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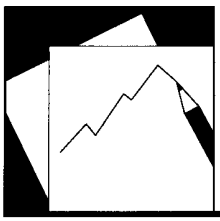

IMF Working Paper

Are Non-Euro Area EU Countries Importing Low Inflation from the Euro Area?

Plamen Iossifov and Jiri Podpiera

INTERNATIONAL MONETARY FUND

 WP/14/191

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European Department

Are Non-Euro Area EU Countries Importing Low Inflation from the Euro Area?

Prepared by Plamen Iossifov and Jiri Podpiera[1]

Authorized for distribution by Jörg Decressin and Anna Ilyina

October 2014

Abstract

The synchronized disinflation across Europe since end-2011 raises the question of whether non-euro area EU countries are affected by the undershooting of the euro area inflation target. To shed light on this issue, we estimate an open-economy, New Keynsian Phillips curve, in which we control for imported inflation. Regression results suggest that falling food and energy prices have been the main disinflationary driver. But low core inflation in the euro area has also had a clear and significant impact. Countries with more rigid exchange-rate regimes and higher share of foreign value added in domestic demand have been more affected. The scope for monetary response to low inflation in non-euro area EU countries depends on concerns about financial stability and unanchoring of inflationary expectations, as well as on exchange rate regime and capital flows dynamics.

JEL Classification Numbers: E12, E31, E58.

Keywords: Inflation, Central and Eastern Europe, Sweden, United Kingdom, Denmark

Author's E-Mail Address: piossifov@imf.org and jpodpiera@imf.org.

[1] This project was carried out under the general guidance of Jörg Decressin and Helge Berger, and has benefited from comments from them, Anna Ilyina, Petya Koeva Brooks, Johannes Wiegand, Andrew Levin, Nigel Chalk, and participants in a seminar at the IMF. Any remaining errors are our own.

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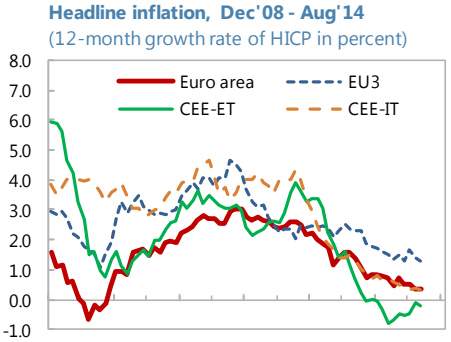
I. INTRODUCTION

Inflation has declined sharply across Europe since end-2011. At present, the 12-month inflation is well below the ECB's price stability objective in the euro area (EA) and its target in the Czech Republic, Hungary, Poland, and Sweden and to a lesser extent in Romania.[2] In several European countries, the region-wide spell of low inflation has turned into an outright deflation. Most of these countries are small economies that peg their currencies to the euro (Appendix Figure 1). In Bulgaria and Bosnia and Herzegovina, prices have been falling at an average 12-month rate of 1.3 and 1.2 percent, respectively, since mid-2013. Montenegro also slipped into a milder deflation in 2014.



Source: Eurostat.
Notes: EU3 - Denmark, Sweden, United Kingdom; Exchange-rate targeting CEE (CEE-ET) - Bulgaria, Croatia and Lithuania; Inflation targeting CEE (CEE-IT) - Czech Republic, Hungary, Poland, and Romania; Plotted data for non-euro area countries are weighted averages using country HICP weights for 2013.

The synchronized disinflation across Europe raises the question of whether non-EA EU countries are affected by the undershooting of the EA inflation target or by other common factors. In this paper, we analyze inflationary developments in non-euro area EU countries within the analytical framework of an open-economy, New Keynesian Phillips curve, in which we control for imported inflation. We focus on the link between domestic inflationary pressures and those in the euro area, because recently the core inflation rates in both the EA and non-euro area EU countries have decoupled from the average in the rest of the world (see Section III below)**.** Section II sketches the model underpinning the analysis. In Section III, we take a closer look at the dynamics of the key demand and supply-side disinflationary drivers. Section IV presents the results of the regression analysis, with a focus on the decomposition of the inflation variance into contributions from domestic and external factors. We also use the estimated regression model to project inflation 12-months ahead. Section V provides a summary of our main findings and draws some broad policy implications.

II. ANALYTICAL FRAMEWORK

We analyze inflationary developments in non-euro area EU countries within the analytical framework of an open-economy New Keynesian Phillips curve (Galí and Gertler, 1999)**.** Inflation is assumed to be both forward-looking and exhibiting some degree of inertia and driven by demand and supply-side shocks. The framework can be described, for a country *i*, as:

[2] The CEE inflation targets range from 2 percent in Czech Republic to 2.5 percent in Poland and Romania, and 3 percent in Hungary.

$$\pi_{it} = \alpha_i + \beta\pi_{it-1} + \gamma\pi_{it}^{*} + \delta\tilde{u}_{it} + \mathbf{z}_{it}\boldsymbol{\theta} + \mathbf{w}_t\boldsymbol{\vartheta} + \varepsilon_{it},\ t = 1,2,\ldots,T \qquad (1)$$

π_{it} – headline inflation;
π_{it}^{*} –expectation of future inflation;
$\tilde{u}_{it}$ – unemployment gap as a measure of demand-side shocks (we expect $\delta < 0$).[3]
$\mathbf{z}_{it}$– $1 \times K$ vector of country-specific supply-side shocks;
$\mathbf{w}_t$ – $1 \times P$ vector of common external supply-side shocks, including imported inflation.

Following Galí and Monacelli (2005) and the analysis of post-crisis inflationary developments in the April 2013 World Economic Outlook (IMF, 2013a), we augment the standard inflation-unemployment relationship to control for imported inflation. We further decompose imported inflation into the impact of the nominal effective exchange rate, world food and oil prices, and core inflation in the euro area, which is a major trade partner for countries in the region.

Before embarking on econometric analysis, we take a closer look at the dynamics of the key demand and supply-side disinflationary drivers. Accounts of inflationary developments by national central banks and the ECB[4] reveal that energy, food, and, where relevant, administered prices have played a key role across the region. Different national central banks further highlight the role of falling import prices (e.g., Bulgaria, Hungary, Denmark, Sweden), the weakness of domestic demand (e.g, Czech Republic, Poland), and exchange rate appreciation (e.g, Poland, Sweden). In presenting the data and regression findings, we group Central and Eastern European (CEE) countries by monetary policy regime (exchange-rate targeting (ET)[5] or inflation-targeting (IT))—following the de facto classification of monetary policy frameworks in IMF (2013b)—and analyze separately Denmark, Sweden, and the United Kingdom.

III. Overview of the Data

A. Demand-Side Factors

The recent spell of low inflation across the region has occurred in an environment of elevated unemployment. The unemployment rates of countries experiencing deflation—most of which are exchange rate peggers—are either trending up or are near their post-crisis peaks (Figure 1). Labor market dynamics are more favorable in CEE inflation-targeting

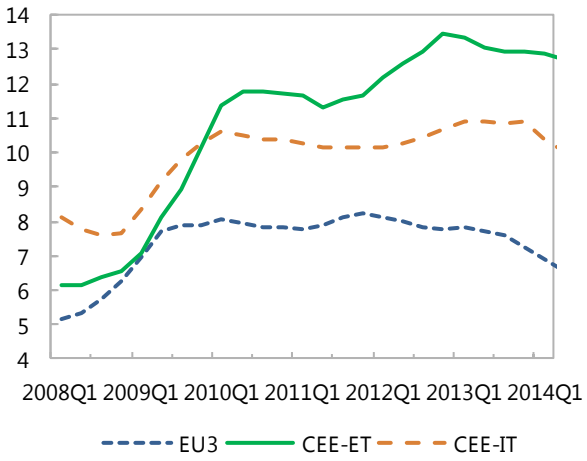
[3] It is given by the cyclical component of the unemployment rate extracted with the Baxter-King bandpass filter (see Appendix II).

[4] See ECB, 2014a; CzNB, 2014; NBP, 2014; MNB, 2014; NBR, 2014; LB, 2014; NBD, 2014; BNB, 2014; CNB, 2014; BOE, 2014; SR, 2014.

[5] All CEE-ET countries peg their currencies to the euro.

countries and across Denmark, Sweden, and the United Kingdom. The gradual pick-up of domestic demand across much of the region in 2013 has not been sufficient to offset deflationary external pressures, as the output gaps remain negative across all three country groups.

Figure 1. Unemployment rate, 2008 - 2014
(Percent)



Source: Eurostat.
Notes: EU3 - Denmark, Sweden, United Kingdom; Exchange-rate targeting CEE (CEE-ET) - Bulgaria, Croatia and Lithuania; Inflation targeting CEE (CEE-IT) - Czech Republic, Hungary, Poland, and Romania; Plotted data are weighted averages using country HICP weights for 2013.

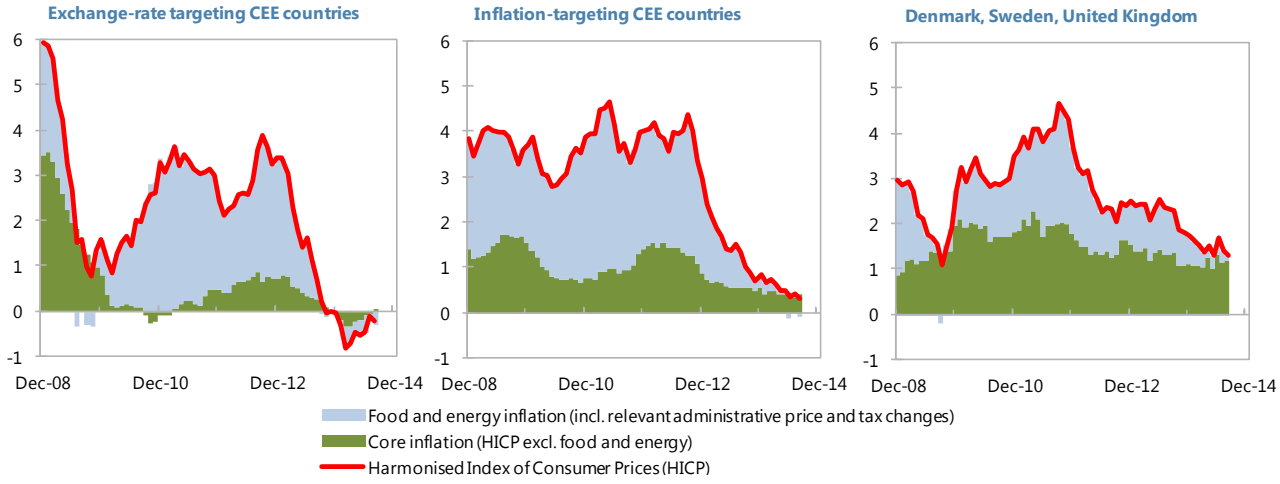
B. Supply-Side, Cost-Push Factors

Price spillovers between trade partners

Falling world food and energy prices and related cuts in administered prices of energy have dampened inflation in all non-euro area EU countries since end-2011 (Figure 2).[6] This effect has been stronger in Central and Eastern Europe (CEE), where the combined share of food and energy in consumer baskets is larger than in their more developed peers—44 percent versus 25 percent, respectively. Better-than-average harvests (e.g., in Romania, Hungary, and Bulgaria) helped ease further food price inflation.

