Regional inflation rate differentials: potential causes, and evidences from the euro area and Hungary

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Abstract: The focus of our research is on the spatial heterogeneities in the observed inflation rates within a currency union. We examine what are the characteristics of the regional monetary heterogeneities across the euro zone countries and across the Hungarian regions. Our study provides a detailed description of the potential factors that cause divergent inflation rates within a currency union. Then, we present the empirical results from the literature concerning the underlying reasons for the observed inflation differentials between the euro zone countries. In Hungary, significant regional inflation heterogeneities were reported in empirical works, therefore we try to assess the possible reasons behind these differentials and compare our results to those observed in the euro area. The basis of our analysis is a disaggregated data set which contains store-level price quotes at a monthly frequency. This data set is complemented by other relevant macroeconomic variables measured at the county-level.

Key words: inflation differentials, regional heterogeneity, currency unions, empirical analysis, Hungary
JEL classification: E31, E32

1. Introduction

After the introduction of the euro, the heterogeneity of inflation rates across the EMU countries was extensively investigated in the literature. Several potential factors were identified that cause divergent inflation rates within a currency union. In this study we provide a detailed description of these potential factors. In a monetary union, individual countries or regions are not able to adjust their monetary policy or exchange rate in response to asymmetric shocks. Therefore, inflation differentials are a natural part of an adjustment process, or they may reflect cross-country differences in real variables, and need not be counteracted by economic policy. However, there are harmful, lasting inflation differentials which may be of concern for domestic economic policy. These may originate from e.g. imperfections in product, labour and capital markets, nominal rigidities and inappropriate domestic policies, and cause sustained competitiveness losses. The paper presents the empirical results from the literature concerning the underlying reasons for the observed inflation differentials between the euro zone countries.

In Hungary, significant regional inflation heterogeneities were reported in empirical works, therefore we try to assess the possible reasons behind these differentials and compare our results to those observed in the euro area. Our approach is based on the preconception that a single country can be regarded, with certain limitations, a currency area, and similar empirical techniques can be applied in the analysis of regional monetary heterogeneities as in the case of the euro area. In the next section we briefly outline the literature about inflation differentials. The data base is introduced and the regional inflationary processes in Hungary are described in section 3. Then, we look through the potential causes and empirically analyse their relevance for the Hungarian economy. In the last section, some concluding remarks are given.

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2. Regional disparities of inflation rates

The potential causes of the divergent inflation rates were analysed by a wide range of empirical studies in the literature. In this context, there are two alternative explanations. One is that the observed differentials are caused by asymmetric, idiosyncratic shocks and the other is that the euro area members share common shocks and the asymmetries are caused by the different transmission mechanisms (see e.g. Stavrev, 2007). There seems to be a consensus that cyclical factors, e.g. output gaps, unemployment and wage differentials play a major role, whereas – contradicting Honohan and Lane (2003) – external factors are not that important. Also, the well-known Balassa-Samuelson effect, investigated by a plenty of studies, is found not significant within the recent European single currency area.

Concerning spatial differences, the above mentioned studies focused on cross-country comparisons, especially on comparative analyses of the euro zone countries or the US and the euro area. Our opinion is that investigating spatial differences in monetary (inflationary) processes is a relevant issue within a single country, as well. Nominal and real heterogeneities may occur not only across countries but also across regions within a country. Such questions were discussed e.g. in the USA (Cecchetti et al. 2002, Schunk 2005, Broda and Weinstein 2008, Campbell and Eden 2010), in the United Kingdom (Hayes 2005), in Italy (Fabiani et al. 2004 and Veronese et al. 2005) and in Spain (Alberola and Marqués 2001), so far.

In the light of the potential factors of inflation differentials, one may ask that to what extent lasting inflation differentials cause problems for economic policy. Inside a monetary union, heterogeneity in the nominal variables is a natural phenomenon, since they are part of an adjustment process. In case of a common monetary policy, regional price and wage flexibility and factor mobility are highly important in correcting asymmetric shocks, since national monetary policy instruments and exchange rates can no longer be used. These kinds of inflation differentials are considered not just unavoidable but desirable. Apart from these adjustment processes, in the long run, inflation differentials may be a reflection of cross-country differences in real variables (e.g. catching-up processes). However, inflation differentials may reflect inappropriate domestic policies or other domestic developments, for example wage increases not kept in line with productivity and employment growth, excessive increases in house prices, unsustainable expansion of profit margins, financial asset price bubbles or an inappropriate fiscal policy setting, market rigidities etc.

3. Data base

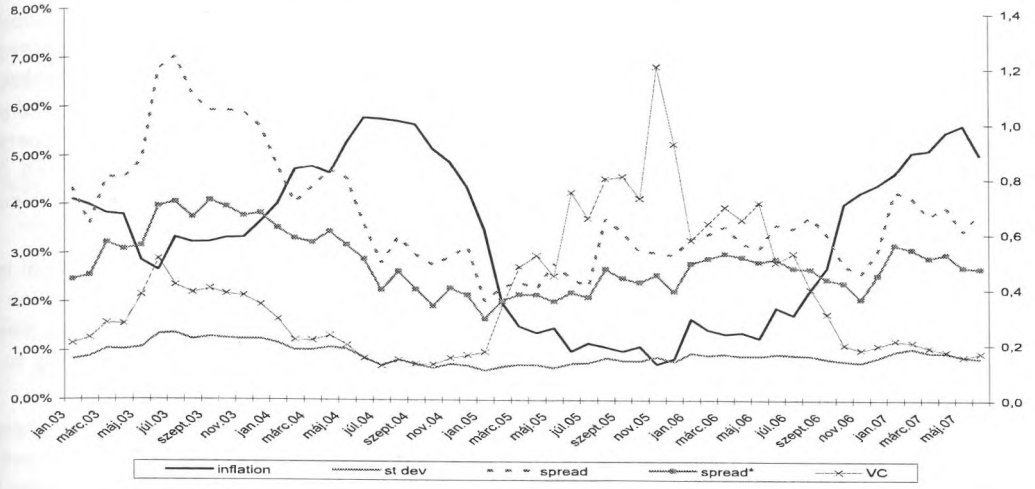
We use a data set collected by the Central Statistical Office of Hungary (CSO), containing micro Consumer Price Index (CPI) data from December 2001 to June 2007 (altogether 67 consecutive months) where the observations were made at store-level. The total number of observations is approximately 4.7 million. Monthly inflation rates were computed as the weighted averages of the item-specific monthly changes in the average price, based on the log differences of average prices. Regional disaggregation was made at the NUTS 3 level including 19 counties and the capital city, Budapest. Note that the data structure does not allow us to compute regional consumer price indices since the weights of the items in the consumption basket are assumed uniform across the counties.

In order to analyse the potential causes of the regional heterogeneities of the inflation rates, we use additional important macroeconomic data. These are measured at the county level on a quarterly frequency and published by the CSO.

