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Inflation Differentials in New EU Member States: Empirical Evidence*

Roman HORVÁTH – Czech National Bank and Institute of Economic Studies, Charles University, Prague (roman.horvath@cnb.cz; roman.horvath@gmail.com) corresponding author
Kamila KOPRNICKÁ – Czech National Bank and Institute of Economic Studies, Charles University, Prague

Abstract
In this paper, we examine the determinants of inflation differentials in a panel of the new European Union member states vis-à-vis the euro area in 1997–2007. Our main results are as follows. Exchange rate appreciation and a higher price level in the new EU members is associated with a narrower inflation differential vis-à-vis the euro area, while a fiscal deficit and a positive output gap seem to contribute to a higher inflation differential. Nevertheless, the effect of price convergence on inflation differentials is found to be dominant in these countries, suggesting that a country with a price level 20 % below the euro area average is likely to exhibit inflation nearly one percentage point above that in the euro area. Overall, our results indicate that real convergence factors rather than cyclical variation are more important for inflation developments in the new EU members as compared to the euro area.

1. Introduction

After the EU enlargement in 2004 and 2007, 12 new countries became members of the Economic and Monetary Union with a derogation as regards introducing the euro. One of the preconditions for successful euro adoption in these countries is to sustain low inflation vis-à-vis their euro area counterparts. This is also stipulated in the inflation criterion of the Maastricht Treaty, which is defined relative to the inflation performance of other EU countries. Therefore, it is of great interest to understand which factors contribute to the inflation differentials in these countries (ECB, 1999), (ECB, 2003).[1]

As the new EU member states (NMSs) catch up, they typically exhibit real exchange rate appreciation (Égert et al., 2006). In many countries with floating exchange rates, real exchange rate appreciation materializes mainly through nominal exchange rate appreciation, contributing to low inflation. Many observers, however, fear that once these countries adopt the euro, which eliminates the possibility of further nominal exchange rate appreciation, they will exhibit higher inflation, which will be harmful to their macroeconomic stability. In fact, this seems to have become one of the main economic arguments against early euro adoption. In this paper, we therefore want to inves-

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[1] According to Fendel and Frenkel (2008), the monetary policy of the European Central Bank took inflation differentials into account in order to avoid deflation in countries such as Germany.

tigate which factors influence inflation differentials in the NMSs. More specifically, we are interested in the contributions of nominal exchange rate appreciation and price convergence (as these countries typically have a much lower price level than the euro area) as well as in the contribution of cyclical factors.

Anticipating our results, we find that both structural and cyclical factors are important determinants of the inflation differentials in the NMSs. However, in terms of their relative contribution, the effect of price convergence seems to dominate. All in all, it can be expected that higher inflation rates will be exhibited primarily in catching-up countries that adopt the euro with a low price level.

The paper is organized as follows. Section 2 provides a brief literature survey. Section 3 presents our empirical model. Section 4 gives the results. Concluding remarks follow.

2. Related Literature

Various New Keynesian models have been used to analyze the inflation differentials in the euro area. One such model for the euro area economies is put forward by Hofmann and Remsperger (2005). Their empirical analysis of inflation differentials is carried out by the panel generalized method of moments over the period 1999Q1–2004Q2. Their results suggest that the observed inflation differentials are mainly influenced by differences in cyclical positions and fluctuations of the effective exchange rate combined with a rather high level of inflation persistence, while the proxy of price level convergence does not come out significantly. Hofmann and Remsperger (2005) also find that the degree of inflation persistence depends on the past monetary policy regime and expectations. Their results indicate that countries with a history of low and stable inflation rates exhibit zero persistence, while the persistence is rather high otherwise. Given this finding, the authors conclude that the monetary policy of the Eurosystem, which is geared at delivering and maintaining low and stable inflation rates in the euro area, should reduce inflation persistence in the future.