[6] In the euro area, a permanent 10 percent rise in USD oil prices is estimated to have a cumulative upward impact on inflation of 0.5 percentage points over three years (see ECB Monthly Bulletin, October 2013, p. 61).

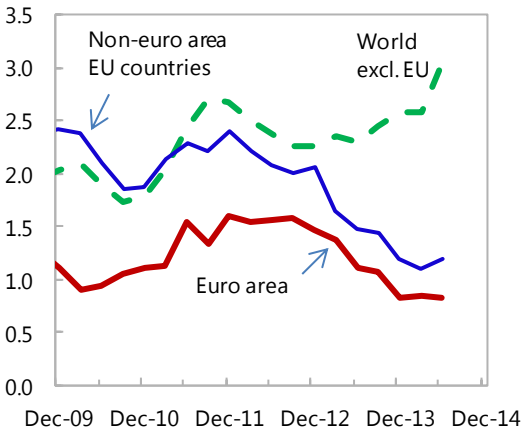
Figure 2. Contributions to Headline Inflation, Dec'08 - Aug'14
(Percentage-points contributions to 12-month growth rates of HICP)



Sources: Eurostat, European Central Bank, and Fund staff estimates.
Note: Exchange-rate targeting CEE countries include Bulgaria, Croatia and Lithuania; Inflation-targeting CEE countries include Czech Republic, Hungary, Poland, and Romania. Croatia is grouped together with exchange rate targetting countries, as in practice the exchange rate is managed within a tight range. Plotted CEE data are weighted averages of country observations, using country HICP weights for 2013.

The EU-wide decline in core inflation suggests that disinflationary spillovers from the euro area may have also been a factor. Since September 2012, core inflation in the euro area and non-euro area EU countries has decoupled from the average in the rest of the world[7] (text figure). In CEE euro peggers, core inflation has even turned negative (Figure 1). The euro area is a major trade partner for both CEE and the other non-euro area EU countries, accounting, respectively, for about half and one third of both their exports and imports of goods. The synchronized disinflation across Europe against the backdrop of divergent trends in core inflation of the euro area and the rest of the world point to possible spillovers of low inflation from the euro area. A portion of the decline in core inflation can also be attributed to the impact of energy and food commodity prices on producer and distribution costs of other products. These effects are likely to be larger in CEE, where the average energy intensity is close to double that of the euro area.

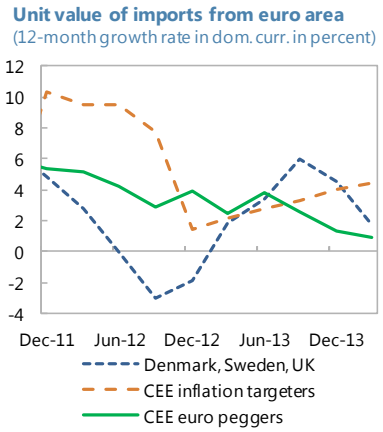
Core inflation
(12-month growth rate in percent)



Source: Haver, Eurostat and Fund staff calculations.
Notes: Data for non-euro area EU countries are weighted averages, using country HICP weights for 2013. Data for the world excluding EU countries are weighted averages, using country GDP weights.

[7] The world core inflation has held up thanks to high core inflation in Brazil and Russia, and more recently pickups in the U.S. and Japan, while it decelerated in India and remained steady in China.

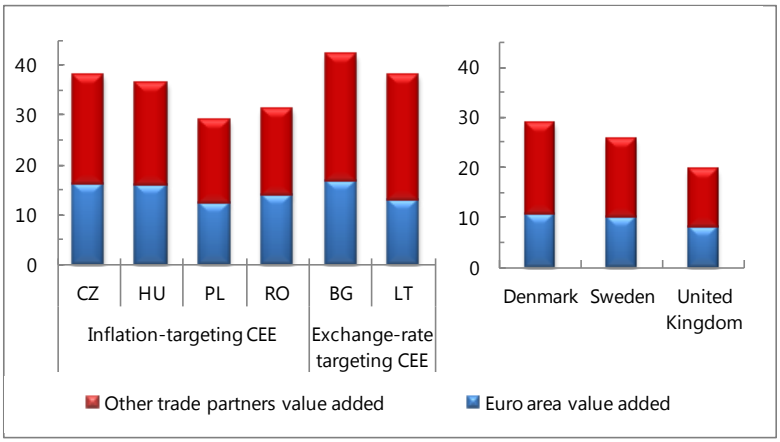
A simple accounting exercise to gauge disinflationary spillovers from the euro area is to calculate the mechanical pass-through to domestic inflation. Since end-2011, the domestic-currency equivalent of the unit value of consumer goods imported from the euro area has declined by a cumulative 6 percentage points in CEE inflation targeters, 4½ percentage points across CEE euro peggers, and 3 percentage points in the rest of the region. Assuming a one-to-one pass-through of costs to final prices and that the share of euro-area sourced goods in consumer baskets is similar to the share of euro area value added in domestic demand (see first text figure in this section), a back-on-the-envelope calculation suggests that, since end-2011, lower EA import prices could have accounted for almost 20 percent of the decline in headline inflation across CEE and almost 10 percent in the rest of the region. This can be seen as an upper-bound of the disinflationary spillovers through the trade channel, in light of the typical findings of low pass-through rates in the empirical literature (Burstein and Gopinath, 2014).



Source: Eurostat.
Notes: Data shown is the domestic-currency equivalent of the unit value of imports from the euro area of consumption goods plus motor spirit and passenger motor cars. Plotted data are weighted averages using country HICP weights for 2013.

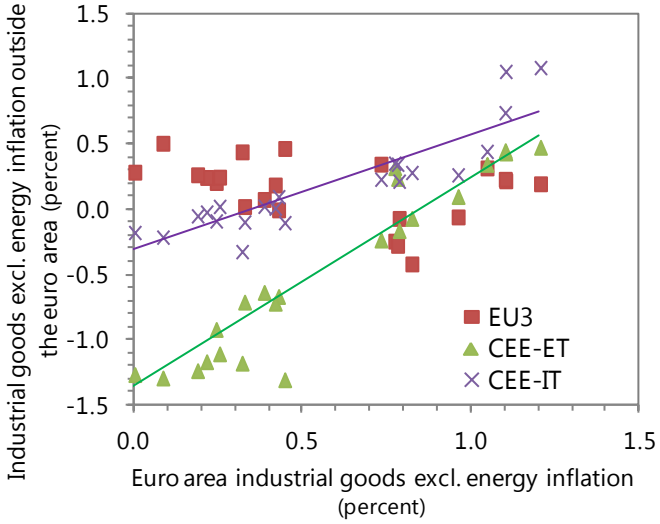
Countries' susceptibility to inflation spillovers from the euro area should vary with the degree of trade openness and the rigidity of the exchange rate regime. The share of foreign value-added content in aggregate demand is between 30 and 40 percent across CEE, with countries with bigger internal markets, such as Poland and Romania, clustered at the lower bound of the range (Figure 3). This ratio is much lower in other non-euro area EU countries. This suggests that smaller CEE countries should be more exposed to disinflationary spillovers from the euro area through the trade channel. At the same time, countries that lack the foreign exchange rate buffer appear to be more susceptible to inflationary spillovers from trade partners. The slope of the regression line linking tradable goods inflation in the euro area and CEE exchange targeters is steeper than in their inflation-targeting peers (Figure 4).

Figure 3. Foreign Value-Added Content of Domestic Final Demand
(Average of 2005 and 2009 values, percent)



Sources: OECD-WTO Trade in Value Added (TIVA) dataset and Fund staff estimates.
Note: Data for Croatia is not available.

Figure 4. EU: Tradable Goods Inflation, Sep 2012- Aug 2014



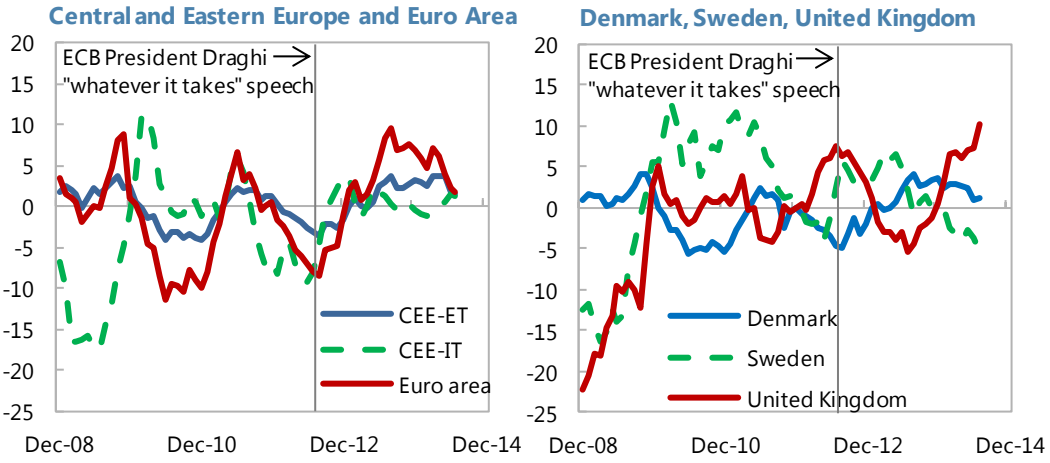
Sources: Eurostat and European Central Bank;.
Note: Exchange-rate targeting CEE (CEE-ET) - Bulgaria, Croatia and Lithuania; Inflation targeting CEE (CEE-IT) - Czech Republic, Hungary, Poland, and Romania; EU3 - Denmark, Sweden, United Kingdom. Plotted data for non-euro area countries are weighted averages of country observations, using country shares in the 2011 GDP for the region, expressed in euros at actual exchange rates.