The average annual inflation rate was 3.3 percent with 1.6 percentage points standard deviation which means that the volatility was quite high. The lowest observed country-level yearly inflation rate was 0.74 percent (in November, 2005) and the highest was 5.8 percent (in June, 2004). This implies that significant changes occurred at around the beginning of the year 2005. While there is a clear co-movement between the different counties, spatial inequalities are present during the whole sample period. The most regularly used indicators of spatial dispersion, depicted in Graph 1,

show that inflation differentials were more pronounced in the first part of the sample period, after it their magnitude decreased, and increased again from 2005.

Graph 1 – Annual inflation rates and the indicators of spatial dispersion



Note: "Inflation": annual average inflation rates (left-hand scale); "st dev": cross-sectional standard deviation (left-hand scale); "spread": difference between the lowest and the highest inflation rates (left-hand scale); "spread*": difference between the average of the three highest and lowest rates (left-hand scale); "VC": variation coefficient, the standard deviation divided by the average inflation rate (right-hand scale).

Source: Own calculations based on CSO data.

The data show that the presence of inflation differentials is sustained over the medium-run. However, the individual counties' position in the inflation ranking is not stable. The average rate of inflation is not a relevant measure for 5 out of the 20 counties, since inflation rates differ significantly between the first half and the second half of the sample period.

4. *The potential causes of regional inflation differentials – theoretical considerations and empirical results*

Several potential factors are mentioned in the literature which may cause inflation rates to diverge across regions or countries. An in-depth analysis of these factors can be found in e.g. ECB (2003), hence, for the sake of comparability, we chose to follow the same categorisation and structure. However, other previously mentioned analyses in the literature would be also highly comparable. In what follows, we describe the potential factors, then present the empirical findings about their importance in explaining inflation differentials across the EMU countries. Finally, we try to repeat the empirical analyses on our Hungarian county-level data base within the limits of data availability.

Composition effect

One factor that may play a role in inflation differentials is the composition effect, that is, the households' consumption structure differs across the regions, therefore, the particular groups of goods and services have changing weights in the regional CPI baskets. As a consequence, even when the magnitude and direction of price changes are identical across the regions, different weights in the CPI basket will result in different regional inflation rates. Previous estimations conducted for the

EMU suggest that the composition effect is not significant since the inflation dispersion proved to be very similar with the official and the simulated series. Unfortunately, this estimation cannot be made in the case of the Hungarian inflation data, since the composition effect is eliminated from our data base due to the data collection technique.

The role of administered or regulated prices and indirect taxes

In a currency union of different countries, changes in regulated and administered prices may have important effect on inflation dispersion, because prices of certain items in the CPI basket are affected by government policies. A useful method to estimate the importance of administered price changes on the inflation dispersion is to compare the time series of the overall inflation dispersion, the administered prices inflation dispersion and the overall basket excluding administered price inflation dispersion. On the basis of these measures, ECB (2003) concluded that the estimated impact of administered prices on inflation dispersion in the euro area has been relatively small.

The analysis of this factor of inflation differentials is not relevant at the sub-national level, since determining the administered and regulated prices is within the government's discretion and they are set uniformly around the whole country. We assume that the regulated prices play an important role in the overall inflation, however, they do not likely contribute significantly to the spatial dispersion of inflation rates in Hungary.

The case of the indirect tax (VAT) changes is very similar to the administered price changes. According to the euro area experiences, the countries with the highest price levels tend to have the highest standard VAT rates. However, there are recent efforts to harmonise and simplify VAT regulations in the European Union which will likely reduce the effect of tax changes on euro area inflation differentials (see Égert et al. 2004).

In Hungary, VAT rates are rather high and there were three important changes during our sample period, two increases (January 2004, September 2006) and a reduction (January 2006). The effects of these changes on overall inflation were analysed by Gábriel and Reiff (2006) in detail. Their results show that the transmission of the VAT changes is not complete and occurs with a time lag, moreover, it is highly asymmetric across the different shops.

On the basis of the patterns of indirect tax changes in Hungary, we assume that they play an important role in the overall inflation, however, they do not contribute much to the spatial dispersion of inflation rates in Hungary (see Graph 1). It would be difficult to detect the direct impact on the spatial patterns, but they seem to be in effect more strongly in the case of the VAT reduction, which is in compliance with the findings of Gábriel and Reiff (2006). Because of the differences in the level of market competition, VAT increases appear in the prices more uniformly across the regions than VAT reductions.

Structural reasons

External factors: oil price shocks

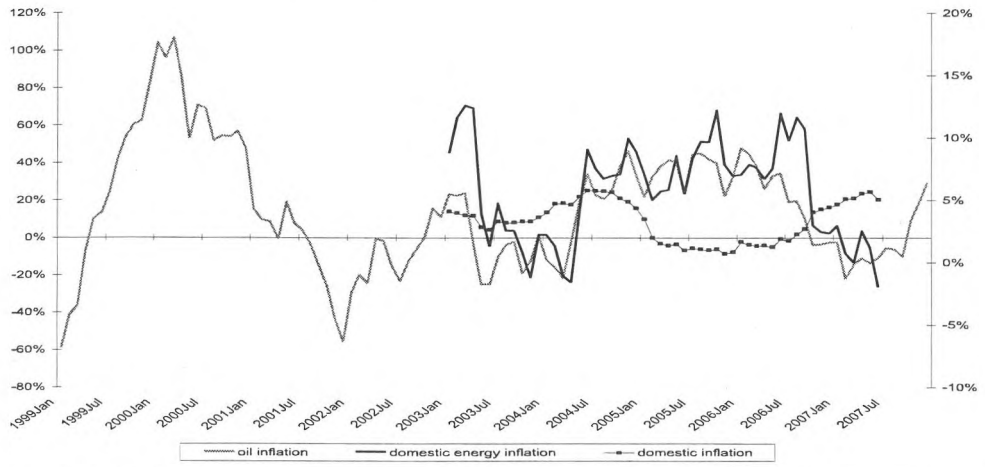
A part of inflation differentials is caused by structural effects which imply that due to the different economic structure of the regions, certain common shocks are absorbed differently across regions and cause prices and inflation to diverge. ECB (2003) discusses three major causes within this group of potential factors: external factors, price convergence and market rigidities. Now, we will start with the external factors which may appear in two forms: the first is the oil price shocks and the other is the exchange rate shocks.

In general, oil price pass-through can contribute to inflation differentials through two main channels. On one hand, regions differ in terms of their oil dependency which is the ratio of net oil imports to GDP. On the other hand, the oil intensity of production, which is the industry oil consumption divided by industrial production, can also be different across the regions. Of course,

those regions (counties) are more affected by oil price changes that are characterised by higher oil intensity and oil dependency, and inflation differentials will reflect this fact. As revealed in the literature, the economies of more developed regions tend to have lower oil dependency and oil intensity, thus, oil price pass-through is lower in these regions.