Analogously to the aforementioned study, Angeloni and Ehrmann (2007) propose a stylized 12-country model of the euro area represented by aggregate demand and aggregate supply equations and use it to analyze the inflation and output differentials observed across the euro area over the period 1998Q1–2003Q2. Angeloni and Ehrmann (2007) point out that the main sources of differentials in the early years of the euro area have been aggregate demand or potential output shocks, followed by domestic cost-push disturbances, while euro exchange rate shocks come only third. Moreover, the authors emphasize that inflation persistence has played a central role in amplifying and perpetuating inflation differentials within the monetary union. They claim that for plausible parameter values even small changes in persistence can produce dramatic changes in inflation differentials. The paper also concludes that tight control of average area-wide inflation around a target tends to reduce the differentials.

The long-run determinants of inflation differentials in the euro area are examined by Altissimo et al. (2005). In the first part of their study, the authors analyze evidence on the statistical features of the observed dispersion in headline inflation rates as well as changes in the components of the consumer price indexes in the euro

area. Their findings suggest that most of the dispersion in European inflation occurs in the services category of the EU's harmonized consumer price index. In the second part of the study, the authors build a dynamic factor model to investigate the sources of dispersion in sector-based measures of dispersion in, on the one hand, a common component driven by common factors and, on the other hand, an idiosyncratic component. Altissimo et al. (2005) conclude that their outcomes are in contrast with the supposition that the real exchange rate is primarily driven by regionally asymmetric productivity shocks in the traded sector. Indeed, they point instead to relative variations in productivity in the non-traded sector as the main cause of price and inflation differentials, with shocks to productivity in the traded sector being largely absorbed by movements in the terms of trade in the regional economies.

Honohan and Lane (2003) estimate the panel data model to assess the driving factors of inflation differentials in the euro area over the period 1999–2001. More specifically, they examine the relative influence of the country's external exposure, cyclical position, fiscal policy, and price level convergence. Their results suggest that all aforementioned variables are vital determinants of inflation differentials in the euro area.

The empirical investigation of inflation differentials in the NMSs is rather scant. The existing literature largely focuses on price convergence and its determinants (Čihák, Holub, 2005), (Égert, 2007), (Égert, 2008). Égert et al. (2003) and Égert (2007) provide a detailed overview of real convergence, price convergence, and inflation differentials in Europe and also analyze the determinants of inflation differentials in the NMSs. It is put forward that the Balassa-Samuelson effect is unlikely to explain the observed inflation differentials and that the effect of the exchange rate on inflation is weakening over time in Central and Eastern European countries. Stavrev (2006) utilizes a dynamic factor model to study the driving forces of inflation in the Central and Eastern European countries that recently became members of the EU and finds that inflation in these countries is largely driven by common factors.

3. Empirical Methodology

We analyze the determinants of inflation differentials in the following NMSs: Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia. The source of our data is Eurostat. Our sample period is 1997–2007.[2]

As concerns our empirical methodology, we largely follow Honohan and Lane (2003), who focus their attention on determining the relationship between inflation differentials and the role of the exchange rate channel, the output gap (we estimate the gap using an HP filter on the log of GDP), fiscal policy, and the countries' relative price level. Honohan and Lane's study (2003) investigates the role of the above--mentioned relations on a panel of euro area countries using annual data over 1999––2001. In contrast to Honohan and Lane (2003), our time coverage is longer and,

[2] Due to end-point bias in the HP filter that we use for construction of the output gap, we exclude the year 2007 in the following regression analysis. Inflation is based on the harmonized index of consumer prices and the price level is measured by Eurostat's comparative price level indicator. Next, we also use the nominal effective exchange rate in the empirical analysis. The source of our data is Eurostat.

therefore, we are likely to evaluate the role of structural factors such as price convergence in a fuller manner.

