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A Fresh Look at Potential Output in Central, Eastern, and Southeastern European Countries

by Jiří Podpiera, Faezeh Raei, and Ara Stepanyan

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A Fresh Look at Potential Output in Central, Eastern, and Southeastern European Countries[1]

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Abstract

Was the postcrisis growth slowdown in Central, Eastern and Southeastern Europe (CESEE) structural or cyclical? We use three different methods—production function approach, basic multivariate filter, and multivariate filter with financial frictions—to evaluate potential growth and output gaps for 18 CESEE countries during 2000-15. Our findings suggest that potential growth weakened significantly after the crisis across most countries in the region. This decline appears to be largely due to stagnant productivity and weaker capital accumulation, which were associated with common external factors, including trading partners' slow potential growth, but also decline in global trade and stalled expansion of global value chains. Our estimates suggest that output gaps in 2015 were largely closed in many countries in the region.

JEL Classification Numbers: E10, E20, E32, E44.

Keywords: Potential output; Output gap; Emerging Markets

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I. INTRODUCTION

The average growth following the global financial crisis has been below precrisis levels across advanced and emerging markets. However, the growth deceleration in Central, Eastern and Southeastern European (CESEE[2]) countries was particularly sharp: from precrisis average growth of 5.4 percent (2000-08) to only 1.2 percent in the postcrisis (2009-15).[3] This 4.2 percentage points drop was much larger than growth decline in advanced economies (1.3 percentage points) and other emerging economies (1 percentage point).

Was this slowdown largely cyclical or structural? The answer to this question is important to determine the appropriate policy mix and sequencing of supportive macroeconomic policies and structural reforms to lift growth. In addition, the possibility that the hysteresis effects may permanently scar potential output following a prolonged cyclical downturn with high unemployment complicates the assessment. For example, expansionary fiscal and monetary policies (subject to the availability of policy space) may be needed to alleviate hysteresis effects, support employment and demand and thus support structural reforms in lifting potential output.

Disentangling the cycle and the trend is notoriously difficult because of measurement errors and challenges in separating demand and supply shocks. Given that potential output is an unobservable variable, differences in theoretical concepts and definitions of potential output entail different methods of estimation. Estimating potential output is even more challenging for emerging economies in general and CESEE countries in particular. That is due to major structural shifts in CESEE economies, including financial deepening, and short time series with just one boom-bust cycle for many of these countries.

In this paper, we aim to provide a consistent set of potential output estimates for 18 countries in the CESEE region.[4] For this purpose, we use several approaches to estimate potential output and output gaps, representing somewhat different economic concepts of potential output as well as a purely statistical method: (i) a Hodrick-Prescott (HP) filter; (ii) a multivariate filter which captures the relationship between actual and potential GDP,

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[2] The CESEE region includes Turkey and the following four sub-regions: (i) Central and Eastern Europe (CE-5), consisting of the Czech Republic, Hungary, Poland, the Slovak Republic and Slovenia, (ii) Southeastern Europe (SEE), consisting of Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Kosovo, Macedonia, Montenegro, Romania and Serbia, (iii) The Baltic region, consisting of Estonia, Latvia and Lithuania, and (iv) The CIS group, consisting of Belarus, Moldova, Russia and Ukraine. European Union (EU) members of SEE are denoted by SEE-EU and comprise Bulgaria, Romania, and Croatia. Due to data limitations, we do not include Albania, Bosnia and Herzegovina, Kosovo, and Montenegro in our analysis.

[3] In most recent years, growth has picked up to around 3 percent in many CESEE countries.

[4] We were not able to include all countries in the region due to data limitations. The output gap and potential growth estimates reported in this paper may be different from IMF staff assessments reported in Article IV reports, as individual country teams may use different methodologies and take additional country-specific information into consideration.

unemployment, and inflation (Blagrave et al., 2015); (iii) an expanded multivariate filter, which in addition to the relationships used in (ii) takes into account financial/credit cycles in order to identify cyclical component of output (a variation of Berger et al., 2015); and (iv) a production function approach.