Motor fuels and oils (petrol) represent 4.75 percent in the consumer basket in our sample. However, it should be kept in mind that in Hungary taxes account for a large part, between 60 and 70 percent, of the fuel prices and they play a buffer role in the oil price pass-through (see Égert et al. 2004).

Graph 2 – Annual inflation rates of brent crude oil prices and Hungarian energy prices and overall inflation rates



Note: Oil price inflation is measured on the left-hand scale, domestic energy price inflation and overall domestic inflation are measured on the right-hand scale.

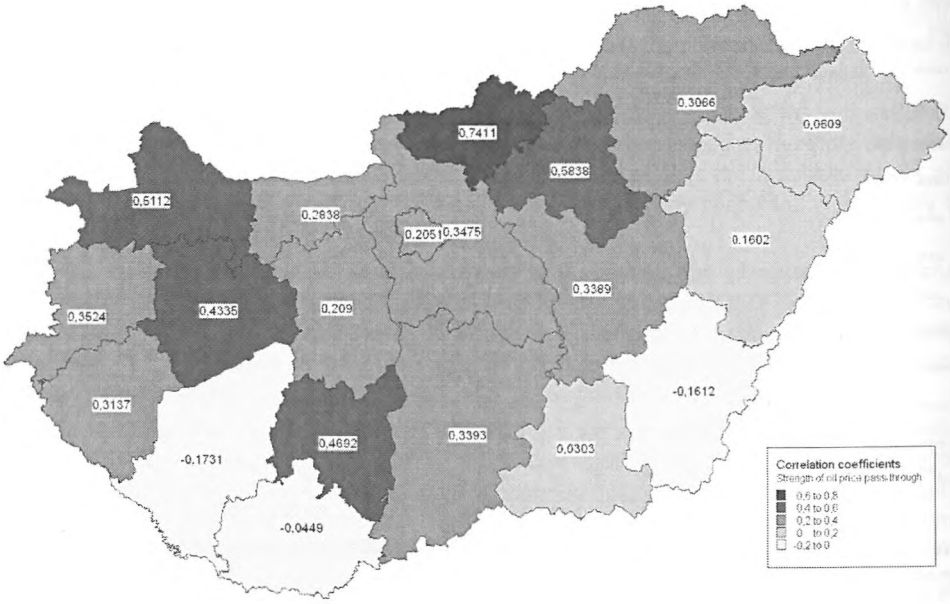
Source: Own calculations based on ECB and CSO data.

The reaction of the domestic prices to oil price changes is delayed and the lag length is different throughout the different parts of the economy. Following Égert et al. (2004), we evaluate the average delay of the effect of oil price developments on energy prices by determining the lag length at which the correlation coefficients between the oil price and the energy price inflation series is the highest. In the case of Hungary, the estimated lag length is 1 month which can also be supported by Graph 2 above. The mentioned correlation coefficient is 0.741 between oil price inflation and domestic energy price inflation, and the highest correlation, 0.803 was measured with the 1 month lag. Oil price pass-through is very similar but not uniform across the Hungarian counties: correlation coefficients varied between 0.682 and 0.850.

A well-known feature of oil price pass-through is that energy price changes sooner or later appear in the prices of almost every item, hence, in the CPI inflation, as well. As mentioned before, in the case of certain goods, this may take even two years. On the basis of our sample, the estimated lag length is 21 months, and the correlation coefficient is 0.275. Graph 3 presents the correlation coefficients between the oil price inflation and the overall CPI inflation computed from our data. The coefficients may give some indication on the oil dependency and oil intensity of the production of the Hungarian counties, and suggest that there are large spatial inequalities in terms of these indicators. The observed patterns do not support the notion that in the more developed counties (Central Hungary and the north-western part of the country) the oil price pass-through tends to be weaker.

In contrast to the facts that the consumption share of fuels is relatively high and that the spatial patterns of the oil price pass-through show significant heterogeneities, we suppose that the disparities in energy prices does not contribute much to the spatial inflation differentials. The reason for this is that relative to other product categories, the spatial dispersion of energy inflation rates is quite low.

Graph 3 – Correlation coefficients between brent oil price inflation and the 21 month lag of domestic CPI inflation



Source: Own calculations based on ECB and CSO data.

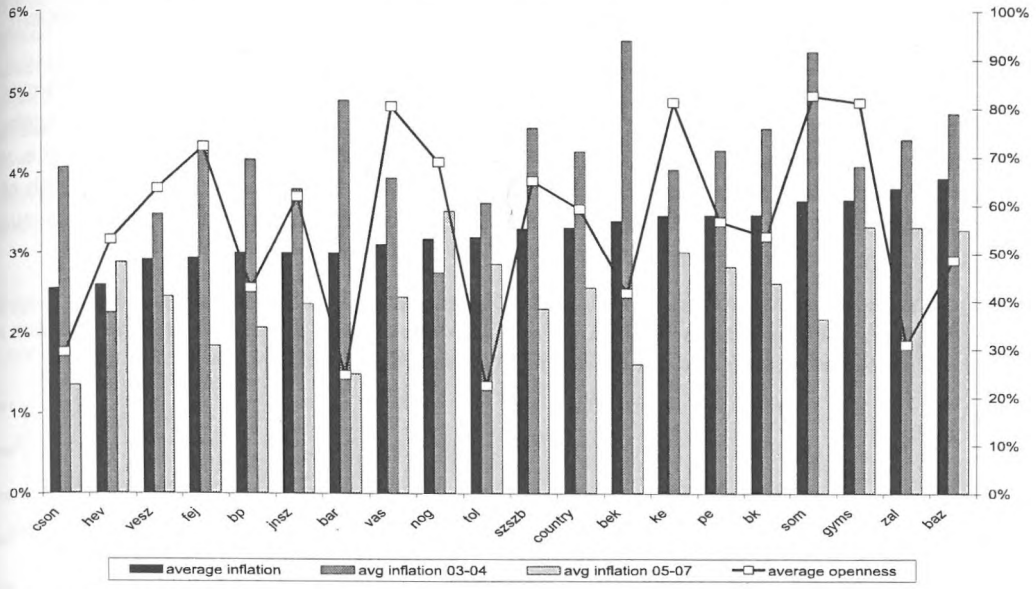
External factors: exchange rate shocks

Within the group of external factors, nominal exchange rate changes significantly affect inflation rates. The magnitude of the exchange rate pass-through basically depends on the openness of the economies. When regions differ in terms of their exposure to exchange rate fluctuations, an exchange rate shock will trigger inflation differentials. According to ECB (2003), three kinds of structural indicators affect the strength of the exchange rate pass-through: the degree of openness, the geographical trade structure, and the commodity composition of imports. Unfortunately, due to the lack of relevant county-level data, we can examine only the effect of different openness of the counties in Hungary. The only available proxy variable to estimate the counties' economic openness is the share of exports in industrial sales.

Graph 4 implies that the direct relationship between the counties' openness and inflation performance is quite weak. This is supported by the correlation coefficient between these two variables which is practically zero (0.00086).

