WP/09/51

IMF Working Paper

Forces Driving Inflation in the New EU10 Members

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INTERNATIONAL MONETARY FUND

 WP/09/51

IMF Working Paper

European Department

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Authorized for distribution by Luc Everaert

March 2009

Abstract

The paper analyzes the forces driving inflation in the new EU10 member countries. A significant part of headline inflation in these countries is due to common factors, such as price level convergence and EU integration. However, idiosyncratic factors have also played a role in the inflation process. These factors are related to the country-specific financial conditions, pass-through from foreign prices, and demand-supply situation in each country, although administered price adjustments and increases of indirect taxes associated with EU accession are also likely to have played a role.

JEL Classification Numbers: C13, C33, E31, F15

Keywords: inflation, generalized dynamic factor model, price convergence

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I. INTRODUCTION

The new EU10 member states from Eastern Europe (NMS) are under the obligation to adopt the euro some time in the future.[1] The Maastricht inflation criterion requires that inflation in a member state applying for euro entry should not exceed the average inflation rate of the three countries with the lowest inflation rate in EU plus 1½ percentage points. However, over the past ten years, with some exceptions, inflation in the NMS has exceeded the Maastricht inflation criterion most of the time.[2] Also, following a disinflation trend since the mid-1990s, over the past couple of years, inflation in most NMS has trended up and with the exception of Poland and Slovakia is currently above the inflation criterion.

A better understanding of the inflation process is important from a broader policy standpoint. In particular, for policy makers it is useful to know the degree to which inflation has been driven by common factors that affect all NMS as opposed to country-specific factors related to domestic aggregate demand/supply conditions. In that regard, the integration in the EU increased the confidence of investors and allowed the NMS to borrow in the international capital markets, stimulating an economic boom, which may have affected inflation beyond the country-specific cyclical factors. Beyond these considerations, inflation is also costly. High inflation results in a redistribution of wealth from those with fixed incomes to those with flexible incomes (from lenders to borrowers) and reduces real returns on savings and investments.

The factors driving inflation dynamics vary depending on the time horizon. Over the short term, the structure of the consumption basket plays an important role for headline inflation. For example, for given commodity price shocks, headline inflation will be higher in countries with higher energy and food price shares in the consumer basket. Over the medium term, business cycle fluctuations are important determinants of inflation. Administered prices and indirect tax changes may also contribute to country-specific inflation over the medium-term, as NMS policies are synchronized with the EU requirements. Over the longer term, factors such as convergence of price levels across countries become a more important driving force.

This paper analyzes the forces driving inflation in the 10 NMS. The analysis suggests that a significant part of headline inflation in the NMS is driven by common factors, such as price level convergence and EU integration. Country-specific factors however, have also played a role in the inflation process. These factors are related to the financial conditions, pass-through from foreign prices, and demand-supply situation in each country, although administered price adjustments and increases of indirect taxes associated with EU accession are also likely to have played a role.

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[1] Slovenia already adopted the euro in January 2007 and Slovakia is scheduled to adopt it in January 2009.

[2] Exceptions are Poland from August 2002 to August 2004 and from January 2006, Slovenia from January 2006 to July 2007; Lithuania from January 2000 to December 2004, Latvia from January 2001 to December 2003, and Czech Republic from August 2002 to November 2007, when inflation was strictly below the Maastricht criterion.

The remainder of the paper is organized as follows. Section II briefly summarizes related literature. Section III provides background information about inflation dynamics in the new NMS. Section IV describes the methodology and the data. Section V discusses the results, while Section VI concludes.

II. Related Literature

There is an ongoing debate in the literature on the importance of common versus country-specific determinants of inflation. Rogoff (2003) for instance, argues that as a result of globalization the level of inflation has declined, partly through increased competition, but also through the political economy process that drives long-term inflation trends. He maintains that competition tends to make factor and output prices more flexible, reducing the real effects of monetary policy surprises. Thus , central banks have less incentives to inflate, which enhances their anti-inflationary credibility. According to Borio and Filardo (2007) and Razin and Binyamini (2007), global economic slack has significant explanatory power for domestic inflation and its role has been growing over time, especially since the 1990s. However, Ihrig and others (2007) find no evidence that the trend decline in the sensitivity of inflation to the domestic output gap observed in many countries owes to globalization.

Several studies have dealt with the relative importance of domestic versus common determinants of inflation of the EU countries. For example, Stavrev (2006), applying a GDFM framework, separates country-specific and common components of inflation in NMS8 and estimates the factors driving country-specific inflation. Mody and Ohnsorge (2007), using a sample of EU25 countries, identify common time and sectoral trends and find that the common, cross-border sources of inflation increase, reducing the extent of domestically-generated inflation. They show that country-specific inflation in the NMS is higher than that in the old EU members and find evidence that a lower initial price level is associated with higher subsequent inflation. Choueiri and others (2008) in a panel of EU25 countries separate common from idiosyncratic components of inflation and find that cross-country differences in common inflation within the EU depend on gaps in the initial price level, changes in the nominal effective exchange rate, the quality of institutions, and the flexibility of the economies.