Taking into account factors specific to the CESEE region, we introduce a number of methodological refinements to the multivariate filters to improve the estimation of potential growth and output gaps. In particular, we account for financial deepening by using an adjusted variation of financial variables such as credit and house prices that better account for cyclical developments. In addition, in a low-inflation environment with external disinflationary pressures (Iossifov and Podpiera, 2014), we expanded the information sets generally used in estimations to include wage inflation, hours worked, and capacity utilization to better gauge the extent of cyclical pressures in the economy. We also provide some reconciliation of the differences in potential output estimates.

The approaches presented in this paper are, of course, part of a broader toolkit for identifying potential output. Using several methods enhances our understanding of the trend growth in CESEE economies as different methods provide useful information about the cyclical state of the economy and the role of different sectors. However, there is no silver bullet for identifying potential output: frequent data revisions and end-point bias of filtering methods may lead to systematic revisions of potential output estimates by all methods. Also, given the structural changes that CESEE economies have undergone and the short time series, the confidence bands on the estimates are large.

Our main findings are as follows:

- All methods suggest that a large share of the postcrisis growth slowdown in CESEE countries was sustained. The potential output growth slowed down by about 2 percentage points after the crisis compared with precrisis years, which accounts for about half of the total growth slowdown.

- Postcrisis potential growth was dragged down mainly by stagnant total factor productivity (TFP) and, to a lesser extent, slower capital accumulation. However, given the uncertainty surrounding estimates of TFP, which is measured as a residual, further analysis is needed to understand what has been driving the TFP slowdown. Our results suggest that the region-wide slowdown in potential growth has been associated with common external factors, which among other things may reflect trading partners' potential growth as well as the evolution of global trade and global supply chains. For some countries, negative demographics have also played a role in holding back potential growth.

- The differences of potential growth estimates based on different methods are generally small, reflecting overlapping information sets used by different methods and the interconnectedness of real and financial sectors of the economy, which results in similar signals from real and financial variables. Differences arise when synchronization between

the real and financial cycles is low, which in part, may reflect the presence of financial frictions and real economy rigidities.

- Given the significant slowdown in potential growth, the postcrisis growth rebound in the region suggests a gradual narrowing of the negative output gaps, which appear largely closed in 2015 for much of the region, except the CIS and Turkey. This is consistent with the gradually dissipating disinflationary pressures in non-tradable sectors that are more directly linked to domestic demand and with declining unemployment rates, while headline inflation remained low on falling import prices, notably energy.

The paper is organized as follows. Section II describes the methods used and their applications to CESEE countries. Section III reports results and Section IV concludes.

II. METHODOLOGY

We employ a battery of methods based on different concepts of potential output to estimate potential growth and output gap.[5] Besides a purely statistical smoothing method, HP filter, we use a number of other approaches:

- ***The multivariate filter*** is used to estimate potential output defined as the level of output achieved under flexible nominal prices and wages and no inflationary or deflationary pressures (Okun, 1962). The temporarily misalignment of actual output from potential due to gradual price and wage adjustments (nominal rigidities) in response to shocks is defined as output gap. This approach is relevant for monetary policymakers that are more concerned about the deviation of inflation from the target.

- ***The multivariate filter with financial frictions*** is used to estimate sustainable potential output, which differs from the traditional notion of potential output described above in so far as it attempts to account for financial cycles. A sustainable potential output is not only inflation-neutral but also finance-neutral (Borio, 2013). Experience shows that imbalances may build up in some sectors of the economy (such as credit or housing markets) without necessarily resulting in inflationary pressures. This concept may be particularly relevant for many CESEE countries that experienced a pronounced credit boom-bust cycle over the sample period.

- ***The production function*** is used to estimate potential output as the economy's maximum output that can be produced for a prolonged period of time without straining capacities. This supply-side approach takes into account the availability and utilization of labor and physical capital, as well as the TFP.

[5] A full structural model and a structural VAR could also be used to estimate potential output, although they are more data intensive.

In what follows, we introduce each method in more detail, describe the application to CESEE countries, and provide some reconciliation across methods. Data and sources for all methods are listed in Appendix E.