Exchange-rate developments

The appreciation of currencies pegged to the euro has magnified the pass-through of lower international prices to domestic inflation since mid-2012 (Figure 5 and Appendix Figure 2). Since ECB President Draghi's "whatever it takes" speech in July 2012, the euro nominal effective exchange rate (NEER) has appreciated by 10 percent. The NEERs of exchange-rate targeting CEE countries and Denmark also appreciated, on average, at roughly half that rate.[8] The Polish złoty, Hungarian forint and Swedish krona initially staged stronger rallies than their CEE peers, but have since partially retreated. Over time, the easing cycle of monetary policies has added to the depreciating pressures on flexible exchange rates in many countries in the region, partially offsetting the deflationary external pressures (Appendix Table 1). NEER developments affect not only the domestic equivalent of world commodity prices, but also the prices of non-energy industrial goods and services.[9] The impact is likely to be larger across CEE, as the share of foreign value-added embodied in their domestic demand is more than twice higher than in the euro area.

Figure 5. Nominal Effective Exchange Rates, Dec'08 - Jul'14

(12-month growth rates)



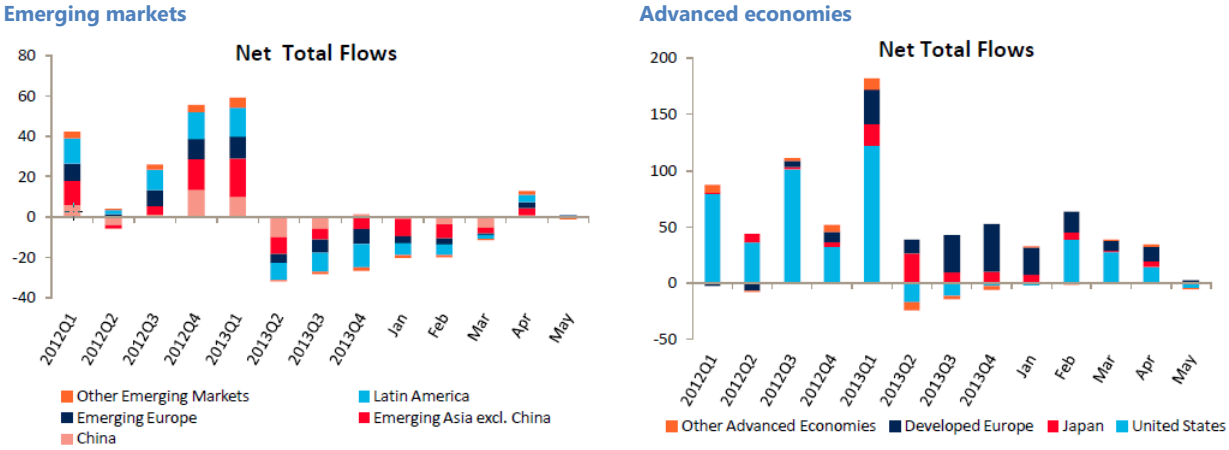
Sources: Eurostat.
Notes: (+) appreciation/ (-) depreciation of the national currency. Exchange-rate targeting CEE countries (CEE-ET) - Bulgaria, Croatia and Lithuania; Inflation targeting CEE countries (CEE-IT) - Czech Republic, Hungary, Poland, and Romania; CEE data are weighted averages of country observations, using country shares in the 2011 GDP for the region, expressed in euros at actual exchange rates.

[8] The lower NEER variance in exchange rate targeting CEE countries is explained by the fact that the euro area is their biggest trading partner, so a large component of the NEER remains constant over time.

[9] In the euro area, a permanent 10 percent NEER depreciation is estimated to have a cumulative upward impact on non-energy industrial goods and services inflation of, respectively 0.6 and 0.5 percentage points over three years (see ECB Monthly Bulletin, March 2014, p. 59).

Portfolio re-allocations by non-residents have been an important driver of exchange rates in inflation-targeting EU countries. The post-July 2012 appreciation of the euro and CEE currencies initially reflected capital inflows driven by improved investor sentiment, as market participants re-evaluated the tail risks, including the risk of a break-up of the euro zone (Figure 6). Since May 2013, the strength of the euro and CEE currencies pegged to it in NEER terms has been supported by the depreciation of the currencies of some large emerging markets, such as Brazil, India, South Africa, as well as the currencies of inflation-targeting CEE countries and Sweden. The post-May 2013 depreciation of emerging market currencies occurred alongside the reversal of capital inflows to these countries, triggered by the announcement of a gradual normalization of US monetary policy. Regression analysis, presented in the April 2014 Regional Economic Issues (IMF, 2014a), shows that benchmark interest rates in advanced economies and global investors' risk aversion—as proxied by the Chicago Board Options Exchange Market Volatility Index—play an important role in dampening/reversing capital inflows and pushing up government bond yields across Central Eastern and South Eastern Europe (CESEE). The empirically observed positive relationship implies, therefore, that monetary policies of advanced economies have a sizable impact on capital inflows and interest rates in CESEE.

Figure 6. Net Fund Flows to Advanced and Emerging Markets, 2012–2014
(Billions of U.S. dollars)



Source: EPFR data, which covers flows to equity and bond funds registered in most major developed market jurisdictions and offshore domiciles, including USA, UK, Canada, Luxembourg, Switzerland, Australia, Hong Kong, Channel Islands, Germany, Austria, France, and many others. Regional data reflects EPFR classifications.

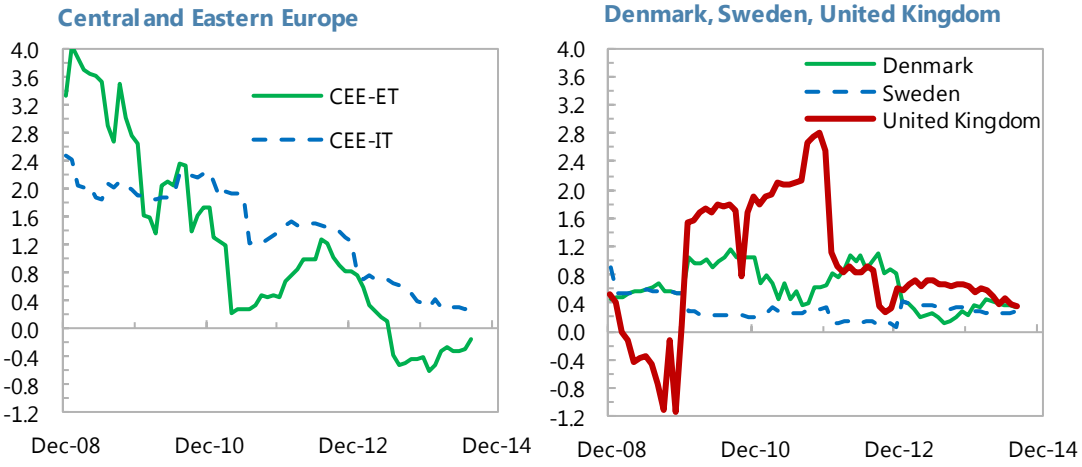
Effect of tax and administered price changes

The contributions to inflation of indirect taxes and, where applicable, administered prices have been significant across non-euro area EU countries (Figure 7). Since end-2011, changes in indirect taxes and administered prices (mostly of energy) have contributed to the easing of domestic price pressures in most countries. On the one hand, the bulk of the post-crisis fiscal consolidation had already taken place in most countries in the region. On the other hand, energy price inflation has eased further in CEE, due to dissipating base effects of previous hikes, and follow-up cuts in administered prices of electricity and/or

gas in Bulgaria, Croatia, the Czech Republic, Hungary, Latvia, Lithuania, and Poland.[10] Many of the countries with the steepest declines in headline inflation have lowered their administered prices of energy by a wider margin than their peers. Changes in indirect taxes and administered prices have been less important for inflation developments in Denmark and Sweden.

Figure 7. Contributions of Taxes and Administered Prices to Headline Inflation, Dec'08 - Aug'14

(Percentage-points contributions to 12-month growth rates of HICP)



Sources: Eurostat.

Notes: The chart shows the sum of: (1) the difference between the growth rates of headline and constant tax HICP; and (2) the contribution of administrative prices to headline inflation. The difference between the growth rates of headline and constant tax HICP captures the theoretical impact of tax and administrative price changes on headline inflation, assuming an instantaneous pass-through of tax rate changes on the price paid by the consumer; Exchange-rate targeting CEE countries (CEE-ET) - Bulgaria and Lithuania; Inflation targeting CEE countries (CEE-IT) - Czech Republic, Hungary, Poland, and Romania; Plotted data for non-euro area CEE countries are weighted averages of country observations, using country HICP weights for 2013. Data for Croatia is an estimate.

Inflationary expectations

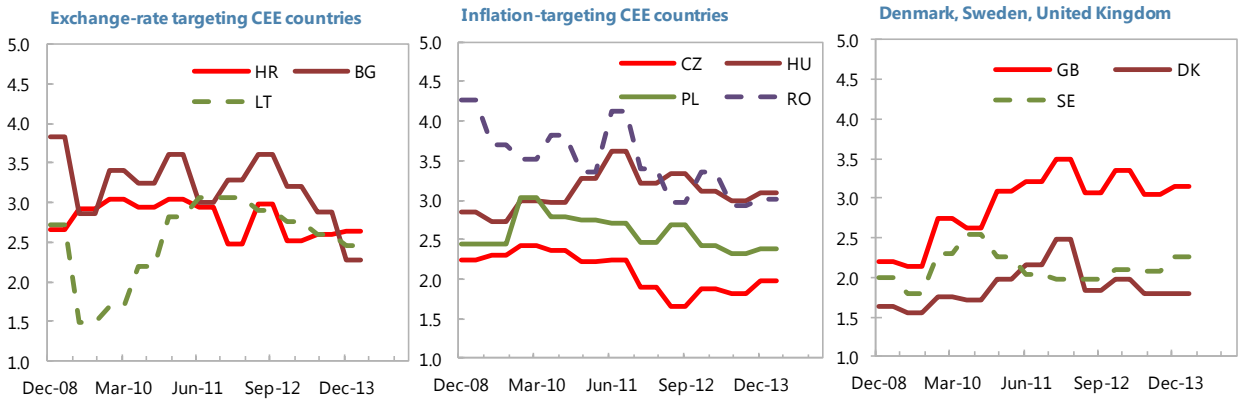
Available survey data, on balance, suggest that the risk of unanchoring of inflationary expectations currently remains low throughout the region. There are important differences in the process of formation of inflationary expectations under fixed-exchange rate and inflation targeting regimes. In euro peggers, inflationary expectations are more exogenous with respect to domestic policies and real sector developments, as these countries import the monetary policy stance and credibility of the European Central Bank. Despite these differences, judging by available indicators of inflationary expectations, the odds of a self-feeding loop between disinflationary expectations and falling inflation currently appear low throughout the region. Projections by professional forecasters from March–April 2014

[10] In Hungary, inflation dynamics are largely determined by the effects of government measures, with the sharp deceleration of headline inflation in recent months explained in part by several cuts in the regulated energy prices for households.

put inflation two-year ahead close to target in the Czech Republic, Hungary, Poland, and Sweden, and above target in Romania and the United Kingdom (Figure 8). Expectations of inflation two-year ahead are also above the ECB target of 2 percent in CEE exchange-rate targeting countries. Furthermore, surveys conducted by the European Commission (EC) show that households in CEE—including in countries experiencing deflation—continue to believe by a wide margin that prices will rise over the next 12-months (Appendix Figure 4). That said, the notable downward drift in medium-term inflationary expectations in a number of non-euro area EU countries is yet to be reversed (Figure 8). For example, in Sweden the July and August EC consumer surveys show more Swedish households now expect prices to fall over the next twelve months than to increase. While other surveys point to a slight uptick in inflation expectations at the one and two-year horizon, the overall picture in Sweden and elsewhere remains of subdued inflation pressures in the short- and medium-term relative to the existing policy targets. And even though longer-term expectations remain well-anchored, survey-based indicators can be wrong—as Moghadam, Teja, and Berkmen (2014) point out, long-term inflation expectations were also positive on the eve of the three deflationary episodes in Japan.