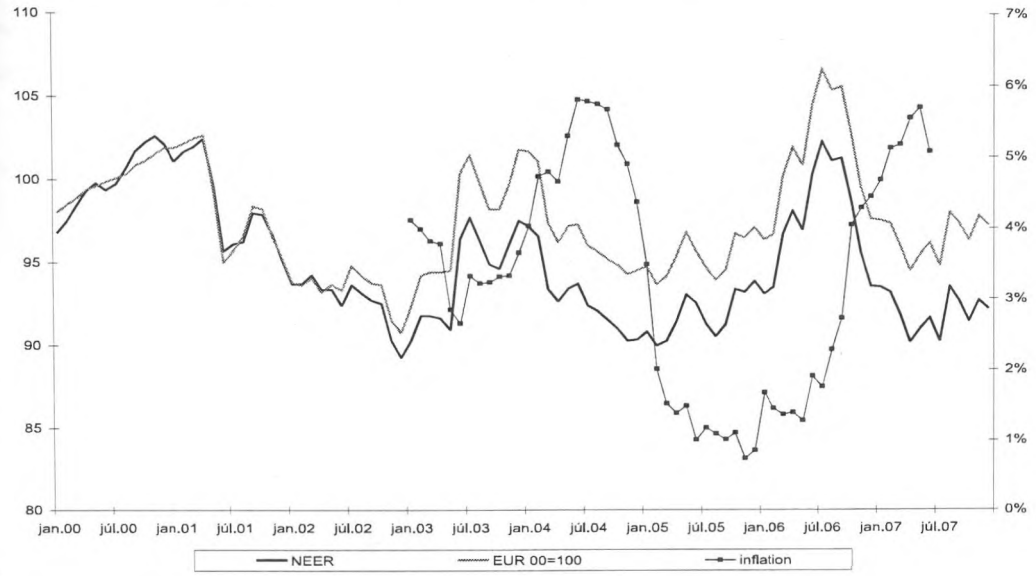
We also investigated the time series of the nominal effective exchange rate and the index of the euro exchange rate against the Hungarian forint (HUF). These are depicted on Graph 5 below.

Graph 4 – Average yearly inflation rates (whole sample period; between 2003 and 2004; and between 2005 and 2007) and the estimated average degree of openness in the Hungarian counties



Source: Own calculations based on CSO data.

Graph 5 – Time series of the yearly inflation rates (right-hand scale); the nominal effective exchange rate (NEER) of the Hungarian forint (100 = average of the year 2000, left hand scale) and the index of the HUF/EUR exchange rate (100 = average of the year 2000, left hand scale)



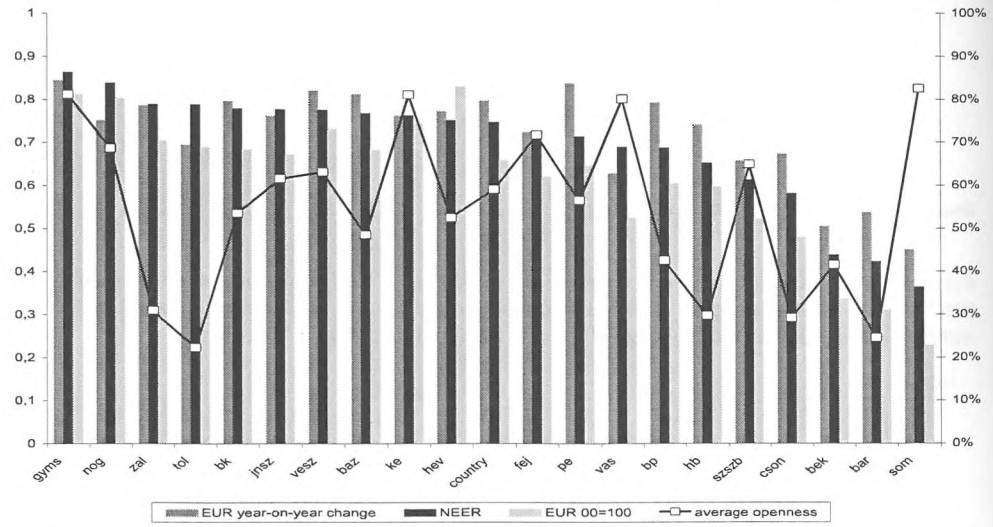
Source: Own calculations based on CSO and MNB data.

As suggested by Graph 5, the exchange rate pass-through is quite strong and, of course, appears with a time lag. We estimated the lag length with the same method as in the case of oil price shocks and found that the correlation coefficient is the highest with the 8 months lag, it is 0.7466 in

the case of the nominal effective exchange rate and 0.6571 in the case of the index of the EUR exchange rate changes. If we compute year-on-year changes in the EUR exchange rate, the correlation will be even stronger, 0.7955 with a 7 months time lag. These values are more or less consistent with the findings of the literature where the average pass-through coefficient was estimated at 0.8.

As a next step, we examined the co-movement between the lagged exchange rate changes and the county-level inflation series and found that there are significant spatial differences. Again, the strength of the pass-through was measured with the correlation coefficients between the series (Graph 6), and it varied between 0.228 and 0.863. Furthermore, we compared the strength of the pass-through with the estimated average openness of the individual counties and our results suggest that there is no direct relationship between these variables on the county level.

Graph 6 – Correlation coefficients between the exchange rate changes and the county-level inflation rates (left-hand scale) and the estimated average openness at the county level (right-hand scale)



Note: for calculating the exchange rate changes we used the following indicators: "EUR year-on-year change": year-on-year HUF/EUR exchange rate change; "NEER": the nominal effective exchange rate index; "EUR 00=100": the HUF/EUR exchange rate changes where 100 = the average of the year 2000 exchange rate.

Source: Own calculations based on CSO and MNB data.

Price level convergence for tradable and non-tradable goods

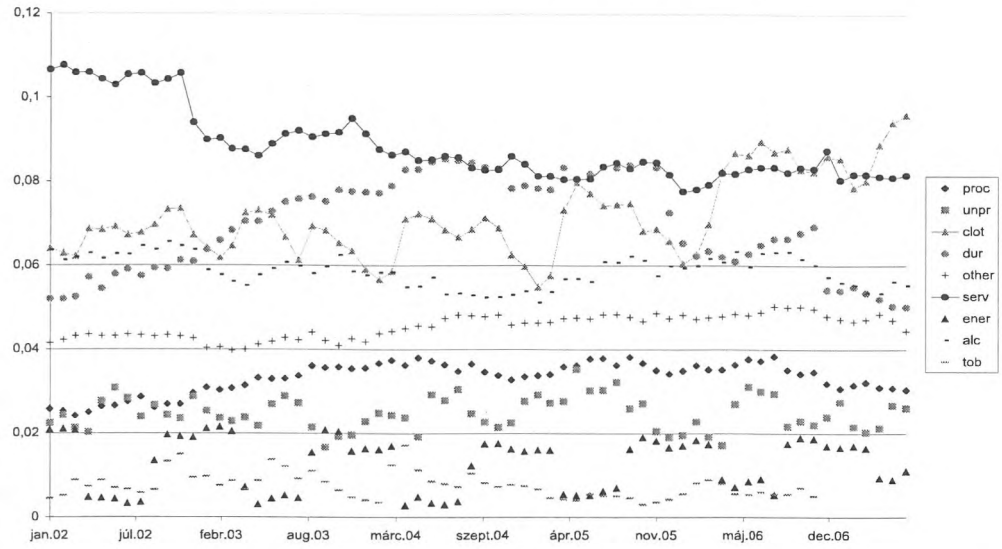
In accordance with the law of one price, the prices of the tradable goods tend to be similar in a currency area. Due to trade liberalisation, increased transparency of the markets or the increased competition, prices may converge towards each other. This means that where prices are initially below the average level they will start to increase and inflation rates will be higher, and vice versa, and this will also result in inflation differentials during the transition process.