Honohan and Lane (2003) start the analysis with a fairly general specification for inflation differentials that can be postulated as

$$\pi_{it} - \pi_t^E = \beta(z_{it} - z_t^E) + \delta([P_{it-1} - P_{it-1}^*] - [P_{t-1}^E - P_{t-1}^{E*}]) + \varepsilon_{it} \quad (1)$$

where π_{it} and π_t^E are the annual national and eurozone inflation rates, respectively; z_{it} and z_t^E denote national and euro area variables that exert a short-term influence on the inflation rate; P_{it} and P_t^E denote the national and euro area price levels; and P_{it}^* and P_t^{E*} represent the national and eurozone long-run equilibrium price levels.

For a convergence club such as the euro area with rather tight trade and institutional linkages probably eliminating income and productivity differentials over time, Honohan and Lane (2003) assume a common long-run national and euro area price level.[3] The assumption of a common long-run price level allows (1) to be simplified to

$$\pi_{it} - \pi_t^E = \beta(z_{it} - z_t^E) + \delta(P_{it-1} - P_{t-1}^E) + \varepsilon_{it} \quad (2)$$

It is easy to see that a combination of euro area variables results in a time dummy. Hence, we can write

$$\pi_{it} = \phi_t + \beta z_{it} + \delta P_{it-1} + \varepsilon_{it} \quad (3)$$

We define the vector z in line with Honohan and Lane (2003) to allow comparison of our results with the previous research, i.e., $z = [\Delta NEER_{it-1}, GAP_{it}, FISC_{it}]$, where $\Delta NEER_{it-1}$ is the lagged change of the nominal effective exchange rate, GAP_{it} denotes the output gap, $FISC_{it}$ represents the fiscal deficit, and P_{it-1} is the lagged price level. This gives us the following empirical specification:

$$\pi_{it} = \phi_t + \beta_1 \Delta NEER_{it-1} + \beta_2 GAP_{it} + \beta_3 FISC_{it} + \delta P_{it-1} + \varepsilon_{it} \quad (4)$$

Note that the time dummies (ϕ_t) in (4) capture the common movements in inflation, so that the regression explains the inflation differentials in terms of idiosyncratic national movements. The coefficient on the effective exchange rate (β_1) is expected to be negative, as exchange rate appreciation decreases the inflation rate. On the other hand, β_2 is expected to be positive, as a higher output gap results in a more inflationary environment. β_3 is likely to be negative, as a fiscal surplus reduces aggregate demand and therefore contributes to lower inflation. The sign of δ is expected to be negative, as a lower price level is likely to be associated with a higher inflation rate. Obviously, the output gap and the fiscal balance can be endogenous to inflation and therefore we estimate (4) by the generalized method of moments (GMM), where we instrument the endogenous variables by their lagged values.

We present the results based on both annual and quarterly data. Clearly, the advantage of quarterly data lies in greater degrees of freedom, but on the other hand, as

[3] Honohan and Lane (2003) also experiment with the alternative hypotheses that long-run price levels may diverge due to productivity or income differences; however, they failed to find a significant role for these hypotheses.

TABLE 1 Inflation Differentials in the NMSs Relative to the Euro Area, 1997–2007

Country	Inflation differential	Country	Inflation differential
Bulgaria	5.44	Lithuania	1.01
Cyprus	0.65	Malta	0.63
Czech Rep.	1.55	Poland	3.65
Estonia	2.95	Romania	35.34
Hungary	6.58	Slovak Rep.	4.49
Latvia	2.98	Slovenia	4.00

Note: The inflation rate is based on the Harmonized Index of Consumer Prices (y-o-y growth rate, annual data); unweighted average of the annual inflation differentials in the period 1997–2007; in percentage points.

Source: Authors' calculations based on Eurostat data.

the price level and the fiscal deficit are available only yearly for these countries, we had to interpolate these two variables (by the quadratic match procedure; note that different interpolation techniques had rather little effect on the results). As some data are interpolated, we make sure that our instruments are sufficiently lagged to address the endogeneity issue appropriately.

4. Results

In this section, we first characterize the inflation developments in the NMSs and second, we provide regression results on the determinants of inflation differentials.