Figure 8. Consensus Forecasts of Inflation 2-Years Ahead, 2004-14

(Percent)



Source: Consensus Economics Long-Term Forecasts.
Note: In a given quarter, the plotted observation is the mean forecast of average annual inflation two years ahead (e.g., in Dec'13 the forecast for 2015 is plotted, and in Mar'14 - that for 2016).

IV. Empirical Analysis

A. Regression Specification

We estimate an open-economy New Keynesian Phillips curve with quarterly data for the ten, present-day, non-euro area EU countries over the period 2004–14. Given the strong inertia exhibited by the inflation series, we include sufficient number of lags of the dependent variable to alleviate the problem of residual autocorrelation. For a country *i*, the regression takes the specific form:

$$\pi_{it} = \alpha_i + \sum_{p=1}^{2} \beta_p \pi_{it-p} + \gamma \pi_{it}^{*} + \delta \tilde{u}_{it} + \zeta_i \pi_t^{EA} + \mathbf{z}_{it}\boldsymbol{\theta} + \mathbf{w}_t\boldsymbol{\vartheta} + \varepsilon_{it},\ t = 1,2,\dots,T \qquad (2)$$

π_t^{EA} – measure of price pressures in the euro area (we expect the country-specific coefficients $\zeta_i \geq 0$).

We allow for differentiated impact of euro area price pressures on inflation in the rest of the EU. Our regression specification captures the average response of inflation across non-euro area EU countries to a set of global and domestic factors, while allowing for country-specific euro area inflation spillovers. We also attempt to explain cross-country differences in the elasticity of domestic inflation with respect to euro area price pressures. Drawing from the stylized facts presented in the preceding section and economic intuition, we examine the possible role of the degree of rigidity of the exchange rate regime and exposure to foreign price developments. This is achieved by interacting the proxy for euro area price pressures in equation (2) with the share of foreign value added in domestic demand (x_i) and allowing for exchange-rate regime specific elasticities (*j)* with respect to the interaction term. If supported by the data, this would represent a more parsimonious parameterization of the link between euro area and inflation in non-euro area EU countries of the form ($\zeta_{\mathrm{i}} = \zeta_j x_i$) than allowing for country-specific elasticities.

B. Regression Analysis

We estimate different regression models based on equation (2) using fixed-effects OLS. The dependent variable is the headline inflation in non-euro area EU countries. Details on the construction of explanatory variables can be found in Appendix II. Our base specification includes proxies for expected inflation, unemployment gap, exchange rate appreciation/depreciation, the contribution of taxes and administered prices to headline inflation, and time effects (Table 1, Model 1). The time effects, which are jointly statistically significant at the 90 percent level of confidence, can be interpreted as a "catch-all" stand-in for external factors common across countries within each time period. All explanatory variables have coefficients with signs consistent with economic theory.

The analysis of the impact of euro area price pressures on domestic inflation allows for a differentiated impact across countries:

- We start by replacing the set of time dummies with world commodity price and euro area core inflation rates (Table 1, Model 2). The euro area core inflation is our preferred proxy for euro area price pressures, as it strips off the effect of imported food and energy prices. The R^2 of the new model is only slightly lower than the one of the regression with common time effects, suggesting that world commodity prices and euro area core inflation account for a large share of the variance of relevant common factors.

- Next, we allow for country-specific coefficients of euro area core inflation (Table 1, Model 3). Results suggest that Bulgaria, Lithuania, and Croatia are most susceptible to price spillovers from the euro area, followed by Hungary and the Czech Republic. Three of these countries have currencies pegged to the euro, while all of them—except possibly Croatia for which data is not directly available—have high foreign value added in domestic demand. In the last step of the analysis, we check whether we can use this information to achieve a more parsimonious parameterization of the link between euro area and inflation in non-euro area EU countries.

- Finally, we interact the euro area core inflation, first, with exchange-rate regime dummy variables (Table 1, Model 4), and, second, simultaneously with the share of foreign value added in domestic demand and exchange-rate regime dummy variables (Table 1, Model 5). Results confirm that the degree of rigidity of the exchange rate regime and exposure to foreign prices explain well cross-country differences in inflation elasticities with respect to euro area core inflation. The R^2 of these models are the same as the one of the regression with unrestricted, country-specific coefficients of euro area core inflation. Model 5 represents our preferred regression specification.

The results suggest that food and energy prices account for a large share of the variance of headline inflation. According to the variance decomposition based on our preferred regression model (Table 1, Model 5) over the whole sample period, world food and energy price changes together with related changes in administered prices, as well as taxes account for about half of the variability of headline inflation across non-euro area EU countries (Figure 7, left panel; see Appendix Figure 3 for country-by-country breakdown).[11] Most administered prices are related to energy, while in Central and Eastern Europe the stepwise increase in alcohol and tobacco excises to EU norms accounts for a sizable share of tax increases. In addition, the positive coefficient of inflationary expectations can, in part, capture 'second-round' effects on headline inflation (as defined in ECB, 2010) of food and energy prices, through the effect of the labor costs adjustments that they trigger on inflationary expectations.

Disinflation spillovers from the euro area have been an important factor for euro peggers, and inflation targeters with high foreign value added in domestic demand. Over the whole sample period, imported price pressures from the euro area account for between 2 and 37 percent of inflation variability in non-euro area EU countries (Appendix Figure 3). These shares have remained roughly unchanged in the last two years of the sample (Figure 7, right panel) and are broadly in line with the findings from the

[11] The contribution of variable X_j to the inflation variance v is $v_j = Var(\beta_j X_j) + Cov(\beta_j X_j, \sum_{k \neq j}^{n} \beta_k X_k)$. It represents a long-term view, when current, past, and expected inflation rates are all equal.

accounting exercise of calculating the contribution of EA import prices to the decline of headline inflation in non-euro area EU countries since end-2011 (see Section III.B above).

Table 1. Fixed-Effects Estimation of Expectations-Augmented Phillips Curve

Explanatory variables / Dependent variable	Domestic Headline Inflation				
	(1)	(2)	(3)	(4)	(5)
Country-specific factors:					
Inflation (-1)	0.98 (0.049)***	0.85 (0.046)***	0.81 (0.047)***	0.83 (0.046)***	0.82 (0.046)***
Inflation (-2)	-0.34 (0.043)***	-0.28 (0.040)***	-0.27 (0.040)***	-0.28 (0.040)***	-0.28 (0.040)***
Inflation expectations (2-year ahead)	0.48 (0.070)***	0.63 (0.083)***	0.61 (0.084)***	0.59 (0.082)***	0.60 (0.082)***
Unemployment gap	-0.13 (0.045)***	-0.18 (0.039)***	-0.16 (0.041)***	-0.18 (0.039)***	-0.17 (0.039)***
Contribution of administered prices and taxes	0.26 (0.036)***	0.34 (0.037)***	0.35 (0.037)***	0.36 (0.037)***	0.36 (0.036)***
Nominal effective exchange rate	-0.04 (0.007)***	-0.05 (0.007)***	-0.05 (0.007)***	-0.05 (0.007)***	-0.05 (0.007)***
Global factors:					
Time dummies	Yes	No	No	No	No
World oil inflation * weight of energy in consumer baskets		0.06 (0.012)***	0.07 (0.012)***	0.07 (0.012)***	0.07 (0.012)***
World food inflation * weight of food in consumer baskets		0.03 (0.011)***	0.03 (0.011)***	0.03 (0.011)***	0.03 (0.011)***
Euro Area core inflation:					
Stand-alone		0.56 (0.126)***			
Interacted with country dummies:					
Bulgaria			1.44 (0.360)***		
Croatia			1.19 (0.329)***		
Czech Republic			0.81 (0.332)**		
Hungary			0.99 (0.335)***		
Lithuania			1.27 (0.376)***		
Poland			0.40 (0.333)		
Romania			0.56 (0.335)*		
Denmark			0.14 (0.325)		
Sweden			0.00 (0.33)		
UK			-0.09 (0.325)		
Interacted with FX-regime dummy variables:					
Pegged				0.92 (0.192)***	
Other arrangement				0.73 (0.199)***	
Free floating				0.07 (0.197)	
Interacted with FX-regime dummy variables and the share of foreign value-added in demand:					
Pegged * foreign value-added in demand					2.95 (0.564)***
Other arrangement * foreign value-added in demand					2.18 (0.563)***
Free floating * foreign value-added in demand					0.46 (0.782)
R^2	0.94	0.91	0.91	0.91	0.91
N	390	390	390	390	390
Time dummies (joint significance)	t = 1.76 (0.078)*				
Fixed effects (joint significance)	F(9, 336) =1.43 (0.17)	F(9, 371) = 1.94 (0.046)**	F(9, 362) =2.68 (0.005)***	F(9, 369) =2.64 (0.006)***	F(9, 370) =3.67 (0.0002)***

Notes: s.e. in parentheses; * p<0.1; ** p<0.05; *** p<0.01; sample 2004q1-2014q1.