For the euro area countries, ECB (2003) states that price level dispersion has continued to moderate and further reduction in the remaining fragmentation of the Single Market is expectable. Rabanal (2006), Andersson et al. (2009), Honohan and Lane (2003) and Égert et al. (2004) also found price level convergence an important factor of inflation differentials in EMU.

In the case of Hungary, price level convergence was investigated by Rátfai (2006) on a data base similar to ours, and the paper concluded that after controlling for certain location specific effects, the low of one price holds between the Hungarian counties.

In our data set, the price levels (relative to the county-level average) are also highly stable in time and across geographical locations. The structure of our data base allows us to analyse the data in a sectoral decomposition, thus, we divided the CPI basket into the following 9 product categories: processed food; unprocessed food; clothing; durable goods; other goods; services; energy; alcoholic beverages; tobacco. On the basis of these categories, we define the services as non-tradable goods and the other categories as tradable goods, as traditional in the literature. Graph 7 shows the cross-sectional standard deviations of the relative price levels in the different product categories. Price level convergence occurs when the standard deviation tends to decrease in time. In this case we cannot find clear evidence for price level convergence excepting the services sector, mainly in the first half of the period, and the durable goods sector in the second half of the sample period.

Graph 7 – Cross-sectional standard deviations of the relative price levels in the different product categories



Note: "proc": processed food; "unpr": unprocessed food; "clot": clothing; "dur": durable goods; "other": other goods; "serv": services; "ener": energy; "alc": alcoholic beverages; "tob": tobacco.

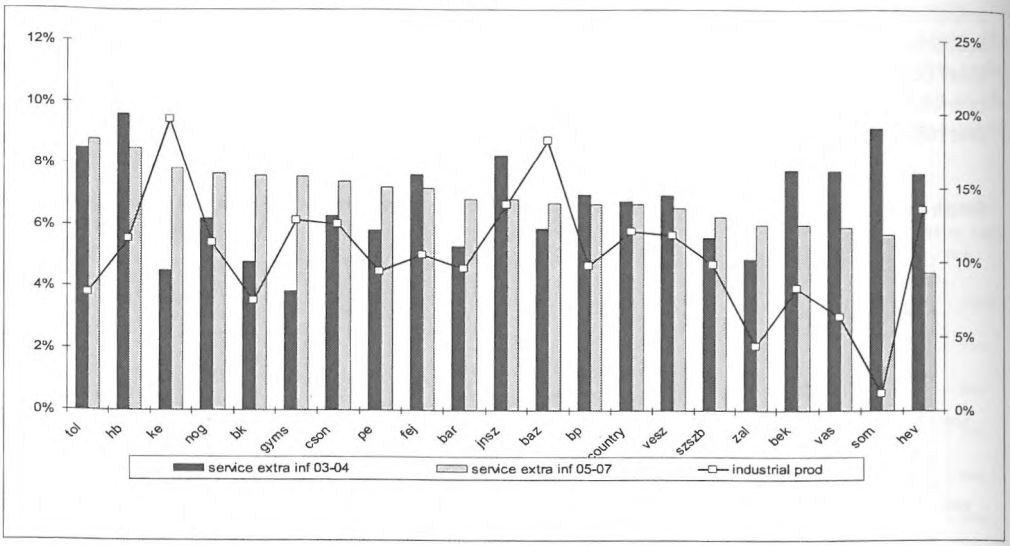
Source: Own calculations based on CSO data.

The Balassa-Samuelson effect

On the basis of the previous section, we may conclude (with some caution) that prices in the non-tradable sector converged, since services are traditionally regarded as non-tradable goods. This is in line with the well-known Balassa-Samuelson (or BS) effect which suggests that inflation differentials across regions can be explained by differences in the productivity growth. In this context, empirical works often examine that to what extent the observed rates of inflation can be explained by differences in productivity growth between the tradable and non-tradable goods sectors. On the basis of this, some inflation differentials across the geographical locations can be considered "equilibrium" or "steady-state" inflation differentials (see ECB 2003). The estimated magnitude of the BS effect is rather different among the empirical studies, but generally they show that catching-up countries experience a real appreciation. However, as noted in ECB (2003), catching-up has not always led to higher inflation historically. Some studies are in favour of the BS effect. For example, Alberola (2000) found that the higher productivity growth in the tradable goods sector runs parallel to the higher price growth in the sheltered sector in the long run. Also, Hofmann and Remsperger (2005) estimated a positive correlation between the structural inflation rate implied by the BS effect and average recent inflation performance in the euro area countries. However, over

their relatively short sample period, the price level convergence or the BS effect were superimposed by the persistent effects of temporary demand and supply shocks.

Graph 8 – Average annual growth of the industrial productivity (right-hand scale) and the inflation surplus of the services (left-hand scale) in the Hungarian counties



Source: Own calculations based on CSO data.

For Hungary (and the whole Central and Eastern European region), estimations suggest a limited role of the Balassa-Samuelson effect which amounts to 3 percentage points at a maximum (see Égert et al. 2003, 2004). From an empirical perspective, our task would be to compare the productivity differential between the tradable and non-tradable sectors and the inflation differential between these sectors (or the services inflation). Unfortunately, county-level data about non-tradable productivity growth are not available, therefore we can only use a rough approximation. For this reason, we compared the average growth of the industrial (tradable) productivity and the services inflation surplus (relative to the other product categories) in each county (Graph 8).