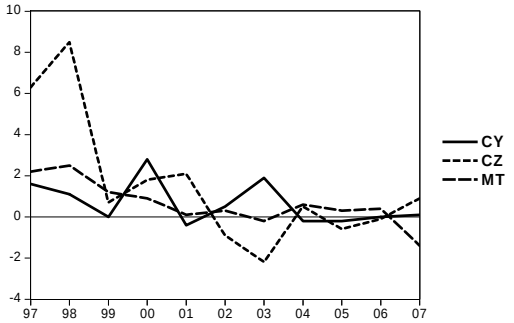
4.1 Inflation Characteristics

Over our sample period 1997–2007, the inflation rates in the NMSs were often close to double-digit levels (the unweighted average in our sample is a 7.7% year-on--year inflation rate), but substantial differences among the countries in terms of their inflation performance exist, too. The lowest inflation rates were observed in Malta and Cyprus (2.6 % for both countries), i.e., the countries that did not undergo a transition from central planning to a market-oriented economy, and the highest were seen in Hungary and Romania (8.5 % and 35 %, respectively). All the countries display a positive inflation differential vis-à-vis the euro area on average during our sample period, as reported in *Table 1*.

Although the NMSs exhibit on average higher inflation than the euro area, there is some country heterogeneity. In general, we can observe three main patterns of inflation developments over time in these countries, as presented in *Figures 1–3*. In *Figure 1*, we put together the countries that experienced relatively stable inflation differentials, which fluctuated around the euro area mean inflation for most of the time (i.e., Cyprus, the Czech Republic, and Malta). A U-shaped development in the inflation differentials is characteristic of the Baltic countries, which disinflated substantially in the 1990s, but whose inflation rates later surged up again (see *Figure 2*). The third group (i.e., Bulgaria, Hungary, Poland, Romania, Slovakia, and Slovenia) can be labeled as a group of formerly relatively high-inflation countries that have, however, undergone a relatively successful process of disinflation recently.

Next, we present scatter plots with kernel fit to assess informally how inflation differentials in these countries are linked to various macroeconomic fundamen-

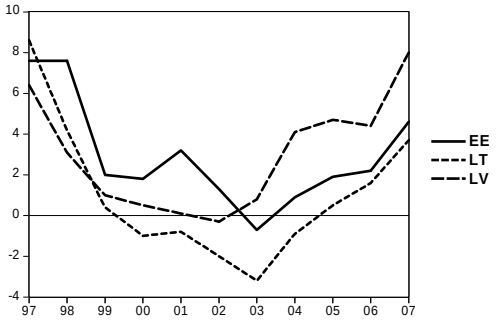
FIGURE 1 Inflation Differentials in the NMS, Low Inflation Group



Note: The inflation rate is based on the Harmonized Index of Consumer Prices (y-o-y growth rate, annual data); in percentage points; period 1997–2007; CY – Cyprus, CZ – Czech Republic, MT – Malta.

Source: Authors' calculations based on Eurostat data.

FIGURE 2 Inflation Differentials in the NMS, Baltic Group



Note: The inflation rate is based on the Harmonized Index of Consumer Prices (y-o-y growth rate, annual data); in percentage points; period 1997–2007; EE – Estonia, LT – Lithuania, LV – Latvia.

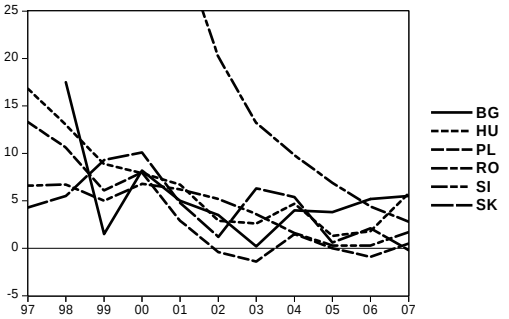
Source: Authors' calculations based on Eurostat data.

tals. *Figure 4* gives the results. We can see that nominal effective exchange rate appreciation is associated with lower inflation. Similarly, a higher price level typically goes hand in hand with lower inflation. Next, cyclical conditions seem to contribute to inflation, too. A positive output gap and a fiscal deficit seem to be associated with higher inflation. However, it is also clear from the data that there are some outliers in terms of the inflation record. More specifically, Romania exhibited very high inflation rates at the beginning of our sample (sometimes even more than 100 %). As a result, we carry out sensitivity checks by excluding Romania from our regression analysis in the following section.