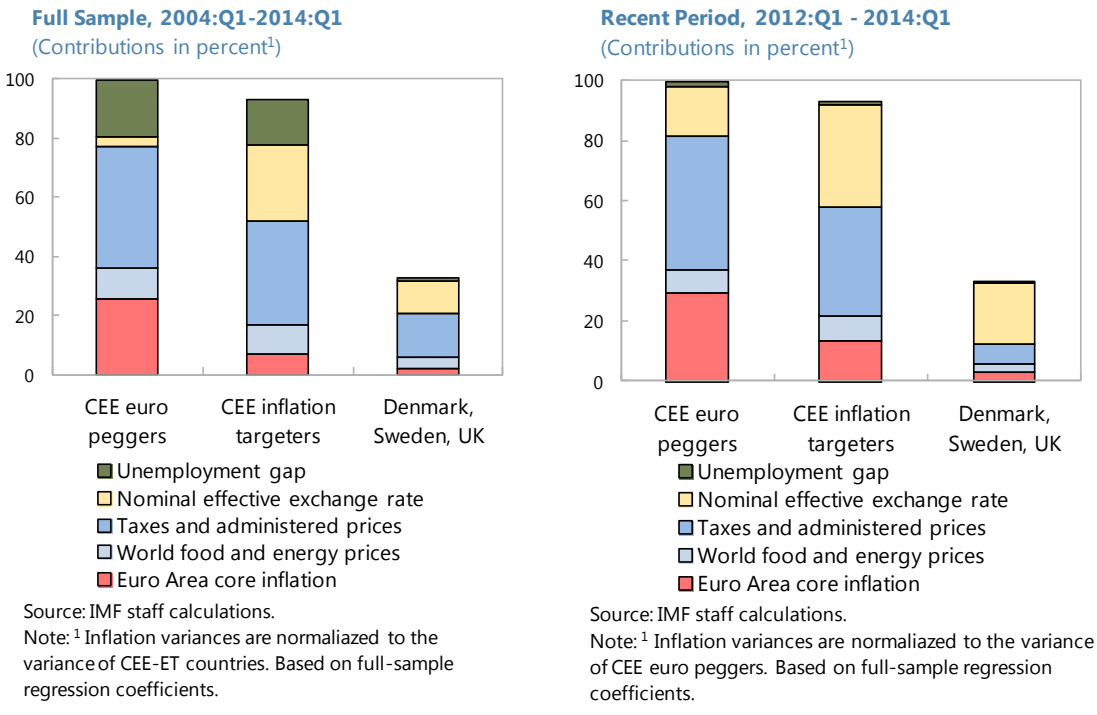
Table 2 provides a summary of the country-specific impact of a one percentage point change in euro area core inflation on domestic headline inflation:

- Countries with more rigid exchange rate arrangements tend to import more inflation from the euro area.

- Inflation spillovers from the euro area are also larger, the higher the share of domestically consumed foreign value-added (e.g., in the Czech Republic and Hungary).[12]

- The disinflationary spillovers from the euro area to Poland, Romania, Sweden, and the United Kingdom are relatively small over the full sample, due to the smaller foreign value-added in domestic demand and the greater exchange rate flexibility of the Polish złoty, Swedish krona, and the British pound (Table 2 and Appendix Figure 3). At the same time, the contribution of euro area core inflation to the variance of domestic inflation in these countries has increased since end-2011, particularly in Poland (Appendix Figure 3). In line with the findings in IMF (2014b), the effect of euro area price pressures on Swedish inflation is positive but small.

Figure 9. Variance Decomposition of Headline Inflation
(Percent)



Source: IMF staff calculations.
Note: [1] Inflation variances are normaliazed to the variance of CEE-ET countries. Based on full-sample regression coefficients.

Source: IMF staff calculations.
Note: [1] Inflation variances are normaliazed to the variance of CEE euro peggers. Based on full-sample regression coefficients.

[12] For a given degree of exposure to foreign prices, the difference in the elasticity of domestic inflation with respect to euro area core inflation in euro peggers and countries with other managed arrangements is not statistically significantly at the 90 percent confidence level.

The nominal effective exchange rate and, to a lesser extent, the unemployment gap are also important determinants of inflation. Over the whole sample period, the nominal effective exchange rate explains about a third of the inflation variance in inflation-targeting countries, while its contribution is much smaller across euro peggers.[13] The unemployment gap accounts for an additional 15 percent of inflation variance across CEE, while its effect is much smaller in the other non-euro area EU countries. The limited impact of the cyclical unemployment seems consistent with the tendency of flattening of the Phillips-curve across advanced economies in IMF(2013a). In the last two years, the nominal effective exchange rate has played a larger role than over the whole sample period, likely reflecting the appreciation of many regional currencies in the aftermath of ECB President Draghi's "whatever it takes" speech in July 2012 and the weakness of the currencies of some large emerging markets since May 2013.

Table 2. Impact of an One Percentage Point Increase in Euro Area Core Inflation on Domestic Headline Inflation

	Foreign Value-Added Content of Domestic Final Demand *(percent)*		
	20	30	40
Exchange rate regime			
Free floating	0.1 (UK)	0.14 (SE, PL)	
Other managed arrangements		0.6* (RO)	0.9*** (HU, CZ)
Currency peg		0.9*** (HR, DK)	1.2*** (BG, LT)

Source: Table 1, Model 5.

Notes: Statistical significance: * p<0.1; ** p<0.05; *** p<0.01. Countries are grouped according to the classification of their *de facto* exchange rate arrangements circa April 2013 in IMF (2013b), except for the Czech Republic, which has since been reclassified to other managed arrangement.

C. Robustness Tests

We test the stability of our preferred regression specification, by using alternative measures of euro area prices pressures, adding global core inflation outside the euro area as an explanatory variable, and excluding the United Kingdom from the sample (Appendix Tables 2):

- Excluding the United Kingdom—which is a large and structurally different economy from other non-euro area EU countries—from the sample has no material effect on regression coefficients (Appendix Table 2, Model 1).
- Global core inflation outside the euro area is not statistically significant, when added to our preferred regression specification (Appendix Table 2, Model 2). At the same

[13] For Romania, Xu (2014) using VAR on monthly frequency arrives at similar results as our findings for the full-sample (see Appendix Figure 3).

time, the effects of euro area core inflation are preserved. This is in line with the stylized fact of decoupling of EU-wide core inflation from developments in the rest of the world.

- Substituting euro area core inflation sequentially with the euro area output gap, unemployment rate gap, and instrumented euro area inflation (Appendix Table 2, Models 3 to 5) does not change the findings from our preferred regression specification.

- The statistical significance of the coefficients of our preferred regression specification remains unchanged, when we adjust the standard errors using the Huber-White sandwich estimator to account for possible heteroskedasticity in the data.

We further check whether our findings are robust to possible endogeneity bias in estimated coefficients. Both the pooled and fixed-effects OLS are generally inconsistent in the presence of endogenous explanatory variables and/or a lagged dependent variable. As an alternative, we estimate Model 5 in Table 1 by System 2SLS and 3SLS (Appendix Table 3).[14] These estimators are less prone to endogeneity biases (Iossifov, Cihák, and Shanghavi, 2008). The System 3SLS estimator is more efficient because it uses the additional information contained in the covariance structure of the errors in the different equations of the system.

The System 2SLS and 3SLS estimators evaluate the system of simultaneous equations formed by stacking the Phillips curves for every country in our sample. The model is estimated with country-specific intercepts and cross-equation restrictions on the other coefficients to make them equal across countries or group of countries. Given the structure of the system, the number of suitably lagged explanatory variables that can serve as potential instruments greatly exceeds the degrees of freedom of each equation in the system (for details, see Iossifov, Cihák, and Shanghavi, 2008). To overcome this problem, we use as instruments (for all equations in the system) the third lags of the euro area output gap, euro area core inflation, global core inflation outside the euro area, as well as the first two principal components of the country-realizations in our sample of domestic inflation, unemployment gap, output gap, exchange rate appreciation/depreciation, and the contribution of taxes and administered prices to headline inflation. This gives us 13 instruments for use on each equation in the system. The instruments are lagged by three periods to ensure their exogeneity with respect to the system's error terms.

Results from the System 2SLS and 3SLS estimation of our preferred regression specification confirm the importance of disinflationary spillovers from the euro area.

[14] The more commonly used Arellano-Bond dynamic-panel GMM estimators are not appropriate in the case of our database, because in order to be able to rely on their asymptotic properties, the cross-sectional unit dimension of the data must be very large.

The System 2SLS and 3SLS estimates of all regression coefficients, except for the lags of the dependent variable, are smaller in magnitude than their fixed-effects OLS counterparts (Appendix Table 3). But, they remain statistically significant at the 95 percent level of confidence for all explanatory variables, except for world food inflation. The System 2SLS confirm the relative ranking by exchange rate regime of the elasticities of domestic inflation with respect to euro area core inflation, derived from the fixed-effects OLS estimation. However, the relative standing of euro peggers and countries with other managed arrangements is reversed in the System 3SLS results. But, in both cases and in line with the fixed-effects OLS findings, the difference in the elasticity of domestic inflation with respect to euro area core inflation in euro peggers and countries with other managed arrangements is not statistically significant at the 90 percent confidence level.

D. Inflation Outlook

Forecasts based on our preferred regression model suggest that over the next 12 months inflation is likely to rebound, but very gradually in most non-euro area EU countries. Inflation forecasts have been constructed under current policy settings—assuming no changes in nominal effective exchange rates and taxes, and no contemporaneous adjustment in administered prices of energy given the small projected decline in commodity prices—and using the WEO projections[15] of commodity prices and GDP growth, inflation forecasts from Consensus Forecasts (as of April 2014), and EA core inflation projection from the ECB (2014b). Given that inflation targets are considered medium-term objectives, we use the model to forecast annual inflation in mid-2015. To this end, we calculate the lagged dependent variable as the average of 12-month inflation rates over the period June 2013–May 2014. Results suggest that the expected firming of the economic recovery and the associated gradual closing of the unemployment and output gaps, together with well anchored inflation expectations and euro area recovery, will provide a small boost to inflation (Figure 10).

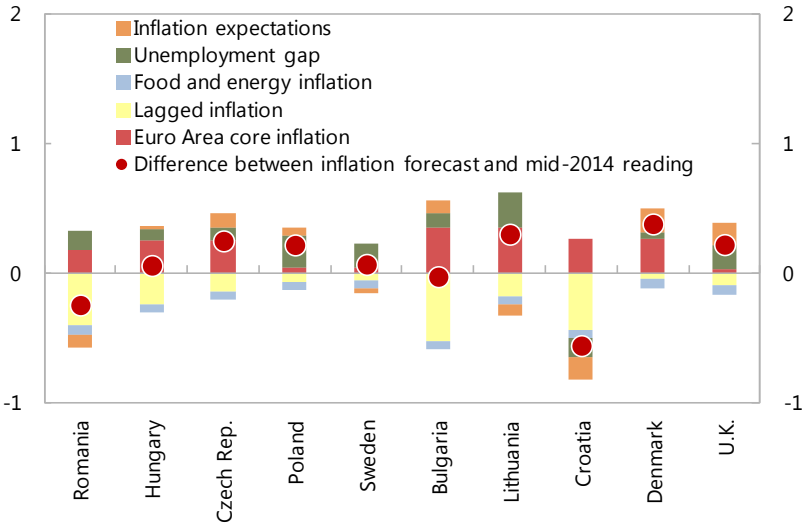
Under current policies, inflation is expected to remain low and below target in the next 12 months in several non-euro area EU countries. The point forecast of the 12-month ahead inflation is around one percent across non-euro area EU countries, except in Romania and the United Kingdom. In Hungary, Poland, and Sweden, inflation appears likely to remain below its target at least until mid-2015 (Figure 11).[16] This is consistent with the current IMF Staff inflation forecasts for these countries.