A. HP Filter

The HP univariate filter (Hodrick and Prescott, 1997) is a purely statistical tool used to extract a trend component from a time series, here applied to GDP. The trend is chosen in a way to minimize a loss function that is increasing in both the deviation of actual GDP from the trend and the curvature of the trend. The relative weights for these two objectives is determined through the selection of a smoothing parameter. The benefit of the HP filter is its simplicity and transparency. However, its shortfall is that as a purely statistical tool it cannot be directly related to the underlying economic concepts. The estimated trend doesn't have the economic meaning of the inflation-neutral or sustainable potential output. It also suffers from the well-known end-of-sample problem—significant revisions of estimates at the end of the sample period when more data becomes available.

B. Multivariate Filtering Approach

Methodology

The multivariate filtering approach (denoted throughout as MVF) estimates the *potential output* based on a model that captures relationships between actual and potential GDP, unemployment, and inflation (Blagrave, et al., 2015). In this approach, the potential output is thought of as the level of output that can be achieved if nominal prices and wages were fully flexible (Okun, 1962). It uses actual inflation, inflation expectations, and the deviation of the unemployment rate from its estimated equilibrium level (unemployment gap) to distinguish between demand and supply shocks. Bayesian techniques are used to estimate a simultaneous system of equations that describe the evolution of three key variables: output, inflation, unemployment, and their trends. Two economic relations are imposed:

- The Phillips curve, linking the output gap (an unobservable variable y_t) to the observable inflation π_t :

$$\pi_t = \lambda\pi_{t+1} + (1-\lambda)\pi_{t-1} + \beta\, y_t + \varepsilon_t^{\pi} \qquad (1)$$

- The Okun's law, governing the relationship between cyclical unemployment and output gap:

$$u_t = \tau_2 u_{t-1} + \tau_1 y_t + \varepsilon_t^{u} \qquad (2)$$

where y_t is the output gap, π_{t+1} is inflation expectation, and u_t is the unemployment gap (the deviation of unemployment rate from its equilibrium level). Additional seven equations describe the evolution of output and unemployment rates as the sum of their respective stochastic trends and shocks (see Blagrave et al., 2015, for a full set of equations).

The method has the advantage of relatively limited data requirements and robustness to end-of-sample problems. In its basic form, the technique is relatively straightforward to implement requiring only a few variables (real GDP, unemployment, and inflation). In addition, the filter could use medium-term growth and inflation forecasts to improve the accuracy of estimates in the outer years and address the common end-of-sample problem prevalent in filtering techniques.

Application to CESEE

Applying the MVF approach to CESEE countries using standard measures of price inflation may be misleading. At the core of the method is the New Keynesian Phillips curve postulating that if the output gap is positive over time, prices will begin to rise in response to demand pressures and *vice versa*. Imported inflation has played a significant role in explaining the variation of headline inflation in the region in recent years (Iossifov and Podpiera, 2014). As such, headline inflation may not provide a complete picture for judging the cyclical position of CESEE economies. Even core inflation is still contaminated by external shocks given the high pass-through of global commodity prices in CESEE and the high share of imported inflation in core inflation (Iossifov and Podpiera, 2014). Therefore, in addition to headline and core inflation, we also use *wage inflation* to better gauge domestic demand pressures. Indeed, using wage inflation in the MVF suggests less slack in several CESEE countries in 2014-15 (Figure 1; Appendix A, Figure A.1).[6]

C. Multivariate Filter with Financial Frictions

Methodology

The multivariate filter with financial frictions developed by Berger et al. (2015) takes into account credit growth and house prices, in addition to inflation and capacity utilization, to obtain *sustainable output* estimates (denoted throughout as MVF-FIN).[7] The main idea behind this approach is to use the link between financial and output cycles as an additional information to identify demand and supply shocks. When inflation and inflation expectations are aligned but financial variables depart from their sustainable level, the filter assigns a larger portion of the actual output to the cyclical component. In this way, it offers a reduced-form approach to capturing the link between financial cycles and output gaps. The model is estimated using maximum likelihood in the state-space context.

Specifically, the sustainable output is estimated by decomposing observed GDP series into two unobservable components, the cycle (in the broadest sense capturing all transitory movements of GDP) and the trend (or sustainable) output:

[6] Throughout the paper, unless stated otherwise, MVF uses wage inflation for calculation of output gaps of EU members of CESEE comprising Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, and Slovenia.