This paper utilizes a two-step approach in analyzing the forces driving inflation in the NMS. In the first step, it decomposes inflation into common and idiosyncratic components, using a generalized dynamic factor model due to Forni and others (2000). By allowing for autocorrelation of the dynamic factors, GDFM is better suited to isolate the unobserved common component of inflation than other filtering methods. In the second step, the paper identifies the driving forces of common and country-specific inflations by regressing them on a set of macroeconomic variables that capture the common and country-specific shocks.

III. Inflation Dynamics in MNS: Background

The NMS countries are more energy intensive and have a significantly higher share of food prices in their consumer baskets than the old EU members (Table 1). In terms of energy intensity, measured by the CPI weight of energy consumption, the NMS, on average, consume about 50 percent more energy than the old EU countries. Regarding the share of food prices, it ranges from 50-60 percent higher in Czech Republic, Slovakia, Estonia, Poland, Slovenia, and Hungary to about 100 percent in Latvia and Lithuania, and to over 120 percent in Bulgaria and Romania.

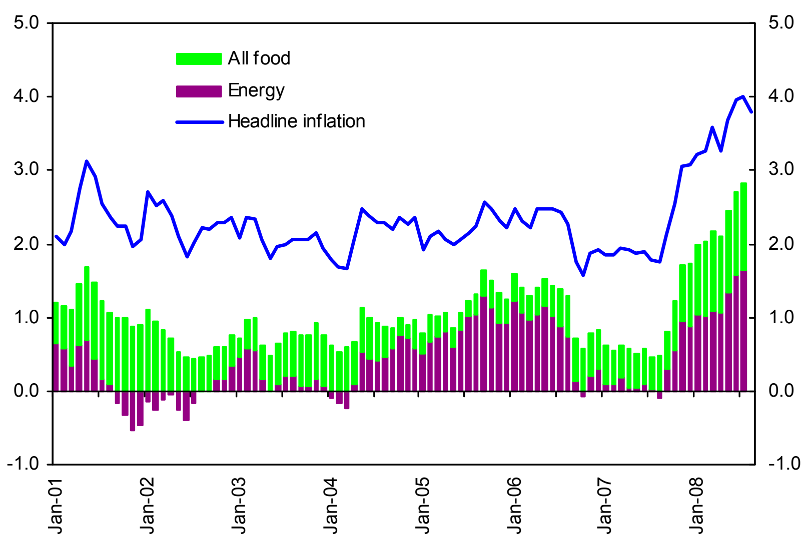
Table 1. NMS and Euro Area: Energy and Food Intensity 1/

	Energy	Liquid fuel	Food
	Share in CPI basket, in percent		
Bulgaria	14.7	4.9	31.6
Czech Republic	13.9	3.9	17.7
Estonia	13.9	6.1	21.4
Hungary	13.0	5.2	18.7
Latvia	12.9	3.6	28.5
Lithuania	14.0	4.7	28.1
Poland	14.9	4.6	22.8
Slovak Republic	16.7	3.4	18.8
Slovenia	12.7	8.0	17.3
Romania	14.7	4.9	31.6
Euro Area	8.8	4.8	14.4

Sources: Eurostat; and IMF staff calculations.
1/ Average for 2000-2008.