4.2 Regression Analysis

Here we provide our estimation results on the determinants of inflation differentials in the NMSs. *Table 2* reports the results for all countries. Columns (1)–(6) contain our results, while (7) presents the attendant results of Honohan and Lane (2003) for the euro area. We present various specifications to shed light on the robustness of the results.

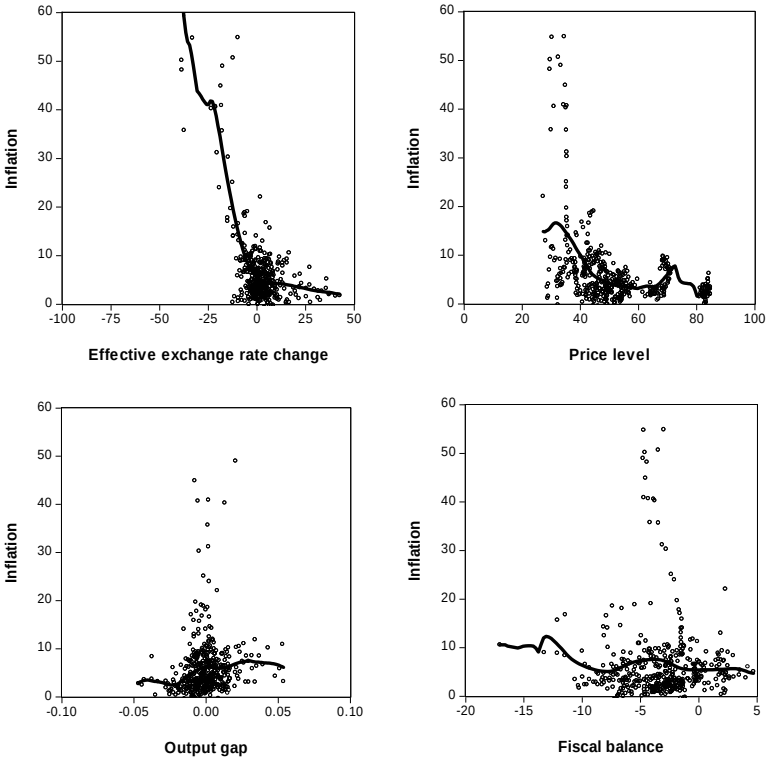
FIGURE 3 Inflation Differentials in the NMS, High Inflation Group



Note: The inflation rate is based on the Harmonized Index of Consumer Prices (y-o-y growth rate, annual data); in percentage points; period 1997–2007; BG – Bulgaria, HU – Hungary, PL – Poland, RO – Romania, SI – Slovenia, SK – Slovakia. The inflation differential in Romania is too high before 2002 and is not reported.

Source: Authors' calculations based on Eurostat data.

FIGURE 4 Inflation and Macroeconomic Fundamentals



The results in *Table 2* indicate that nominal effective exchange rate appreciation in the NMSs reduces the inflation differentials. This result is robust to different data frequency, different sample period and different exchange rate lag (one