[15] Desks' real GDP projections are converted into unemployment rate forecasts using a calibrated Okun's Law type relationship: Δ Unemployment rate = 1.0 - 0.7 x GDP growth.

[16] We consider the inflation target to be within reach, if it falls within the 95-percent confidence interval of our forecast. National inflation targets are set in reference to the national definition of the consumer price index. Therefore, the comparison between the forecast of HICP inflation and national inflation targets should be seen as illustrative only, though in practice the national and HICP indices generally exhibit similar trends.

Figure 10. Difference Between Model-based Forecast of Annual Inflation in Mid-2015 and Its Mid-2014 Reading

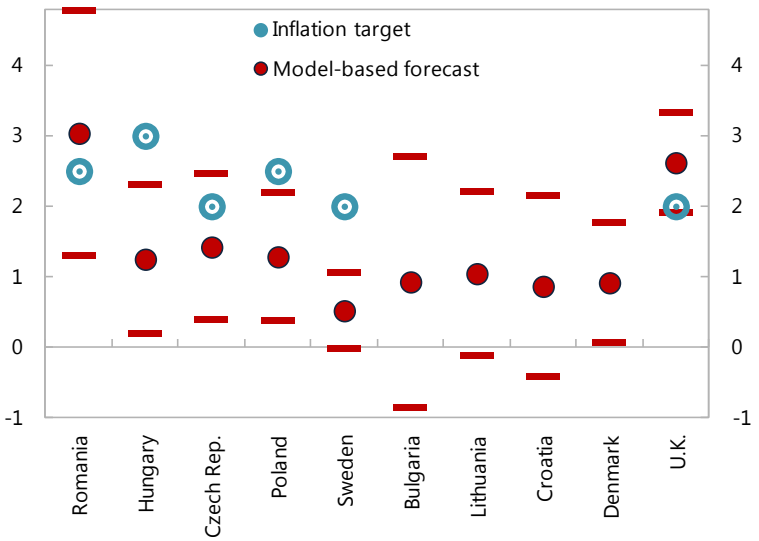
(Percentage-points contributions of explanatory variables)



Source: IMF staff estimates based on Model 5 in Table 1.
Note: The value of annual inflation in mid-2014, which is also used for the one-year lag of inflation, is calculated as the average of 12-month inflation rates over the period June 2013 – May 2014.

Figure 11. Conditional Inflation Forecast, mid-2015

(Percent)



Source IMF staff estimates based on Model 5 in Table 1.
Note: The red lines mark the 95-percent confidence interval of the conditional inflation forecast.

V. Summary and Policy Implications

Disinflationary trends in non-euro area EU countries are primarily driven by cost-reducing, external factors. Falling world food and energy prices and related cuts in

administered prices, as well as taxes account for more than half of the volatility of headline inflation across non-euro area EU countries since end-2011. Disinflation spillovers from the euro area have been an important factor for exchange-rate targeters, and inflation targeters with high foreign value added in domestic demand. The exchange rate regime is not the main factor determining countries' susceptibility to inflation spillovers from the euro area, as most exchange rate targeters are also small open economies with a high share of foreign value-added in domestic demand. The dynamics of the nominal effective exchange rates also play an important role, particularly in inflation targeting countries. The limited impact of cyclical unemployment could suggest a flattening of the Phillips-curve across the EU in the post-crisis period.

Low inflation is projected to persist through 2015. Under current policies and WEO assumptions, inflation is likely to pick up but remain low through at least mid-2015 in most non-EA EU countries. Regression-based, point forecasts of inflation 12-months ahead fall short of the inflation targets in Poland, Hungary, and Sweden.

While euro peggers do not have monetary autonomy, the monetary policy response to low inflation in inflation-targeting countries needs to weigh the risk of a self-feeding loop between disinflationary expectations and falling inflation, capital flows, and financial stability concerns:

- Judging by indicators of *inflationary expectations*, the risk of their unanchoring currently appears low throughout the region assuming long-term inflation expectations and actual inflation do not drift lower in the euro area. However, continued vigilance is warranted, as long-term inflation expectations were also positive on the eve of the three deflationary episodes in Japan.

- In countries with significant presence of non-resident investors in local markets, *capital flows* have a bearing on the space for policy maneuver. On the one hand, capital inflows may pick up as risk appetite returns or as EA yields fall in response to the ECB easing. On the other hand, there is a risk that capital outflows may resume due to heightened geopolitical concerns or unexpected Fed tightening.

- *Financial stability* concerns are typically best addressed with macroprudential tools, but central banks might have to "lean against the wind", where such policies are not effective.

The ECB monetary policy stance has important implications for inflation developments in non-EA EU countries. Euro peggers are proportionately more affected, as euro area inflation is transmitted more directly via the trade channel—due to the lack of exchange rate buffer and the high share of foreign value-added in domestic demand—and the impact of euro area monetary policy on domestic liquidity conditions and inflationary expectations.

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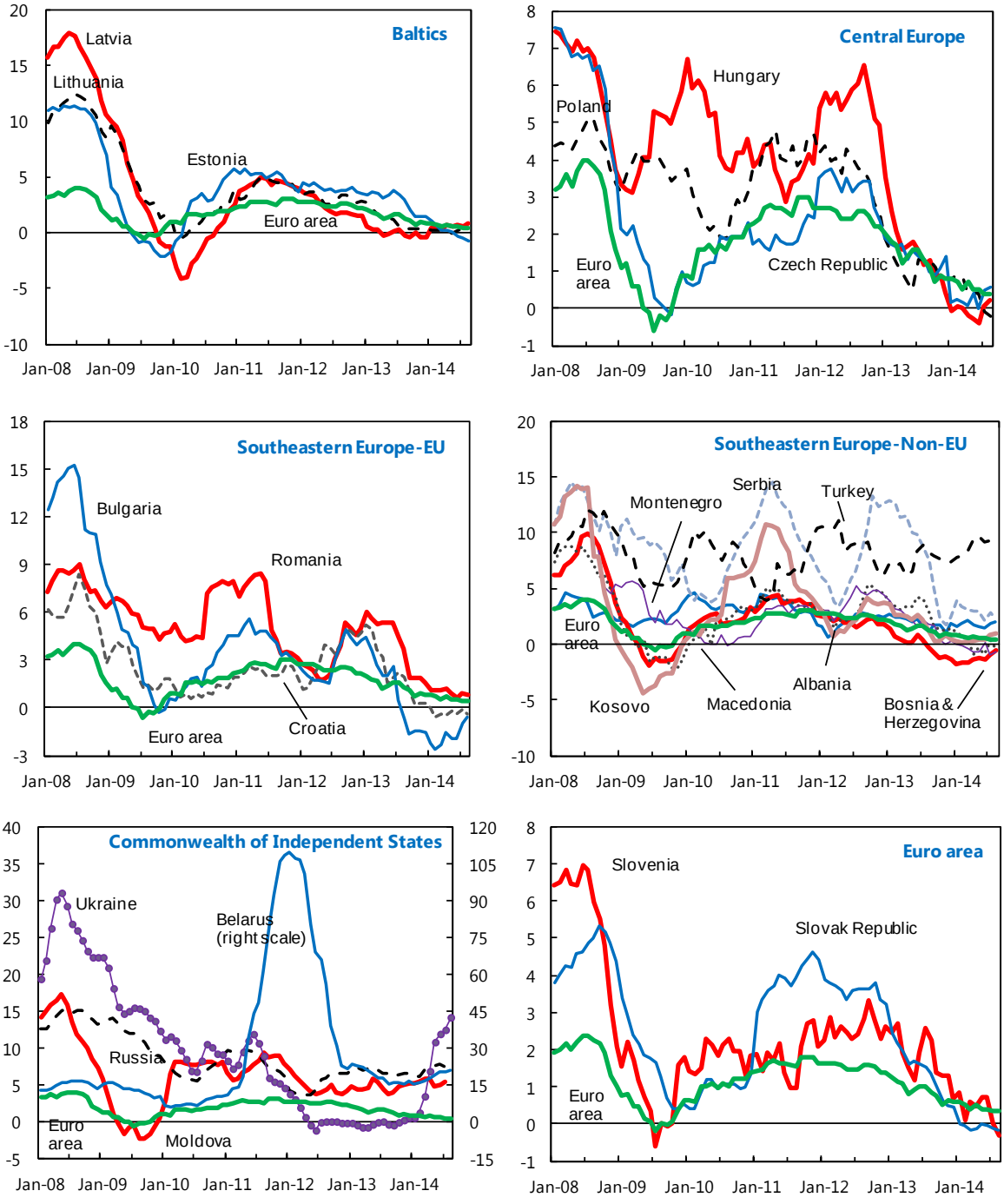
APPENDIX I. APPENDIX FIGURES AND TABLES