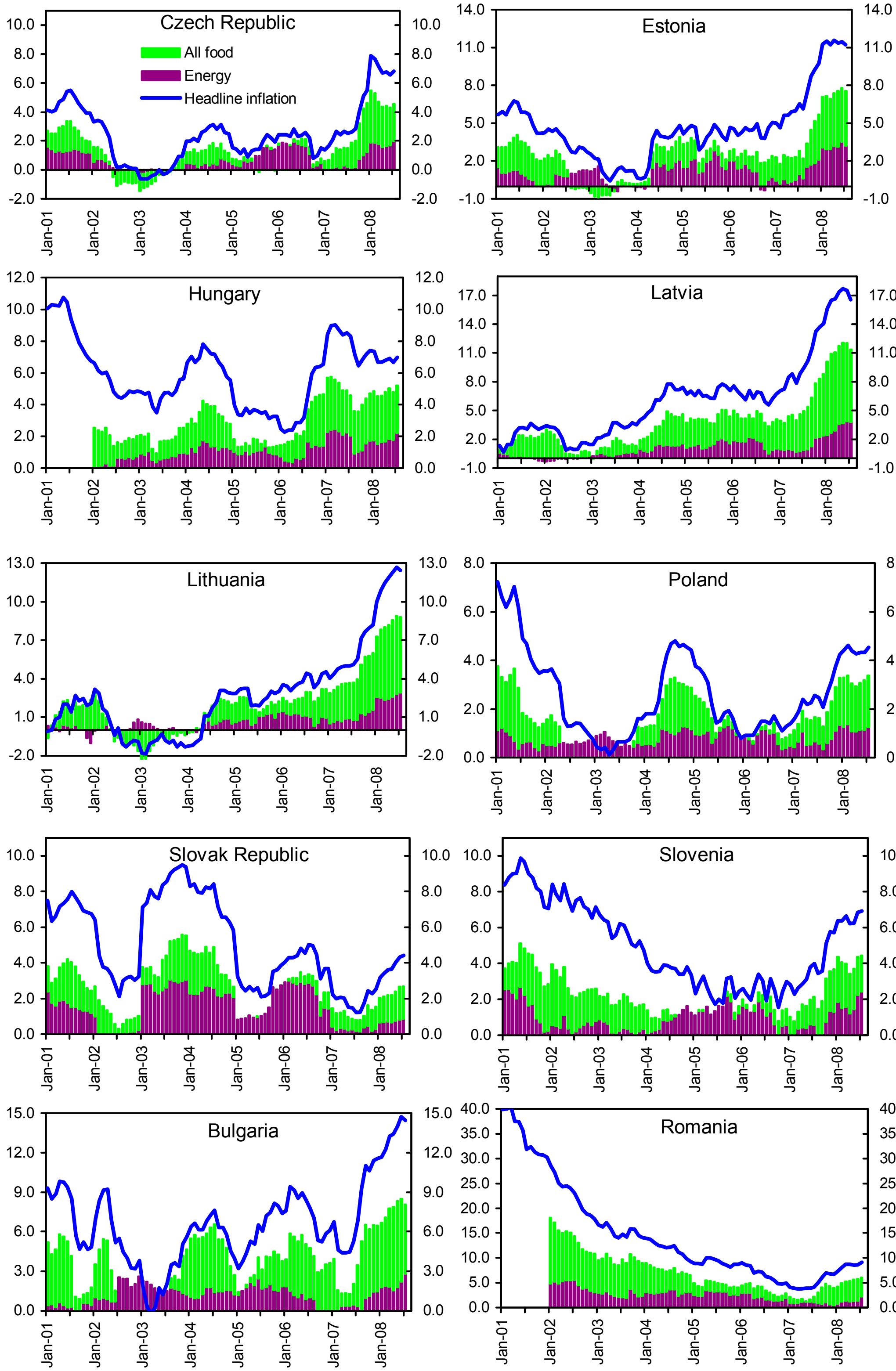
Consequently, commodity price shocks have a much more pronounced effect on headline inflation in the NMS compared to the old EU countries (Figures 1 and 2). In particular, over the past several years food and energy inflation contributed slightly less than 40 percent to headline inflation in the euro area, while it contributed close to 60 percent in the NMS.

Figure 1. Euro Area: Contribution of Energy and Food to Headline Inflation
(Inflation in percent; energy and food in percentage points)



Sources: Eurostat; and IMF staff calculations.

Figure 2. NMS: Contribution of Energy and Food to Headline Inflation
(Inflation in percent; energy and food in percentage points)



Sources: Eurostat; and IMF staff calculations.

From a policy standpoint however, of interest is the degree to which commodity prices trigger an indirect impact on underlying inflation. To gauge the importance of food and energy as potential sources of indirect (second-round) effects to underlying inflation, a tri-variate vector autoregressive model (VAR) comprising food, energy, and core inflation (HICP excluding energy and all food) for each country is used.[3] The results suggest that commodity prices seem to impact core inflation in most of the NMS, either through domestic energy or food prices or both, but the effects are not large. Exceptions are Estonia and Slovenia, where, as in the euro area, commodity prices seem to have little impact on underlying inflation. In Bulgaria food prices seem to be the cause of the indirect effects, in Lithuania, Latvia, Hungary, and Slovakia energy prices are responsible, while in the Czech Republic, Poland, and Romania both food and energy prices are behind the indirect effects on underlying inflation.

Also, the stability of inflation expectations plays an important role in inflation dynamics. To determine how well anchored inflation expectations in the NMS are and the factors that affect them, a pooled regression is used. In particular, inflation expectations (measured by the EC consumer surveys) are regressed on energy, food, and core inflation. The results suggest that inflation expectations in the NMS are in general well anchored. Energy and core inflation have little impact on inflation expectations, while food inflation has a significant but relatively small effect (one percentage point higher food inflation increases inflation expectations by 0.1 percentage points).