TABLE 2 The Determinants of Inflation Differentials, Panel GMM Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Effective exchange rate	-0.34***	-0.33***	-0.24***	-0.23***	-0.29***	-0.31***	-0.28***
	(0.10)	(0.10)	(0.02)	(0.03)	(0.02)	(0.02)	(0.08)
Output gap	1.77	1.73	1.07*	1.23**	0.26	0.99	0.23***
	(1.83)	(1.74)	(0.55)	(0.61)	(0.51)	(0.51)	(0.06)
Fiscal surplus	-0.13	-0.16	-0.11	-0.20*	-0.08	-0.07	0.07
	(0.14)	(0.15)	(0.08)	(0.11)	(0.07)	(0.09)	(0.04)
Price level	-0.10**	-0.10**	-0.09***	-0.10***	-0.08***	-0.07***	-0.03***
	(0.04)	(0.05)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)
No. of observations	98	86	407	359	392	344	30
Data frequency	A	A	Q	Q	Q	Q	A
Sample period	97-06	97-05	97-06	97-05	97-06	97-05	99-01
Adjusted R^2	0.25	0.26	0.29	0.28	0.46	0.47	0.60

Notes: The results in columns (1)–(2) are based on yearly data. Columns (3)–(6) are based on quarterly data. Columns (1)–(4) assume that the exchange rate and the price level are lagged by one period, while columns (5)–(6) assume that they are lagged by four periods to shed light on the sensitivity of the results. Column (7) presents the original Honohan and Lane (2003, p. 375, Table 6, column 1) results for the euro area countries. Period fixed effects included. White diagonal standard errors with degrees of freedom correction are given in the brackets. *, **, *** denote significance at the 10, 5, and 1% levels, respectively. Constants not presented. Annual and quarterly frequency are denoted by A and Q, respectively.

Source: Authors' calculations based on Eurostat data.

vs. four quarters). The output gap exerts a positive influence on inflation, although in many cases the standard errors are larger (especially with yearly data).[4] Next, the sign of the fiscal surplus coefficient is correct, but in most cases insignificant. Countries with a lower price level are found to exhibit higher inflation.

To compare with the results of Honohan and Lane (2003) presented in column (7), the effect of price convergence seems to be more important in the NMSs than in the euro area countries. Our results for the NMSs seem to be somewhat in contrast to the evidence on the euro area countries, such as that provided by Hofmann and Remsperger (2005), as their results suggest that cyclical factors rather than real convergence matter for inflation differentials. On the contrary, our cyclical factors are often found to be insignificant.

Next, we exclude the country that exhibited the highest inflation during our sample period (Romania). The results are relatively unchanged in terms of the significance of the coefficients, but the size of the estimated coefficients seems to change somewhat. The results are available in *Table 3*. Notably, the effects of effective exchange rate appreciation and price level convergence seem to be a bit smaller (but still significant in all specifications, as in *Table 2*), and the output gap and the fiscal surplus become significant in more specifications. We think that the point estimates

[4] See (Fidrmuc, Korhonen, 2006) on the synchronization of cyclical conditions in the NMSs. We also used the output gap from the AMECO database operated by the European Commission. This gap is available at yearly frequency and so we used the gap in the specifications where we use yearly data, too (e.g. columns 1 and 2 in Tables 2 and 3). Similarly to the results that we present in these tables, this measure of the output gap was also found to be insignificant.

TABLE 3 The Determinants of Inflation Differentials: Panel GMM Estimates, without Romania

	(1)	(2)	(3)	(4)	(5)	(6)
Effective exchange rate	-0.21***	-0.20***	-0.20***	-0.19***	-0.21***	-0.20***
	(0.05)	(0.05)	(0.02)	(0.02)	(0.03)	(0.03)
Output gap	1.18	1.08	0.43**	0.44**	1.72**	1.71**
	(1.01)	(0.88)	(0.20)	(0.21)	(0.77)	(0.81)
Fiscal surplus	-0.11	-0.11	-0.10**	-0.16***	-0.07	-0.08
	(0.16)	(0.17)	(0.05)	(0.06)	(0.08)	(0.09)
Price level	-0.06**	-0.05*	-0.06***	-0.05***	-0.06***	-0.06***
	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)
No. of observations	91	80	379	335	364	320
Data frequency	A	A	Q	Q	Q	Q
Sample period	97-06	97-06	97-06	97-05	97-06	97-05
Adjusted R^2	0.29	0.24	0.39	0.39	0.15	0.15