[7] The authors would like to thank Mico Mrkaic for kindly providing the STATA codes for multivariate filter with financial frictions.

$$y_t = y_t^* + c_t \tag{3}$$

$$\Delta^2 y_t^* = \varepsilon_t^* \tag{4}$$

$$\lambda \equiv \frac{\mathrm{Var}\left(c_t\right)}{\mathrm{Var}\left(\varepsilon_t^*\right)} \tag{5}$$

where y_t and y_t^* represent observed and sustainable output, respectively, and c_t is the business cycle. Mirroring the HP filter, the model is estimated with a constraint on the variance ratio λ.

In addition, the model takes into account information from a set of observable variables, x_t, which could be correlated with the output gap. To match the dynamic properties of the latter, the approach allows for the current output gap to depend on its lagged values:

$$y_t - y_t^* = \rho\left(y_{t-1} - y_{t-1}^*\right) + x_t\beta + \varepsilon_t^o, \tag{6}$$

where the variance ratio $\frac{\mathrm{Var}\left(y - y^*\right)}{\mathrm{Var}\left(\Delta^2 y^*\right)}$ is constrained to match the one implied by equations (3)-(5). In the empirical application, x_t includes credit growth, consumer price inflation, and, where available, house price inflation, and a survey-based measure of capacity utilization.

Application to CESEE

Estimating potential output using MVF-FIN is relevant for CESEE countries because most of them have experienced strong credit expansion before the financial crisis and rapid credit slowdown/contraction afterwards (Figure 1). However, a special challenge in the case of CESEE is to disentangle financial cycles from financial deepening.

To address this challenge, we use credit gap estimates from the IMF (2015) to ensure that the structural increase in credit stocks in CESEE countries is not considered part of credit cycle.[8] The differences between output gap estimates using original credit data and adjusted credit data are substantial. The results suggest that ignoring the structural increase in credit due to financial deepening would have led to an underestimation of potential output during boom years. Similarly, after the crisis, it would have resulted in overestimation of potential output. This is particularly prominent for the Baltic states and SEE-EU countries that have experienced strong credit booms and busts (Appendix A, Figure A.2).

[8] It estimates a reduced-form, demand and supply system for real, per capita, private debt in PPP USD with data for 36 European countries over the period 1995-2013. Explanatory variables include per capita GDP (in PPP USD) as a proxy of debt servicing capacity and the nominal interest rate on private debt. We estimate an auto-regressive, distributed lag model, using Arellano-Bond dynamic-panel system GMM estimator. We use the regression coefficients to construct the long-run relationship between private sector debt and its main determinants. The credit gap is then the deviations of real, per capita, private debt in PPP USD from its fundamentals-consistent values.

D. Production Function Approach

Methodology

The production function approach (denoted throughout as PF) focuses on the supply side—production factors—to decompose output into structural and cyclical components. In its full specification, it takes into account the cycles in labor input (including average hours worked), capital (including capacity utilization), and the total factor productivity (TFP), which is obtained as a residual.

We use a standard Cobb-Douglas production function approach (as in e.g. Christiansen, 2013; Johnson, 2013; Epstein and Macchiarelli, 2010; Konuki, 2008; Moore and Vamvakidis, 2007; Denis et al., 2006, and Faal, 2005). What remains unexplained after accounting for capital and labor inputs and their intensities is attributed to the TFP, denoted by A_t (the Solow residual). The specification for the quarterly real output Y_t is the following:

$$Y_t = A_t(K_tCU_t)^{(1-\alpha)}(L_tAHW_t)^{\alpha}$$

where:

- K denotes the capital stock, which is derived using the usual perpetual inventory model (Epstein and Macchiarelli, 2010, and Teixeira de Silva, 2001) as $K_t = (1-\rho)K_{t-1} + I_t$, where ρ is the depreciation rate calibrated using the historical average rate and I stands for investment. The capital stock of the initial year is taken from the Penn World Tables.
- CU is a survey based measure of capacity utilization.
- L is the number of employed persons, using the national accounts concept.
- AHW is the average hours worked from the national accounts.
- α stands for the labor share in the production function. Labor share is calculated as the ratio of compensation of employees to gross value added.[9]

The TFP, which is computed as a residual, includes human capital, as its contribution to the TFP growth before and after the crisis is small.[10] Due to data constraints, the TFP in some countries also includes capacity utilization and average hours worked.