IV. Methods and Data

Inflation in the NMS may be driven by both common and country-specific forces. Common inflation may be a result of common shocks hitting the global economy. Commodity price increases is an example of such global shocks. However, there may be other common factors at play in the NMS. In particular, as all of these countries started their transition to market economy with significantly lower price levels compared to the old EU members, the process of convergence to their new equilibrium level would affect inflation. Also, while not fully orthogonal to the price level convergence, the economic boom associated with the EU membership is also expected to play a role, which may go beyond the impact of the normal cycle.

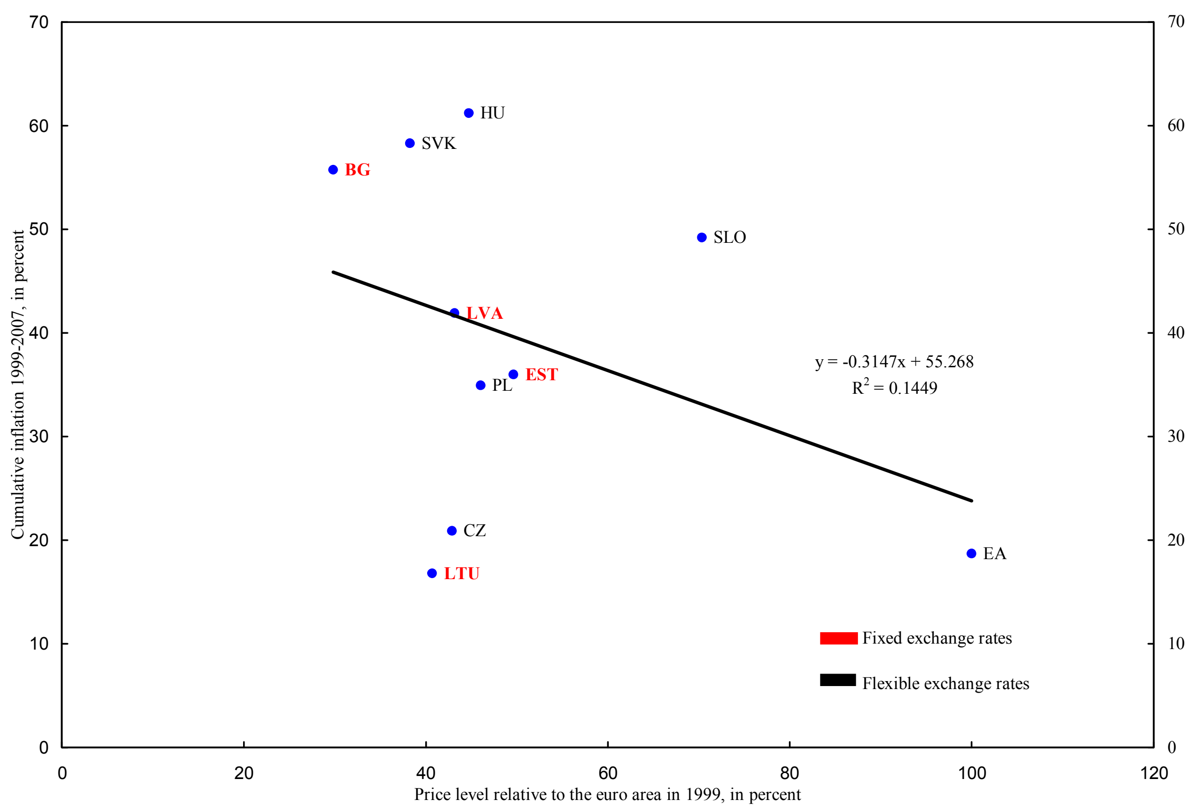
The analysis of the determinants of inflation in the NMS is carried out in two steps. First, inflation is decomposed into a component common to all NMS and a component which is specific to each country. The separation into a common and country-specific components is done using the generalized dynamic factor model (GDFM). In the next step, the determinants

[3] The VAR model is estimated using monthly seasonally adjusted data for the period January 2000 to June 2008. The indirect effects on core inflation are estimated using domestic energy and food prices. This is done with a view of filtering the effect of short-term volatility of international energy prices that are not passed onto domestic energy prices. The pass-through from international commodity prices into domestic energy and food retail prices is determined by several factors. In particular, exchange rate movements, as domestic prices are priced in local currency, taxes and subsidies on fuels and food, and the cost structure of domestic production of energy and food, as labor costs account for a large share of their production.

of common inflation are estimated in a panel setup, by regressing the common factor on variables that capture the effects of common driving forces. Specifically, commodity prices, initial price levels of NMS, and proxies for the role of EU integration.

