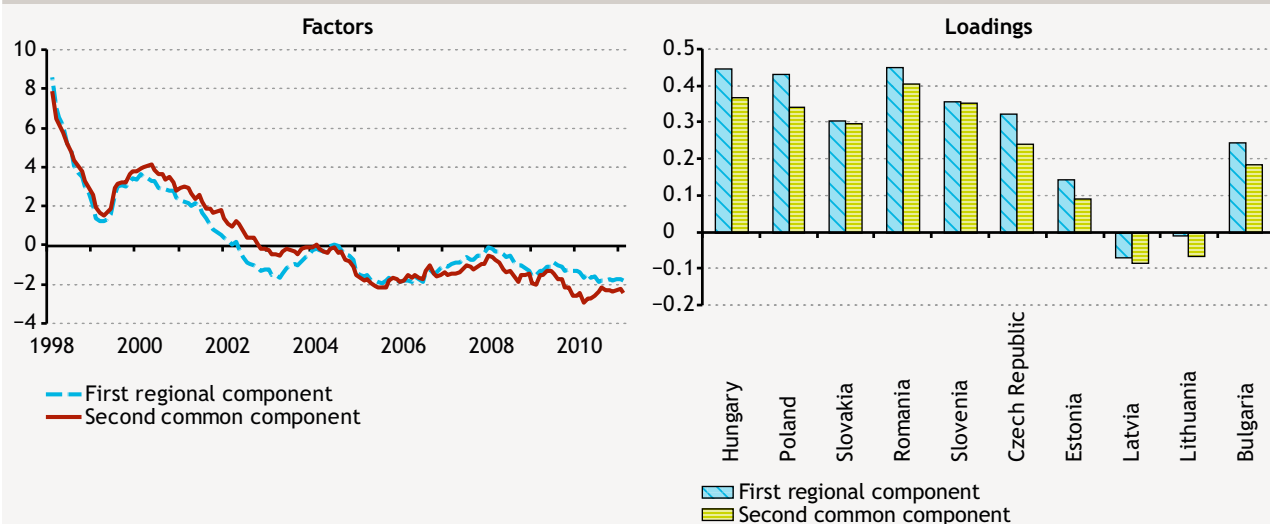
**Chart 18**  
Regional factor before the crisis



**Chart 19**  
Common factor after the crisis



**Chart 20**  
CEE factor and the corresponding loadings, estimated by the first regional and the second common component



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