The potential output is derived using calibrated labor share, smoothed trends in unemployment and TFP, and the actual capital stock. Unemployment rates, average hours worked, and TFP are smoothed using HP filter (smoothing factor 1600). Capacity utilization

[9] Labor share could be larger than the ratio of compensation of employees to gross value added in countries with large share of small businesses that use their profits as a compensation.

[10] Human capital accounts for very small part of TFP change before and after the crisis, on average close to 0.04 percentage points.

series are demeaned. Employment consistent with NAIRU is derived using actual labor force and the smoothed unemployment rate.

Application to CESEE

Not accounting for intensities of production factors may potentially understate booms and busts. Besides the cycle in employment, the measures of intensity of the input utilization—namely capacity utilization and average hours worked—have cyclical components as well, contributing to the overall business cycle. Figure 1 shows that cycles in average hours worked and capacity utilization are synchronized, exacerbating the potential output identification problem if not accounted for explicitly:

- *Capacity utilization* increases during booms, when growing output is hitting production limits and falls during busts when capacity becomes excessive for a new lower level of output. Figure 1 shows the fluctuations in capacity utilization throughout the business cycle. This suggests that not accounting for such cyclical components in capacity utilization may overstate potential output growth during booms and understate during busts—making output gap less volatile.

- The *average hours worked* measure exhibits cyclical fluctuations as well. During booms, incumbent workers are working more hours while during busts their hours are reduced. Figure 1 shows that this is most pronounced in the Baltic states and SEE-EU countries.

Figure A.3, in Appendix A, shows a comparison between output gaps derived using production function approach with and without adjusting capacity utilization and average hours worked for the CESEE EU countries. The output gap amplitude appears to be smaller by 2-8 percentage points in the case of production function without adjustments for capacity utilization and average hours worked.

E. How can different approaches be reconciled?

While all approaches aim to disentangle cyclical and structural components in the real GDP series, they use different economic concepts, information sets, and estimation methods. Having said that, the differences in trend growth estimates seem to come mainly from differences in information sets.

Two factors—the richness of the model specification and synchronization of the labor and capital markets cycles—seem to matter most in explaining the divergence between potential output estimates:

- *The richer the specification of each method, the smaller the differences in potential output estimates across methods.* As can be seen from Figure 2, information inputs overlap to a large degree across methods, more so between MVF-FIN and PF than with the MVF. A richer specification results in a better identification of cyclical component of business cycle, thus increasing the likelihood of overlaps between cyclical components captured by different methods – as shown in Figure A1-A3.

- *More flexible labor markets and deeper capital markets also tend to reduce differences in potential output estimates across methods.* Various structural characteristics and rigidities—in particular frictions in the financial (related to the level of financial deepening) or labor markets—may lead to larger differences in potential output estimates across methods. The established correlation between output (through capacity utilization) and credit cycles (see Claessens et al., 2011) seems to be more pronounced for countries with relatively deeper financial markets (CEE countries), see Table 1. Similarly, the correlation between average hours worked and wage inflation appears to be stronger in countries with more flexible labor markets (the Baltics).

Given that we use a rich specification across the models, most of the differences in our estimates are stemming from different degrees of the cycle synchronization across markets. Taking the example of SEE-EU countries, the precrisis credit growth, capacity utilization, hours worked, headline and wage inflation all moved in tandem (Figure 1) and hence all methods depict similar output gap dynamics in the precrisis period (Figure 5). However, in the postcrisis period, credit remained flat while capacity utilization and wage inflation have increased robustly. As a result, output gap estimates by MVF and PF show a closed gap in 2015 while MVF-FIN interprets the low credit growth as negative output gap.

What do the differences in output gap estimates or sometimes even conflicting estimates mean? As with any model estimation, judgment and country-specific information are crucial for appropriately interpreting the results and formulating a policy response. Given the economic concept and information set behind each method, large differences among methods suggest the need for further analysis of the state of the economy and the interlinkages between different sectors. Continuing with the example of SEE-EU, the range of negative (MVF-FIN) and positive output gap (MVF and PF) estimates in 2015 may be indicative of a *creditless recovery*,[11] with employment growth possibly creating pressures in the labor market and increasing capacity utilization, while credit still contracting or sluggish. There are two possible interpretations:[12]

- A more benign interpretation could be that the financial cycle is lagging the business cycle and would soon catch up. Therefore, no policy action is required.