The NMS differ considerably in their exchange rate regimes. In particular, the Baltics and Bulgaria are at the one extreme with the most rigid exchange rate regimes (currency boards or a peg with a very narrow band in Latvia), while the rest are at the other end with fully floating (or managed, as in Hungary for most of the sample period) exchange rates. Therefore, before proceeding with the analysis, it is worthwhile looking whether the differences in exchange rate regimes could potentially dampen the effects of the common factors discussed above on inflation. As the number of the NMS is small (10 countries), an econometric estimate of the impact of the exchange rate regime on inflation is not feasible. Nevertheless, the role of the exchange rate regime could be assessed by looking whether it is correlated with inflation after controlling for the income level. The results in Figure 3 suggest that the exchange rate regime does not seem to be a significant driver of inflation in the NMS, as given the income level, countries are randomly distributed around inflation-income line.

Figure 3. NMS: Price level, Inflation, and Exchange Rate Regime



Source: IMF staff estimates.

A. Generalized Dynamic Factor Model

As a first step, to separate inflation in NMS on a common and country-specific components, the paper applies the GDFM methodology developed by Forni and others (2000).

The GDFM is well suited to macroeconomic that are driven to a considerable degree by common shocks. For example, among others, Stock and Watson (1988, 1989) find factor models useful in disentangling a small number of common shock that are behind the covariation of the major macroeconomic time series (output, prices, interest rates, yields, etc.). Cristadoro and others (2005), using inflation and financial variables for the euro area countries, apply the GDFM model to estimate the underlying inflation. What the GDFM does is to extract this smaller number of orthogonal common shocks by maximizing the part each additional shock explains in the variation that remains unexplained by the previous shock.

Consequently, inflation in each country is represented as the weighted sum of the common shocks and a variable/country-specific, or idiosyncratic component. The common component is driven by a small number of common shocks, which are the same for all the cross section, but possibly translated into the common-component inflation in each country with different coefficients and/or lag structures. By contrast, the country-specific (idiosyncratic) component is driven by country-specific shocks. As a result, overall inflation in each country is the sum of the common and the idiosyncratic component as in:

$$x_{i,t} = x^c_{i,t} + \theta_{i,t} = b_i(L)\nu_t + \theta_{i,t} \tag{1}$$

where $x_{i,t}$ is individual country's inflation, $x^c_{i,t}$ is the common component, $\theta_{i,t}$ is the mean zero country-specific component, ν_t is a vector of size q of common unobservable dynamic factors driving the common component, b_i is a vector of loading factors, which are specific to each country and shock q. Note also that the country-specific component, $\theta_{i,t}$, is orthogonal to each element of the vector of common factors, ν_t, for all i and t.

The above assumptions are crucial for the decomposition of a country's inflation into common and country-specific components. They mean that covariation of inflation among countries is due to the effect of q common unobservable factors, while variation of inflation in each individual country is due to the variation of the country-specific factors plus the variation of the common factor.

B. Modeling Common and Country-specific Components

In the second stage, the common and the country-specific components derived from the first step are modeled.

Common component

Several common factors (shocks), which can be global or regional in nature, can drive the common component of inflation in the NMS. In particular, such factors include differences in initial positions at the beginning of the transition process (price and income levels), commodity price shocks, EU integration process, and policies.

The effects of the common factors on common inflation in the NMS is analyzed using a pooled regression. In particular, the common component estimated from the first stage is regressed on several variables that are used as proxies for the common shocks discussed above. In particular,

$$x_{i,t}^{c} = \alpha + \beta_1 P_{i,1998} + \beta_2 \Delta r_{i,t-1} + \beta_3 \pi_{i,t-1}^{e} + \varepsilon_{i,t} \tag{2}$$

where $x_{i,t}^{c}$ is the common component of inflation estimated in the fist step, $P_{i,1998}$ is the price level of NMS relative to EU15 in 1998, $\Delta r_{i,t-1}$ is the change in interest rates, and $\pi_{i,t-1}^{e}$ is energy inflation.

As a proxy for the effect of the initial price levels, the 1998 level of relative prices is used. This variable measures the gap between an individual country's price level and the EU15. It is supposed to capture the effects of price adjustments that are required to achieve the price level of EU15 countries over the medium to longer term (this variable could also capture to some degree effects of real income convergence). The forces behind price level adjustments may be different, for example, due to Balassa-Samuelson effect or quality convergence of consumer goods as a result of product market integration.[4] The change in interest rates is used as a proxy for the effect of EU integration of the NMS, while energy prices are intended to capture the effects of global commodity price shocks.

Country-specific component

The idiosyncratic component of inflation is modeled separately for each NMS by regressing the country-specific component from the first stage on variables intended to capture shocks specific to each country. In particular,

$$\theta_t = \delta + \gamma_1 y_{t-1} + \gamma_2 \Delta neer_{t-1} + \gamma_3 rr_{t-1} + \beta_3 \pi_{i,t-1}^{f} + \nu_t \tag{3}$$

where θ_t is country-specific inflation, y_{t-1} is output gap, $\Delta neer_{t-1}$ is percent change of nominal effective exchange rate, rr_{t-1} is real interest rate, and $\pi_{i,t-1}^{f}$ is foreign inflation.