Appendix Figure 1. Consumer Prices

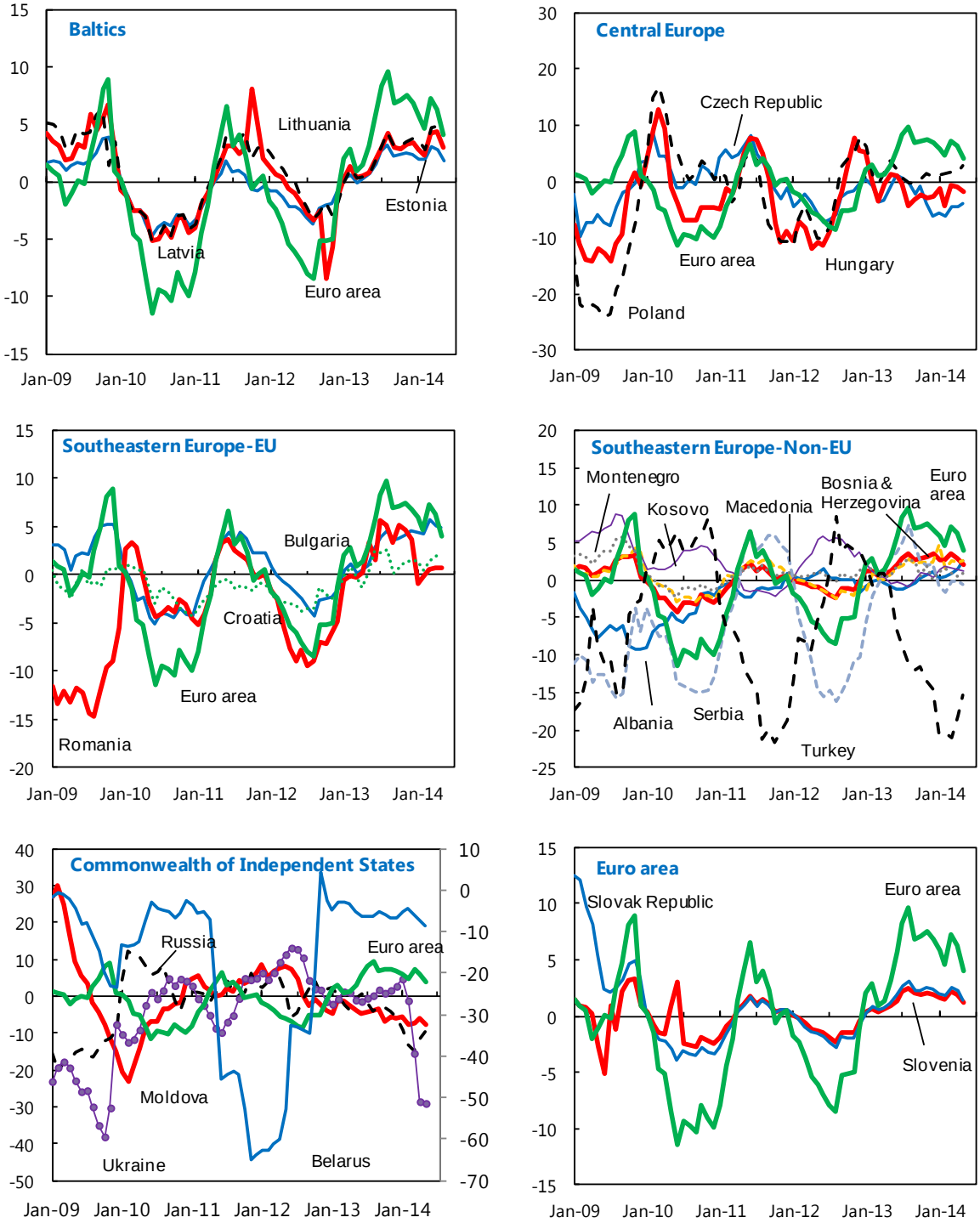
(In percent, year on year)



Sources: Haver Analytics; and IMF, International Financial Statistics.
Note: National CPI indices for non-euro area countries except for Serbia, for which HICP data is shown. Not seasonally adjusted.

Appendix Figure 2. Nominal Effective Exchange Rate

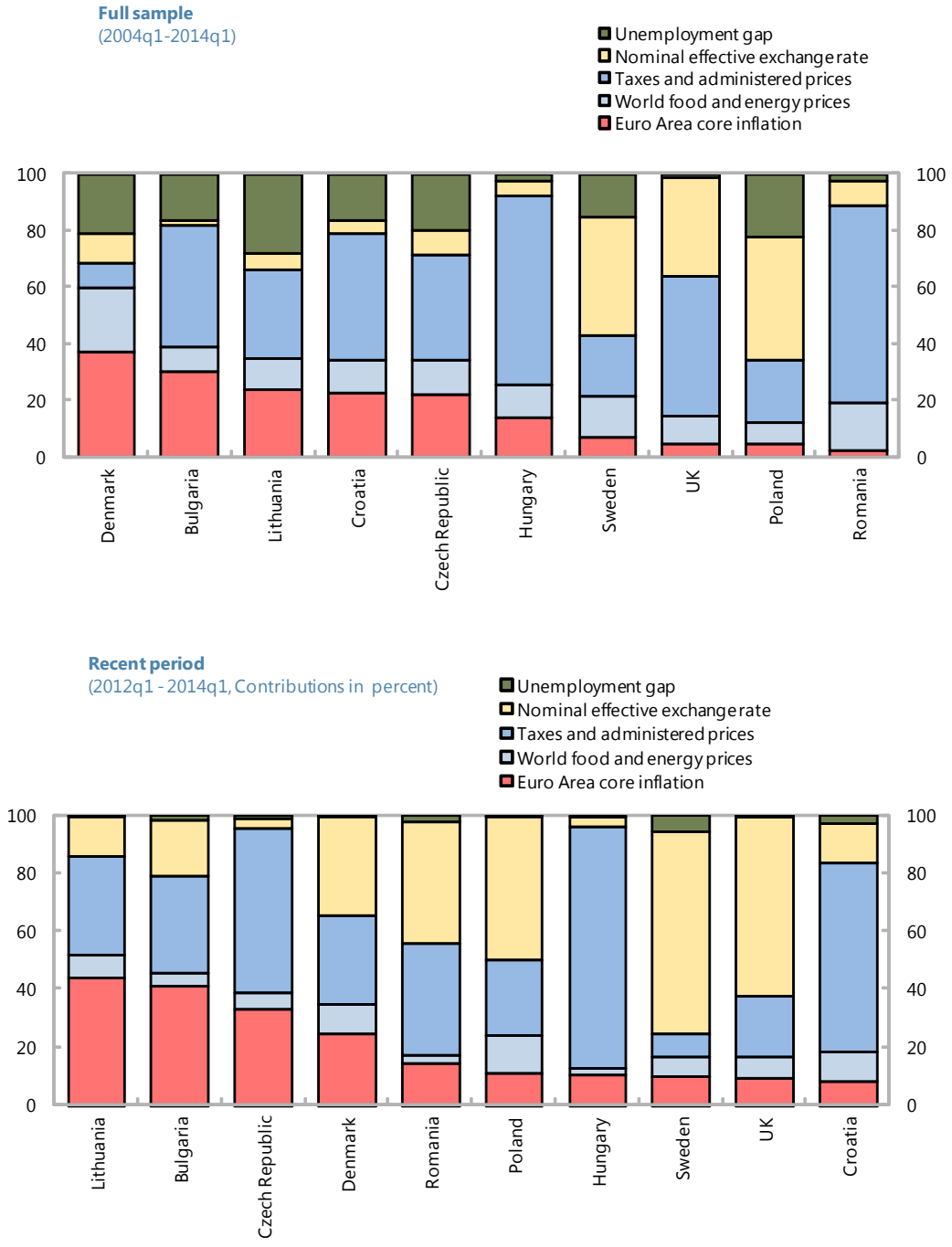
(Percent, year-over-year)



Sources: IMF, Information Notice System.

An increase denotes appreciation of the national currency.

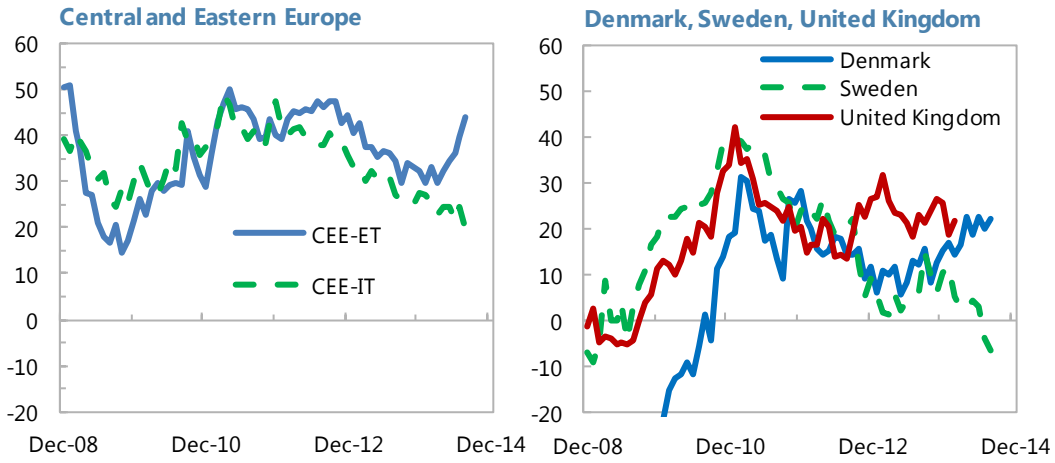
Appendix Figure 3. Non-EU EA Countries: Inflation Variance Decomposition, 2004-14



Source: IMF Staff calculations.

Appendix Figure 4. Consumer Inflationary Expectations over Next 12 Months, 2009-14

(Index)



Sources: European Commission.

Notes: Seasonally adjusted. The shown indicator summarizes survey responses to the question on price trends over next 12 months. It is calculated as +1* ("Will rise a lot")+ 1/2 * ("Will rise moderately"- 1/2 * ("Will stay about the same") - 1 * ("Will fall"). Exchange-rate targeting CEE countries (CEE-ET) - Bulgaria, Croatia and Lithuania; Inflation targeting CEE countries (CEE-IT) - Czech Republic, Hungary, Poland, and Romania; CEE data are weighted averages of country observations, using country shares in the 2011 GDP for the region, expressed in euros at actual exchange rates.

Appendix Table 1. Chronology of Monetary Policy Measures in Non-Euro Area EU Countries, Jul 2012 -2014