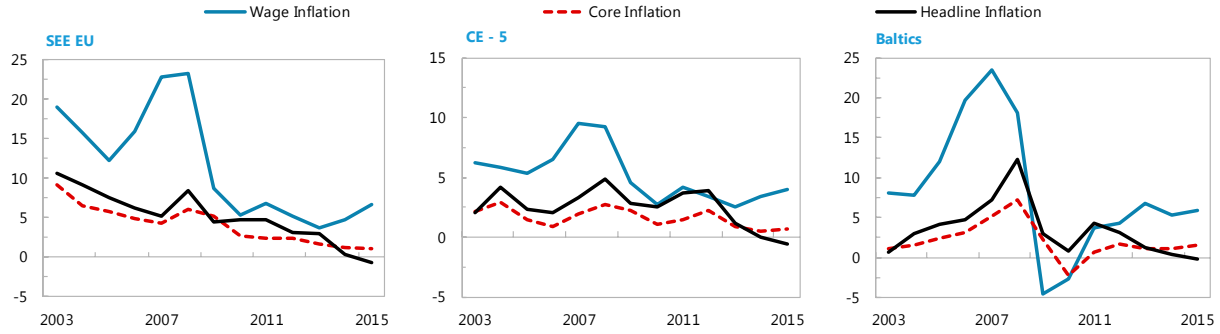
- A less benign interpretation could be that the balance sheets of firms, households and/or financial intermediaries remain impaired, preventing the economy from growing at its full potential. In this case, further policy action may be needed to address balance sheet weaknesses.

Choosing between these two interpretations requires more country-specific information about the state of the private sector balance sheets and the nature of financial frictions in these economies.

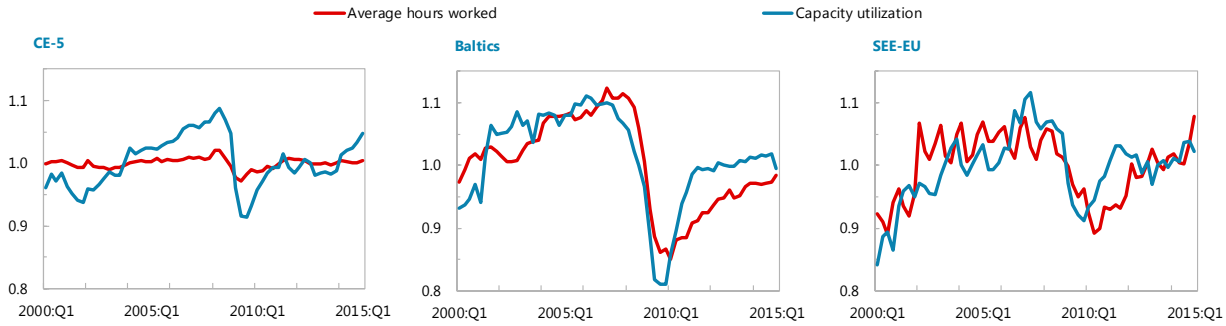
[11] Creditless recoveries are characterized by significant job creation and no growth in real credit.
[12] Abstracting from the possibility of substantial measurement errors driving these results.

Figure 1. CESEE EU: Comovement of Cyclical Variables

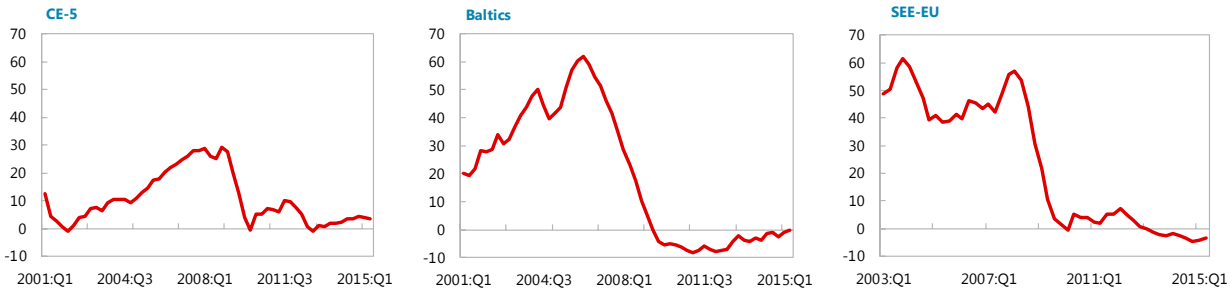
Headline, Core, and Wage Inflation Rates *(y-o-y, percent)*