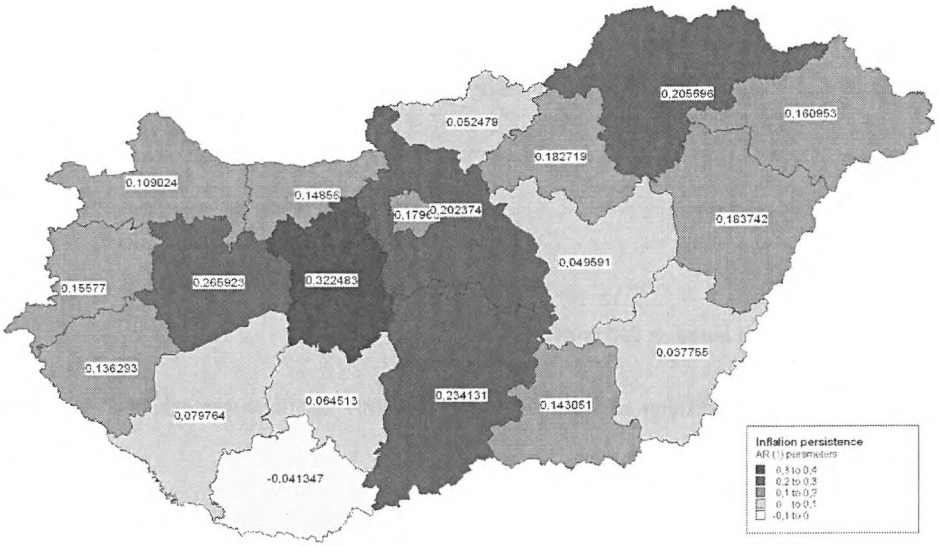
As indicated on the graph above, the relative services inflation (non-tradable inflation), compared to the other (tradable) categories is positive and relatively large in every county (between 4.9 and 8.9 percentage points). There are apparent differences between the counties and between the first (2003 to 2004) and the second half (2005 to 2007 June) of the sample period. However, the link between the industrial (tradable) productivity growth and the inflation surplus of the services is quite weak across the counties. Thus, we conclude that the Balassa-Samuelson effect has little relevance in explaining the spatial differences in inflation rates.

Market rigidities and structural reforms

The level and persistence of inflation differentials can be affected by nominal and real rigidities. According to ECB (2003), reducing market rigidities through structural reforms facilitates the absorption of shocks, thereby reduces their impact on inflation in the long run. The paper of Zsibók and Varga (2009) focuses on the spatial differences in inflation persistence and estimated persistence parameters for the counties from the same data base as ours. The parameters are first-order autoregressive (AR1) parameters of the county-level monthly inflation series. The results are depicted on the chart below.

The numbers indicate that inflation persistence was not high during the sample period, but the spatial differences are significant. This means that the speed of the absorption of the inflationary shocks is very different across the counties. These facts suggest that market rigidities play a role in explaining inflation differentials.

Graph 9 – Parameters of the inflation persistence in the Hungarian counties



Source: Own calculations based on Zsibók and Varga (2009).

Cyclical factors

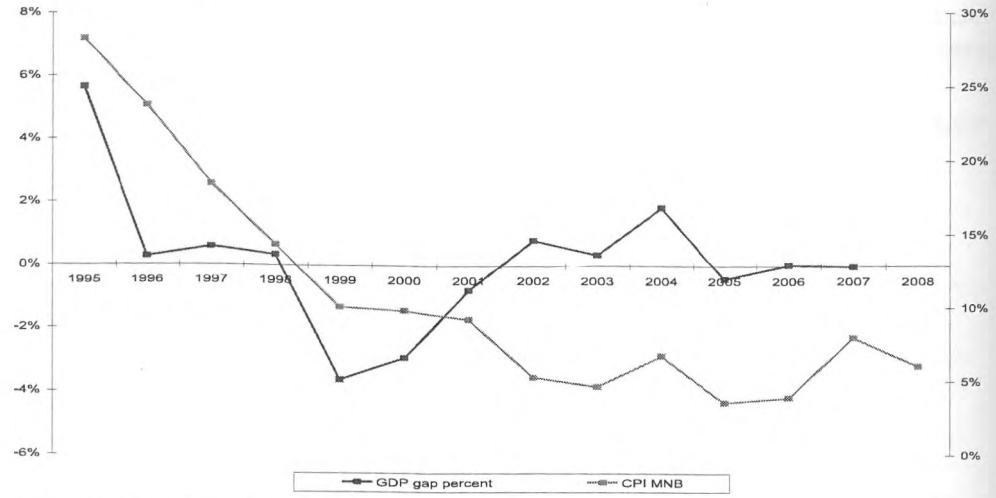
Output gap

The cyclical position of an economy is considered one of the most important factors in inflation developments. The most common indicator of the cyclical position is the output gap which is the difference between the actual and the potential gross domestic product (GDP) of an economy. Practically there is a consensus in the literature analysing inflation developments that the relationship between the output gap and the level of inflation is positive.

Our database allows us to repeat the same analyses for Hungarian county-level data. Unfortunately, GDP is published by the CSO only at the annual frequency for the counties, still, the results are quite clear. On Graph 10 we compared the GDP gap in percentage and the inflation rates at an annual frequency. The GDP gap was calculated, according to the common practice, with the help of the Hodrick-Prescott filter.

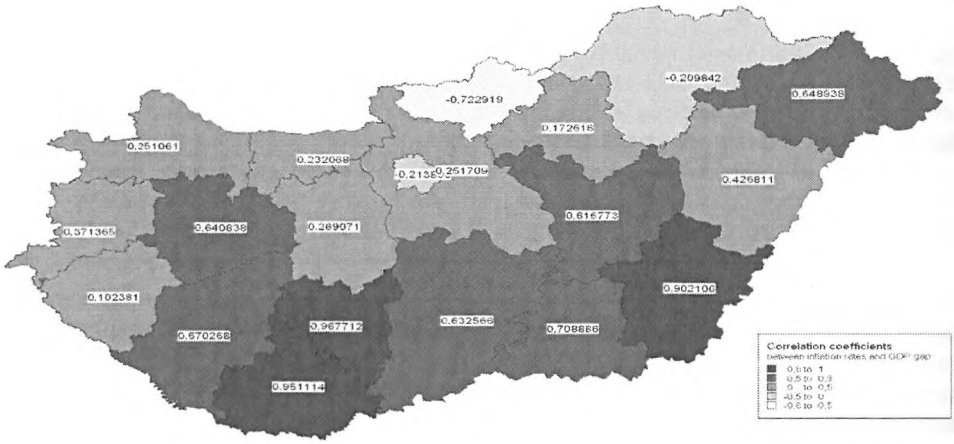
The co-movement between the two series is apparent, the correlation coefficient is 0.493, and concerning our sample period and our inflation data it is higher, 0.631. We calculated the correlation coefficients between the county-level GDP gap and the county-level inflation rates for the 20 Hungarian counties. This indicator reflects the strength of the cyclical factor in spatial inflation differentials. The results are highly dispersed, and as indicated by Graph 11, there is a clear north-south divide in Hungary.

Graph 10 – The time series of the GDP gap in percentage (left-hand scale) and the CPI inflation (right-hand scale) at an annual frequency



Source: Own calculations based on CSO and MNB data.