Notes: The results in columns (1)–(2) are based on yearly data. Columns (3)–(6) are based on quarterly data. Columns (1)–(4) assume that the exchange rate and the price level are lagged by one period, while columns (5)–(6) assume that they are lagged by four periods to shed light on the sensitivity of the results. Column (7) presents the original Honohan and Lane (2003, p. 375, Table 6, column 1) results for the euro area countries. Period fixed effects included. White diagonal standard errors with degrees of freedom correction are given in the brackets. *, **, *** denote significance at the 10, 5, and 1% levels, respectively. Constants not presented. Annual and quarterly frequency are denoted by A and Q, respectively.

Source: Authors' calculations based on Eurostat data.

in *Table 3* – which can be used for some simple policy analysis – are more trustworthy, as we exclude a clear outlier.

The point estimate of around -0.2 indicates that a 5% appreciation of the exchange rate reduces inflation additionally by one percentage point. To compare, the Czech nominal effective exchange rate appreciated on average by 3.7 % during 1997–2006. As in *Table 2*, a positive output gap seems to increase inflation and the size of the estimated coefficients varies somewhat across the specifications. As regards the fiscal surplus, the point estimate of between -0.1 and -0.2 indicates that an increase in the inflation differential of an additional one percentage point is related to a fiscal deficit of about 5–10 % of GDP. The point estimate of about -0.05 indicates that a country with a price level 20 % below the euro area average is likely to exhibit inflation nearly one percentage point above the euro area. This is a plausible effect when taking into account the relative price level in the NMSs, where our data show that the average price level in the NMSs in 2006 was about 60 %. In this regard, Mody and Ohnsorge (2007) find the effect of the comparative price level on inflation in the NMSs somewhat smaller, at around -0.02. Overall, our results suggest that real convergence factors rather than cyclical variation are likely to be more important for the NMSs as compared to the euro area.

5. Concluding Remarks

In this paper, we investigate the driving factors for inflation differentials in the EU's New Member States (NMSs) by means of panel data analysis in 1997–2006. Our main results are as follows. Nominal effective exchange rate appreciation in

the NMSs reduces the inflation differentials. Our point estimate of around -0.2 suggests that a 5% appreciation of the exchange rate decreases inflation by an additional one percentage point. To compare, the Czech nominal effective exchange rate appreciated on average by 3.7 % during 1997–2006. The output gap is positively associated with inflation and the fiscal surplus seems to decrease inflation. A point estimate of between -0.1 and -0.2 for the fiscal surplus indicates that an increase in the inflation differential of one percentage point would be related to a fiscal deficit of about 5–10 % of GDP. Countries with a lower price level exhibit higher inflation. A point estimate of about -0.05 suggests that a country with a price level 20 % below the euro area average is likely to exhibit inflation nearly one percentage point above the euro area. This is a plausible effect when taking into account the relative price level in the NMSs, where our data indicate that the average price level in the NMSs in 2006 was about 60 %. Comparing our results to Honohan and Lane (2003) for the euro area, who use an analogous empirical approach, we find that although the set of inflation differential determinants is largely comparable, the effect of the price level seems to be more important in the NMSs than in the euro area. More generally, our results indicate that real convergence factors rather than cyclical variation are likely to be more important for inflation developments in the new EU members as compared to the euro area.

In terms of future research, we believe that it would be worthwhile to build carefully calibrated general equilibrium models simulating the inflation developments in the NMSs after euro adoption. This is important, as the results based on regression analysis are typically not immune to the Lucas critique and therefore only shed light on potential developments of inflation differentials after joining the monetary union. More specifically, it would be especially interesting both for academic circles and for policy makers to obtain the relative contribution of the exchange rate channel in curbing inflation in these countries.

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