Date		Croatia	Czech Republic	Hungary	Poland	Romania	Denmark	Sweden	United Kingdom	Euro area
		Lombard loan rate	Repo rate	Repo rate	Repo rate	Monetary policy rate	Repo rate	Repo rate	Asset Purchase Programme	Main refinancing operations fixed rate
2012 Jul	05						▼ 25 bp to 0.20%		▲ GBP 50 bln to 375 bln	
	11									▼ 25 bp to 0.75%
2012 Aug	28			▼ 25 bp to 6.75%						
2012 Sep	06							▼ 25 bp to 1.25%		
	25			▼ 25 bp to 6.50%						
	27		▼ 25 bp to 0.25%							
2012 Oct	30			▼ 25 bp to 6.25%						
2012 Nov	01		▼ 20 bp to 0.05%							
	07				▼ 25 bp to 4.50%					
	27			▼ 25 bp to 6.00%						
2012 Dec	05				▼ 25 bp to 4.25%					
	18			▼ 25 bp to 5.75%				▼ 25 bp to 1.00%		
2013 Jan	09				▼ 25 bp to 4.00%					
	25						▲ 10 bp to 0.30%			
	29			▼ 25 bp to 5.50%						
2013 Feb	06				▼ 25 bp to 3.75%					
	26			▼ 25 bp to 5.25%						
2013 Mar	07				▼ 50 bp to 3.25%					
	27			▼ 25 bp to 5.00%						
2013 Apr	24			▼ 25 bp to 4.75%						
2013 May	02									▼ 25 bp to 0.50%
	03						▼ 10 bp to 0.20%			
	09				▼ 25 bp to 3.00%					
	28			▼ 25 bp to 4.50%						
2013 Jun	05				▼ 25 bp to 2.75%					
	25			▼ 25 bp to 4.25%						
2013 Jul	01					▼ 25 bp to 5.00%				
	03				▼ 25 bp to 2.50%					
	23			▼ 25 bp to 4.00%						
2013 Aug	05					▼ 50 bp to 4.50%				
	27			▼ 20 bp to 3.80%						
2013 Sep	24			▼ 20 bp to 3.60%						
	30					▼ 25 bp to 4.25%				
2013 Oct	29			▼ 20 bp to 3.40%						
2013 Nov	05					▼ 25 bp to 4.00%				
	07									▼ 25 bp to 0.25%
	25	▼ 125 bp to 5.00%								
	26			▼ 20 bp to 3.20%						
2013 Dec	17							▼ 25 bp to 0.75%		
	18			▼ 20 bp to 3.00%						
2014 Jan	08					▼ 25 bp to 3.75%				
	21			▼ 15 bp to 2.85%						
2014 Feb	04					▼ 25 bp to 3.50%				
	18			▼ 15 bp to 2.70%						
2014 Mar	25			▼ 10 bp to 2.60%						
2014 Apr	29			▼ 10 bp to 2.50%						
2014 May	27			▼ 10 bp to 2.40%						
2014 Jun	05									▼ 10 bp to 0.15%
	24			▼ 10 bp to 2.30%						
2014 Jul	03							▼ 50 bp to 0.25%		
	22			▼ 20 bp to 2.10%						
2014 Aug	04					▼ 25 bp to 3.25%				
2014 Sep	04									▼ 10 bp to 0.05%

Notes: Additional monetary policy measures:

Euro area

The European central bank changed the deposit facility and marginal lending facility rates in lockstep with the changes made to the main refinancing operations fixed rate.

On June 5, 2014, the ECB announced a prolongation of fixed rate, full allotment tender procedures, suspension of the weekly fine-tuning operation sterilising the liquidity injected under the Securities Markets Programme, and a decision to launch outright purchases of asset-backed securities in the coming months.

Croatia

On April 10, 2013, Hrvatska Narodna Banka lowered the interest rate on banks' overnight deposits from 0.25% to 0.00%.

Czech Republic

On November 7, 2013, the CNB Board decided to start using the exchange rate as an additional instrument for easing the monetary conditions. The CNB intervenes on the foreign exchange market to weaken the koruna so that the exchange rate of the koruna against the euro is close to CZK 27.

Denmark

On April 25, 2014, the Danmarks Nationalbank increased its interest rate on certificates of deposit by 15 basis points to 0.05%.

Hungary

The "Funding for Growth Scheme" was launched in June 2013 with to improve SMEs access to bank financing by extending no-cost loans to banks for on-lending to SMEs at negative or close to zero real interest rates.

United Kingdom

The Bank of England increased the size of its asset purchase program by GBP 50 billion to a total of GBP 375 billion in July 2012, and later extended it until January 2015 and further modified it in 2013.

On August 1, 2013, the Bank of England introduced forward guidance, and announced its intention not to raise Bank Rate from its current level of 0.5% at least until the Labour Force Survey headline measure of the unemployment rate has fallen to a threshold of 7%, subject to three knockout conditions related to inflation forecast and expectations as well as financial stability.

Appendix Table 2. Fixed-Effects Estimation of Expectations-Augmented Phillips Curve with Alternative Measures of Euro Area Inflationary Pressures

	Headline inflation				
	(1)	(2)	(3)	(4)	(5)
	Euro area core inflation w/o UK	Euro area core inflation w/ world core (ex euro area)	Euro area output gap	Euro area unemployment gap	Euro area inflation instrumented [1/]
Country-specific factors:					
Inflation (-1)	0.83 (0.049)***	0.83 (0.046)***	0.83 (0.046)***	0.83 (0.046)***	0.78 (0.050)***
Inflation (-2)	-0.28 (0.042)***	-0.28 (0.039)***	-0.23 (0.041)***	-0.27 (0.040)***	-0.22 (0.042)***
Inflation expectations (2-year ahead)	0.60 (0.088)***	0.60 (0.082)***	0.46 (0.085)***	0.52 (0.083)***	0.53 (0.085)***
Unemployment gap	-0.18 (0.041)***	-0.17 (0.039)***	-0.19 (0.039)***	-0.17 (0.041)***	-0.23 (0.037)***
Contribution of administered prices and taxes	0.36 (0.039)***	0.35 (0.037)***	0.39 (0.037)***	0.37 (0.037)***	0.41 (0.039)***
Nominal effective exchange rate	-0.05 (0.008)***	-0.05 (0.007)***	-0.05 (0.007)***	-0.05 (0.007)***	-0.04 (0.007)***
Global factors:					
World oil inflation * weight of energy in consumer baskets	0.07 (0.013)***	0.07 (0.013)***	0.07 (0.012)***	0.08 (0.012)***	0.05 (0.013)***
World food inflation * weight of food in consumer baskets	0.03 (0.011)***	0.03 (0.011)***	0.00 (0.012)	0.00 (0.013)	0.03 (0.011)**
World core inflation (excl. euro area)		0.14 (0.12)			
Proxies for Euro Area price pressures interacted with FX-regime dummy variables and the share of foreign value-added in demand:					
Euro Area core inflation:					
Pegged * foreign value-added in demand	2.90 (0.588)***	3.08 (0.575)***			
Other arrangement * foreign value-added in demand	2.17 (0.586)***	2.30 (0.57)***			
Free floating * foreign value-added in demand	0.66 (0.915)	0.65 (0.799)			
Euro Area output gap:					
Pegged * foreign value-added in demand			0.82 (0.137)***		
Other arrangement * foreign value-added in demand			0.44 (0.134)***		
Free floating * foreign value-added in demand			0.01 (0.183)		
Euro Area unemployment gap:					
Pegged * foreign value-added in demand				-2.17 (0.362)***	
Other arrangement * foreign value-added in demand				-1.07 (0.349)***	
Free floating * foreign value-added in demand				-0.17 (0.482)	
Euro Area instrumented headline inflation:					
Pegged * foreign value-added in demand					1.24 (0.239)***
Other arrangement * foreign value-added in demand					0.54 (0.233)**
Free floating * foreign value-added in demand					0.03 (0.302)
R^2	0.91	0.91	0.91	0.91	0.91
N	351	390	390	390	390
Fixed effects (joint significance)	F(9, 362) =2.98 (0.003)***	F(9, 368) =3.68 (0.000)***	F(9, 369) =1.6 (0.11)	F(9, 370) =1.77 (0.072)*	F(9, 370) =3.77 (0.001)***

Notes: s.e. in parentheses; * p<0.1; ** p<0.05; *** p<0.01; sample 2004q1-2014q1.

[1/] Conditional forecast derived from estimating model (2) in Table 1 for the Euro Area without an Euro Area price pressure LHS variable.

Appendix Table 3. System 2SLS and 3SLS Estimation of Preferred Regression Specification

	(1) System 2SLS		(2) System 3SLS	
Country-specific factors:				
Inflation (-1)	1.21	(0.073)***	1.29	(0.061)***
Inflation (-2)	-0.52	(0.064)***	-0.59	(0.053)***
Inflation expectations (2-year ahead)	0.44	(0.105)***	0.42	(0.078)***
Unemployment gap	-0.07	(0.039)*	-0.08	(0.035)**
Contribution of administered prices and taxes	0.19	(0.047)***	0.16	(0.035)***
Nominal effective exchange rate	-0.04	(0.006)***	-0.03	(0.005)***
Global factors:				
World oil inflation * weight of energy in consumer baskets	0.06	(0.014)***	0.04	(0.018)**
World food inflation * weight of food in consumer baskets	0.01	(0.013)	0.01	(0.015)
Euro Area core inflation interacted with FX-regime dummy variables and the share of foreign value-added in demand:				
Pegged * foreign value-added in demand	1.64	(0.666)**	1.44	(0.654)**
Other arrangement * foreign value-added in demand	1.57	(0.735)**	2.01	(0.727)***
Free floating * foreign value-added in demand	0.24	(0.607)	0.32	(0.630)
Median R^2	0.83		0.82	
N	38 per country			

Notes: s.e. in parentheses; * p<0.1; ** p<0.05; *** p<0.01; sample 2004q1-2014q1.

APPENDIX II. DEFINITIONS OF EXPLANATORY VARIABLES

In the regression analysis, we use the following variables:[17]

- *Headline inflation*—calculated using the Harmonized Indices of Consumer Prices (HICP) published by Eurostat.
- *Expected inflation*—we proxy expectations of future inflation by the mean forecasts of average annual inflation two-years ahead published by Consensus Economics.
- *World commodity price inflation*—the IMF's World Economic Outlook (WEO) world oil and food price indices in US dollars are used to capture commodity price changes. They are interacted with the weights of energy and food in consumer baskets to allow for differentiated impact across countries.
- *Exchange rate appreciation/depreciation*—calculated using the nominal effective exchange rates published by the IMF.
- *Unemployment rate gap*—the cyclical unemployment rate is extracted with the Baxter-King bandpass filter from data from Haver and national sources.[18]
- *Contribution of taxes and administered prices to headline inflation*—the impact of taxes and administered prices is captured by their combined contribution to headline inflation, calculated with HICP data published by Eurostat.
- *Euro Area price pressures*—our preferred measure of euro area price pressures is the HICP core inflation, which is stripped of direct, first-round effects of commodity price changes. As a test of the stability of the estimated relationship, we also use alternative proxies for euro area price pressures, such as the euro area output gap, cyclical unemployment rate, and instrumented headline inflation.
- *Exchange rate regime dummies*—based on the classification of exchange rate regimes in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (IMF, 2013b).

[17] All variables are expressed in 12-month growth rates in percent, except for the interaction terms (i.e., foreign value-added content of domestic demand and the weights of food and energy in consumer baskets), which are ratios

[18] The Baxter-King filter decomposes, in the frequency domain, the analyzed series into trend, cyclical, and irregular components, which are additive. For all countries, the Baxter-King filter is based on an 11-quarter centered moving average and a widely used definition of the business cycle—movements in economic series that occur with periodicity of between 6 quarters and eight years (32 quarters). In order to obtain estimates for the whole sample period, we augment the dataset with Fund staff forecasts through end-2016.

- *Share of foreign value added in domestic demand*—calculated using OECD-WTO's Trade in Value Added dataset as an average of the 2005 and 2009 values. Data for Croatia is not available in the OECD-WTO database. We approximate the share of foreign value added in Croatian domestic demand by the average of its readings in Poland and Romania, as the ratio of imports to GDP of these three countries are very similar.