In this specification, the country-specific inflation is modeled as depending on domestic cyclical conditions, which are proxied by the output gap and real interest rates as well as on the openness of the economies which are captured by the nominal effective exchange rate and foreign inflation. Notice also that the idiosyncratic component of inflation in the NMS may be partially driven by changes in regulated prices and indirect taxes. For example, Choueiri and others (2008) note, such policy-induced price changes may have significant

[4] Depending on the monetary policy setup in a particular country, the real effective exchange rate appreciation implied by the Balassa-Samuelson theory will be split between nominal exchange rate appreciation and higher inflation.

contribution to country-specific inflation in the NMS. In the above specification however, these effect are not explicitly modeled and therefore are captured by the residual term.

C. Data Description

For the first stage GDFM estimates, the data set comprises 955 predominantly four-digit level HICP series for the NMS over the period January 1998 till June 2008 at monthly frequency. Where four-digit level series are not available, they are replaced with the next level of aggregation (about ¼ of the total data set). All HICP data are from Eurostat.

The following data transformations were done before applying the GDFM model. As the GDFM methodology requires stationary series, first- and twelve-month difference of the HCIP components were used. Prior to calculating the month-on-month percent changes, all HICP components were seasonally adjusted using the U.S. Bureau of Labor Statistics X12 procedure. Finally, to ensure that the estimation results are not contaminated by variables with high-volatility, the data for both month-on-month and year-on-year regressions were normalized by subtracting their means and dividing by their standard deviations.

In the second stage of the estimation the following non-HICP data are used: industrial production (seasonally adjusted), interest rates, nominal effective exchange rates (all three at monthly frequency), and price levels of the NMS relative to EU15 (at annual frequency). In addition to using monthly data, the models for the determinants of the common and country-specific components were estimated with quarterly (country-specific component) and annual data (common component) as well. In that case, the corresponding monthly data were averaged over the respective periods to obtain quarterly or annual figures. In the quarterly models, industrial production was replaced with real GDP figures. Nominal effective exchange rates, industrial production data for the majority of the countries, and price levels are from Eurostat. The remaining industrial production data are from Haver Analytics database.

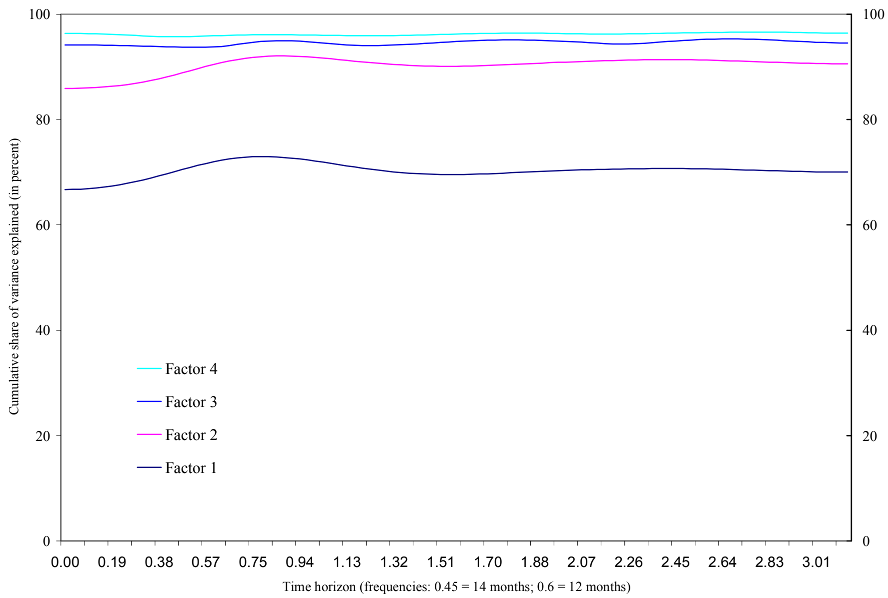
V. Discussion of the Results

A. GDFM Results

The number of common factors is determined by analyzing the spectral density matrix of the data. On Figure 4, the cumulative share of the data variability explained by the largest four eigenvalues is plotted over the interval $[0, \pi]$. Note that in the time domain, the frequency of 0.52 on the horizontal axis corresponds to twelve months. The region to the left of that point correspond to periods greater than, while the region to the right to less than twelve months. On the vertical axis, the area below the eigenvalues indicates the cumulative share of the variance of the data set explained by each consecutive common factor.
As can be seen from Figure 3, the first common factor, corresponding to the largest eigenvalue, explains most of the variation of the data over the medium to longer term in the frequency domain. In particular, the first common factor explains about 65 percent of the data variability at a medium-term horizon and a slightly higher share, about 70 percent, at shorter horizons. Notice the fast decline of the marginal contribution of each additional common factor—the marginal contribution of the third principal component is considerably

smaller than the second. Following Cristadoro and others (2005) the threshold for identifying common shocks is chosen at about 50 percent, to avoid bias from excessive noise at the higher frequencies. Thus, the first factor is chosen as the single dynamic common factor of inflation in the NMS. The remaining factors are assumed to contribute to the country-specific components.