Graph 11 – Correlation coefficients between the county-level GDP gap (in percentage) and the county-level inflation rates



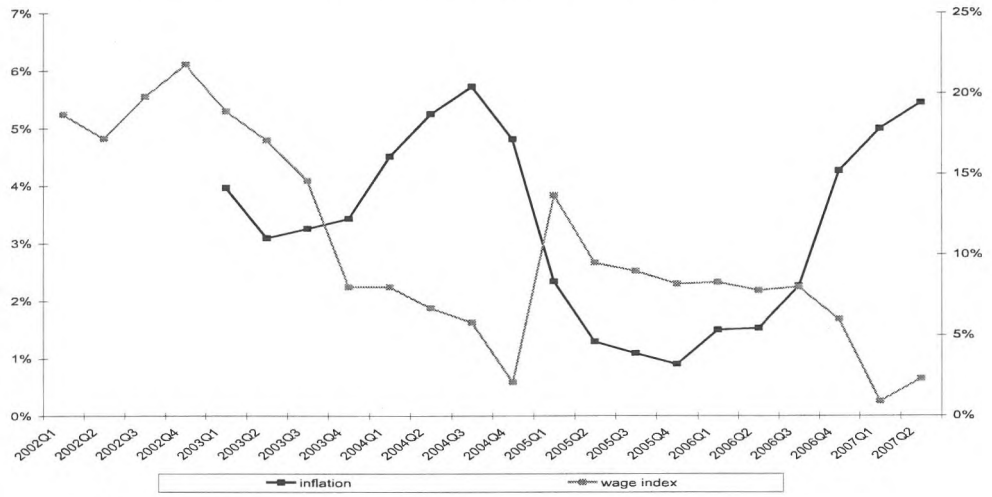
Source: Own calculations based on CSO data.

Wage developments and unemployment

For the euro area, ECB (2003) found that wage and unemployment developments may have played a role in the differences in output gap positions and inflation rates. Above-average inflation rates occurred together with high compensation growth and substantial reductions in unemployment levels. Since the causality between wage changes and inflation is not obvious (price-wage spiral), the paper tested for it and showed that short-term variations in the dispersion of nominal wage growth appear to have caused changes in HICP dispersion.

On the basis of quarterly nominal wage data we made similar analyses. Graph 12 depicts the time series of the country-level annual inflation rates and the year-on-year wage index. As implied by this figure, there is some kind of co-movement and there is a lag, but the causality is uncertain. For this reason, we applied two techniques to reveal the patterns of co-movement. First, as usual, we computed correlation coefficients between the two series with lags. We found relatively high values in both directions. The highest correlation coefficient between the inflation rates and the lagged values of the nominal wage index was 0.604 with 5 quarters lag. The highest correlation coefficient between the lagged inflation series and the nominal wage index was 0.537 with 6 quarters lag. With some exceptions, the correlation coefficients were relatively similar across the counties.

Graph 12 – Time series of the country-level inflation rates and the wage index



Source: Own calculations based on CSO data.

From a statistical point of view, correlation does not say anything about the causality, therefore we made causality tests (Granger causality) – however, the interpretation of the results is limited by the low number of observations (altogether 18 quarters). According to the test results, the direction of the causality is from inflation towards wage changes, and the adequate number of lags is 2 (in quarters).

On the basis of the presented results, correlation coefficients suggest that spatial differences in wage changes may contribute to inflation differentials, however, this fact is not supported by the causality tests, indicating that demand side pressures are not that important in inflation patterns.

Real exchange rates, real interest rates and house price trends

In a monetary union, inflation differentials may cause real interest rate differentials which have transitory expansionary effects on aggregate demand, resulting higher inflation dispersion. Changes in inflation differentials may affect competitiveness through real exchange rate changes. Locations with above-average inflation rates experience a loss in their international competitiveness which may adversely affect their export potential and aggregate demand. In the particular case of Hungary, regional-level real exchange rates and real interest rates do not likely affect the cyclical position of the different geographical locations since the size of the internal market is relatively small.

ECB (2003) found that divergent house price trends across the euro area countries may have reinforced the effects of differences in nominal interest rate changes on business cycles. In some

countries, house price increases likely fuelled domestic demand, thereby inflation. Unfortunately, house prices, even the house rental expenditures are eliminated from our CPI data, therefore we cannot examine this effect.

5. A first draft of the welfare-oriented analysis of the observed spatial inflation differences

Our study is not directly policy-oriented, however, the data base and the presented results make it possible to apply a somewhat normative approach. Within the framework of the inflation targeting strategy of the central bank (National Bank of Hungary – Magyar Nemzeti Bank), certain relevant economic variables are evaluated by the monetary authority when implementing its policy. It seems to be natural that these economic variables are measured at the national level and regional inequalities are not taken into account. However, heterogeneous economic stances of the regions may make dissimilar needs towards monetary policy from the regions. Importantly, we found that there is no convergence in the nominal and real economic indicators across the Hungarian counties, that is, inequalities are sustained and cause large welfare losses. In this part of our study, we examine that to what extent the common monetary policy followed by the MNB fits the needs of the individual regions. The goal of this normative approach is not the evaluation of the Hungarian monetary policy but our aim is to get an insight into the nature and implications of the spatial inequalities.

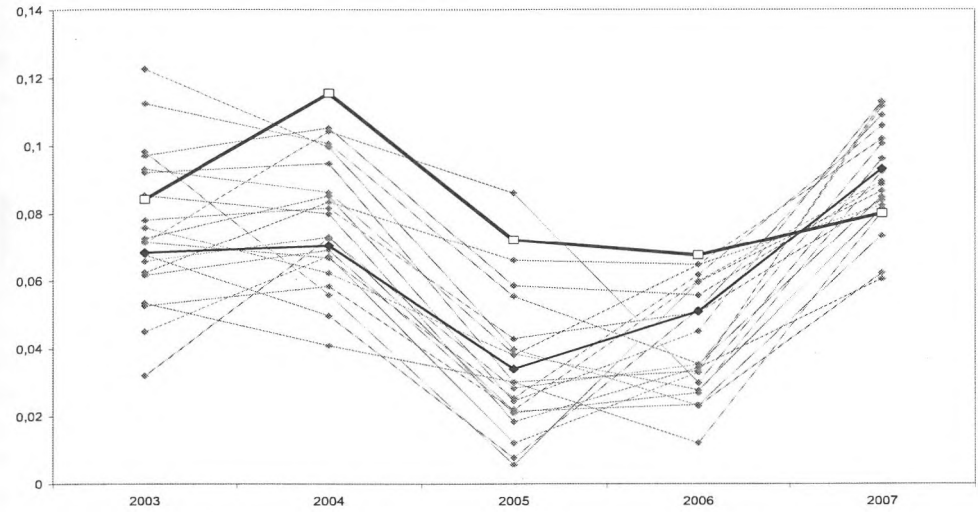
As usual in the literature, we evaluate the well-known Taylor rule (Taylor 1993) as a monetary policy reaction function and compare the actual interest rates with the hypothetic "regionally optimal or desired" interest rates. Such exercises were made in the literature e.g. by Honohan and Lane (2003), Moons and Van Poeck (2005), Crawley and Lee (2008), Licheron (2009) or Van Poeck (2010) on the EMU level. They examined that to what extent whether independent monetary policies would have delivered different outcomes in the euro area countries. Taylor rules were estimated several times for the ECB, and e.g. Hidi (2006) estimated it for the MNB in Hungary. A proposed Hungarian Taylor rule can be written in the form:

$$i_t^{Taylor} = 3 + \pi^{target} + 1.5(\pi_t - \pi^{target}) + 0.5 y_t^{gap}. \quad (1)$$