Figure 4. Cumulative Share of Data Variance Explained by Common Factors
(In percent)

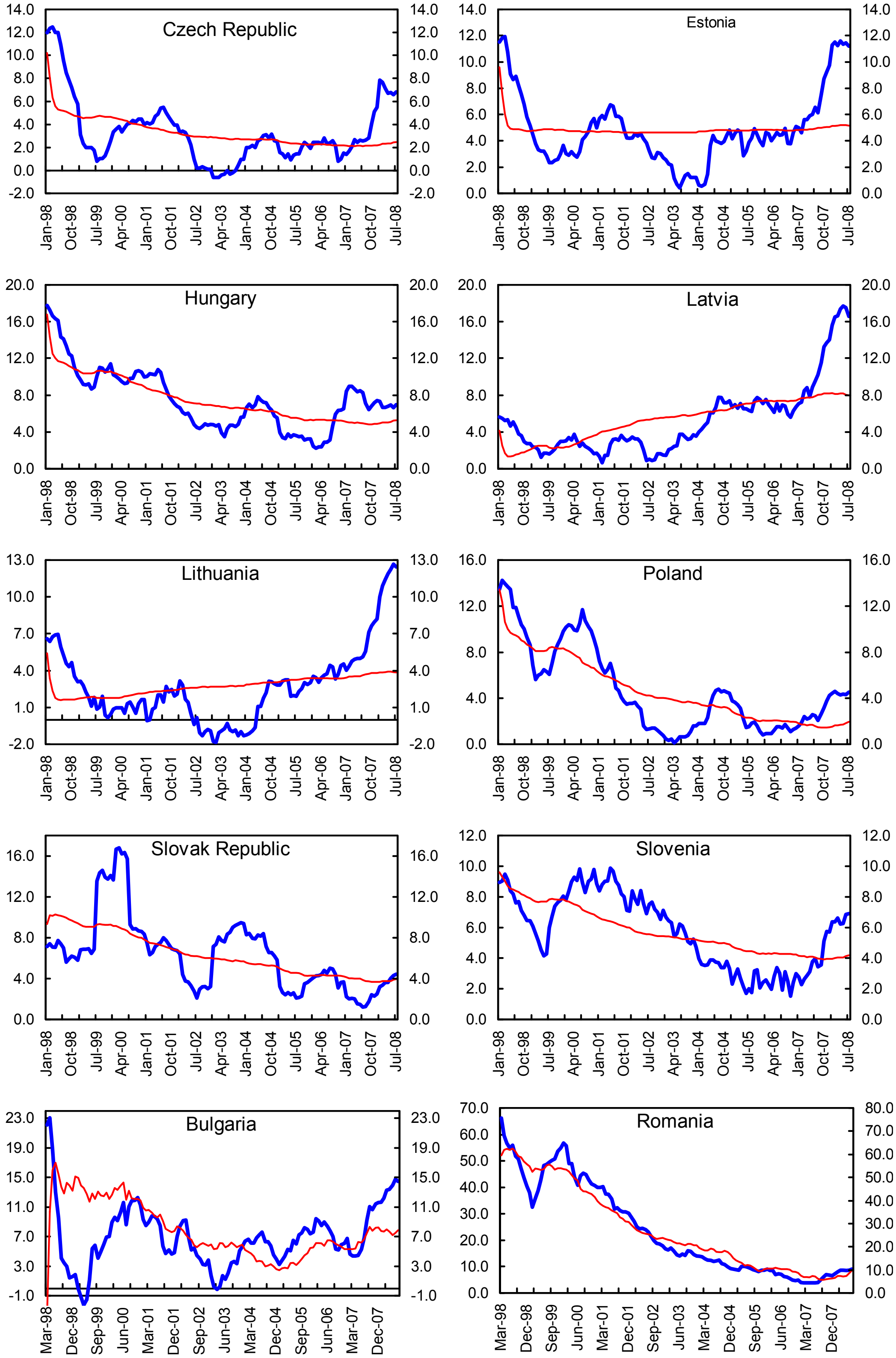


Source: IMF staff estimates.

The number of static factors is chosen using the algorithm proposed by Bai and Ng (2002). The algorithm minimizes the sum of squared errors from the regression of the data on the static factors, subject to a penalty for the sample size. The criterion reaches a minimum at 7 static factors. Given the selection of one common shock from the spectral density analysis, this implies six lags for the dynamic common factor in equation (1).

Figure 5 plots headline and common component inflation derived from the GDFM model using one common dynamic factor. In the time domain, the share of inflation variation explained by one dynamic factor varies significantly across NMS. In particular, it explains about 15 percent in the Baltics, around 45 percent in the Czech Republic and Slovakia, 75 percent in Hungary and Poland and over 80 percent in Bulgaria and Romania. Adding a second dynamic factor increases the share of explained inflation variation to above 80 percent on average for the NMS, suggesting that the two common factors are of different importance for each NMS.

Figure 5. NMS: Headline and One Common Factor Inflation
(Percent)



Sources: Eurostat and IMF staff estimates.

B. Determinants of Common and Country-specific Inflation

Drivers of common inflation

The estimates from the pooled regression discussed in Section IV B, suggest that the relative price level, EU integration forces (proxied by the convergence of nominal interest rates), and energy prices explain over 40 percent of the variability of common inflation in the NMS.

Price convergence forces are found to play a significant role in explaining common inflation (Table 2). In particular, half of the variability explained by the above factors is accounted for by the initial relative price level. Consistent with price convergence, the estimated coefficient of the initial relative price level is negative and significant. The estimated coefficient implies that in a NMS with a price level 30 percent below the level observed in the EU15 countries, common inflation would be about 1½ percentage points. This result is in line with findings elsewhere in the literature about the impact of the relative price level on inflation in the NMS. For example, Ashoka and Ohnsorge (2007) estimate the impact to be 1 percentage point.

Table 2. NMS: Determinants of Common Component 1/

	Relative price level in 1998	Change in interest rates	Energy inflation	Adjusted R-squared
Coefficient	-0.05 (0.02)	-0.35 (0.05)	0.12 (0.01)	0.44

Source: IMF staff calculations.
1/ Dependent variable: common inflation derived from the GDFM model.
Interest rate change in percentage points; relative price level and energy inflation in percent.
Standard errors in parenthesis.

The effect of EU integration on common inflation, captured by the convergence of interest rates, is also found to be significant. The estimated coefficient implies that a country that experiences a 1 percentage point decline in interest rates would have about 1/3 of a percentage point higher. Finally, energy prices are also an important determinant to common component inflation, with the estimated coefficient implying that a 1 percent increase in energy prices accounts for 0.12 percentage points common inflation.

Determinants of country-specific inflation

In most NMS the idiosyncratic component is driven by cyclical factors, financial conditions, and openness (Table 3). Overall, these factors explain about half of the variation of the country-specific inflation. Cyclical factors, captured by the output gap are statistically significant in most NMS. Financial conditions, captured by the real long-term interest rate are also a significant determinant of the idiosyncratic component.

Table 3. NMS: Determinants of Country-specific Component 1/

	Output gap	Real interest rates	Nominal effective exchange rate	EU inflation	Adjusted R-squared
Czech Republic	0.08	-0.90	-0.04	n.s.	0.84
	(0.03)	(0.05)	(0.01)		
Estonia	0.16	-0.38	-0.08	n.s.	0.40
	(0.05)	(0.10)	(0.02)		
Hungary	0.12	-0.40	n.s.	n.s.	0.40
	(0.06)	(0.07)			
Latvia	0.1	-0.70	0.50	1.8	-0.70
	(0.07)	(0.05)	(0.05)	(0.50)	
Lithuania	0.05	-0.65	0.16	n.s.	0.70
	(0.03)	(0.06)	(0.05)		
Poland	0.20	-0.05	-0.03	0.60	0.30
	(0.04)	(0.03)	(0.01)	(0.20)	
Slovak Republic	n.s.	-0.45	-0.20	n.s.	0.55
		(0.05)	(0.05)		
Slovenia	n.s.	n.s.	-0.11	1.30	0.40
			(0.04)	(0.40)	
Bulgaria	n.s.	n.s.	-0.40	3.00	0.35
			(0.12)		
Romania	n.s.	-0.35	-0.16	1.00	0.45
		(0.07)	(0.02)	(0.06)	

Source: IMF staff calculations.
1/ Dependent variable: country-specific component of inflation, defined as headline inflation minus common component inflation. Long-term interest rate in percent; the other variables year-on-year, in percent. Standard errors in parenthesis. Statistically significant variables reported; n.s.—not statistically significant at 1 percent, 5 percent, or 10 percent.

VI. Concluding Remarks

This paper decomposes inflation in the NMS on a common and country-specific components. The estimation results suggest several conclusions. First, a significant part (about 65 percent) of inflation in the NMS over the medium term is driven by common factors. Second, among the common factors, price level convergence and convergence of real interest rates are significant determinants common inflation, as are commodity prices.

However, idiosyncratic factors have also played a role in the inflation process. Domestic cyclical conditions and financial conditions play an important role for country-specific inflation in the NMS. Finally, pass-through effects from foreign prices have also played a role.

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