Following Hidi (2006), this expression assumes that the optimal real interest rate is 3 percent when the GDP is at its trend level. As in Taylor (1993), the parameters give equal weight for the output and the inflation stabilisation. The target level of the long-run inflation rate in Hungary is 3 percent, however, Hidi (2006) proposed to set the target level of inflation to 5 percent in the year 2004, because it was more realistic than the official target due to the VAT increase in January 2004. We will also follow this procedure. According to the results, the above Taylor rule performed well in approximating the actual interest rates in Hungary (with some exceptions).

In what follows, we will compute the desired interest rates for each county on the basis of the above equation. Because county-level GDP data are published only at the yearly frequency, we report annual data. These are depicted on the chart below. Since spatial inequalities are quite high in both the inflation rates and the output gaps across the Hungarian counties, the county-level desired interest rates are dispersed, too. In periods of relatively high inflation (2003 and 2004), the central bank maintained a high level of the interest rate, and later with decreasing inflation rates, the base rate was cut. It is important to note that the main reason behind the sharp increase of the policy rate at the end of 2003 was the financial market imbalance and not purely the high inflation. This can explain the fact that the actual base rate did not correspond to the needs of the regions derived from their fundamental data during the middle of our sample period. Apart from these phenomena, the actual interest rates are relatively close to the average needs of the Hungarian regions, but the spatial dispersion is high.

Graph 13 – The spatial distribution of the "desired" average interest rates for each county in comparison with the actual policy rate during the sample period



Note: white square marks represent the actual average interest rates and black marks represent the country-level average desired interest rates.

Source: Own calculations based on CSO and MNB data.

Following Moons and Van Poeck (2005) we calculated the deviations of the desired interest rates from the actual interest rate for each county with the help of two indicators. The root mean squared interest rate gap measures the average size of the deviations, that is, the appropriateness of the common interest rate setting to the needs of the individual counties:

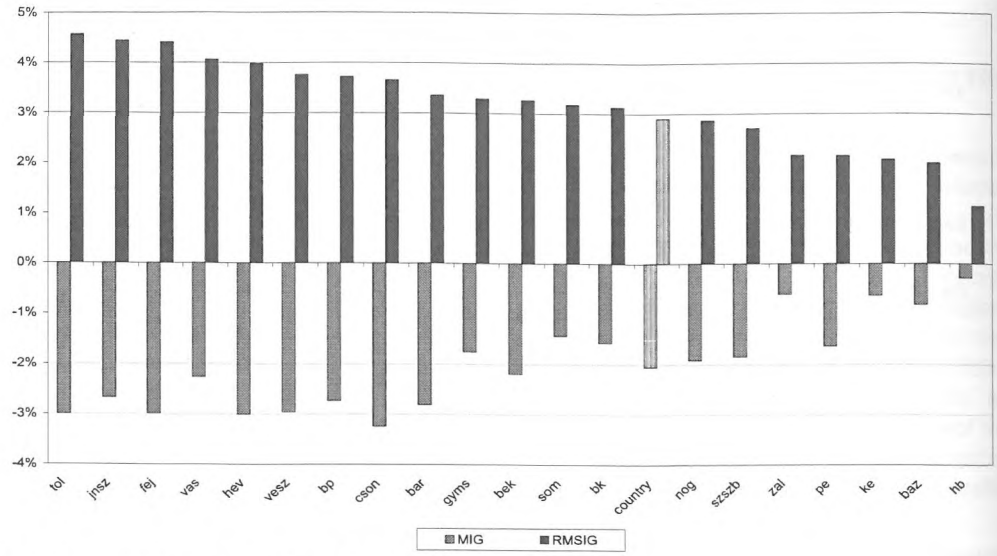
$$RMSIG_j = \sqrt{\frac{\sum_{t=1}^{T}(i_{j,t}^{*} - i_t)^2}{T}}, \qquad (2)$$

where $i_{j,t}^{*}$ is the desired interest rate for county j in year t, it is the average of the actual interest rates set by the monetary authority in year t, and T is the number of the periods which is 5 in our case (from 2003 to 2007). The mean interest rate gap is the average of the deviations, and it informs us not only about the magnitude of the deviations but also about their direction:

$$MIG_j = \frac{\sum_{t=1}^{T}(i_{j,t}^{*} - i_t)}{T}. \qquad (3)$$

The values of these indicators are depicted on the chart below. As expected from Graph 13, the interest rate set by the MNB is generally too high relative to the needs, which is indicated by the negative sign of the mean interest rate gap in the individual counties. It is also true at the country-level. The rank order of the counties in terms of the two indicators is very similar but not the same: the Spearman rank correlation coefficient is 0.848.

Graph 14 – The values of the root mean squared interest rate gap and the mean interest rate gap in the individual counties



Source: Own calculations based on CSO and MNB data.

6. Conclusion

Our paper focused on the potential causes of inflation differentials within a monetary union. We presented the theoretical basis and the empirical findings available in the literature, since this issue was addressed in the euro area in detail. On the basis of a county-level disaggregated data base from Hungary, we adapted the methodology to analyse within-country inflation differentials. Within the limits of data availability, we tried to assess the importance of all potential factors that were identified in the literature. We found that the most important factor is the output gap, that is, differences in the cyclical positions explain the major part of the regional inflation differentials. Since Hungary is a small, open economy, external factors are also important and the different external exposure of the regions can explain the inflation dispersion to some extent. Market rigidities also contribute to lasting inflation heterogeneity. Differences in wage growth may have also played a role, however, causality tests did not showed a clear picture. Other potential factors, such as price level convergence, regulated prices or demand-side factors were not found relevant.

Many empirical papers in the literature use a model-based approach or regression techniques. We think that our results presented in this paper serve as a proper basis for these kinds of analyses, therefore in a later stage of our research we aim to estimate an econometric model, and then build a macroeconomic model of Hungarian within-country inflation differentials. Finally, we computed that what would be the optimal monetary policy for the individual counties on the basis of a regional-level Taylor rule. Our results can be developed in two ways: first, regional loss functions can be computed and a monetary policy seeking to minimise the weighted average of the loss functions can be outlined. Second, it could be investigated that to what extent monetary policy would be effective if spatial inequalities had been taken into account.

In sum, spatial inequalities are significant in both real and monetary variables, and cannot be disregarded at the regional level in Hungary.

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