Labor and Capital Utilization Rates *(index, long-term average = 1)*



Credit Growth *(y-o-y, percent)*



Sources: Haver Analytics and IMF staff calculations.
Note: CE-5 = Czech Republic, Poland, Hungary, Slovakia and Slovenia. SEE EU = EU countries in South-Eastern Europe.

Table 1. Correlations between intensity measures of capital and labor utilization

(Correlation coefficients, 2000-2014)

	Capacity utilization and credit growth	Average hours worked and wage inflation
Bulgaria	0.1	0.6
Croatia	0.5	0.8
Czech Republic	0.6	0.1
Estonia	0.5	0.7
Hungary	0.6	0.3
Latvia	0.5	0.8
Lithuania	0.7	0.9
Poland	0.0	n/a
Romania	0.5	0.1
Slovakia	0.5	0.1
Slovenia	0.6	0.1
Turkey	0.6	n/a
Average	0.5	0.5

Sources: Haver Analytics and IMF staff calculations.
Note: Highlighted cells indicate above average correlation coefficients. Red-labeled countries indicate above average correlations in variables in both credit and labor markets.

Figure 2: Information used in Different Methods of Estimating Potential Output

		Methodologies for Estimating Potential Output		
		MVF	**MVF-FIN**	**PF**
Information Inputs	**Factors of production**	**Labor** Intangibles (TFP)	**Labor** **Capital** Intangibles (TFP)	**Labor** **Capital** Intangibles (TFP)
	Intensity of utilization of production factors	**Price pressures:**		
		Labor: wage inflation*	**Labor**: headline inflation **Capital**: credit growth, house price inflation	
		Rate of utilization:		
		Labor: unemployment rate; hours worked	**Labor**: unemployment rate **Capital**: capacity utilization	**Labor**: hours worked **Capital**: capacity utilization
	Structural model?	Yes (Okun's law; Phillips curve)	No	Yes** (Cobb-Douglas production function)
	*if headline or core inflation is used instead of wage inflation, it may be capturing broader price pressures **While the PF approach uses structural framework of Cobb-Douglas production function, structural components of factors of production are obtained using filtering techniques.			

III. RESULTS

A. Potential Growth and its Drivers

The postcrisis potential growth has been below precrisis levels across CESEE countries. Although with some variation—1-2 percentage points across methodologies—all methodologies point to a substantial postcrisis decline in potential growth (Figures 3, 6, and B1 and B2 in Appendix B). Estimated potential growth appears to have been broadly stable over 2001-07, but has declined significantly in the aftermath of the global financial crisis and, as of 2015, had not recovered to the precrisis level. While the large fall in potential growth happened after the crisis, the potential growth slowdown in many countries had already started before the crisis.[13] In more than two thirds of the countries in our sample, potential growth slowdown has started before 2007.[14] A similar pattern is also observed in advanced economies and other emerging markets (WEO April 2015).

Why the postcrisis slowdown in potential growth has been so dramatic across a large number of countries? While it is well documented that financial crises are associated with declines in potential output (Cerra and Saxena, 2008), recent research suggests that there may also be persistent effects on growth (Blanchard, et al. 2015). To answer these questions for CESEE countries, first we decompose potential growth into contributions from capital, labor, and TFP using production function framework and second, we quantify the importance of external/common factors relative to domestic/idiosyncratic factors in explaining the slowdown in potential growth.

Factors of production:

Before the crisis, most countries in our sample appear to have enjoyed strong TFP growth and some countries also dynamic capital accumulation, while labor played a smaller role (Figure C.1, Appendix C). On average, capital accumulation contributed more than 2 percentage points to the region's potential growth during 2005-09. In Bulgaria, Estonia, and Latvia, capital contribution was even higher—about 4 percentage points. Average estimated TFP contribution to the potential growth was about 2 percentage points during 2005-09. In Latvia, Lithuania, Serbia, and Slovakia, estimated TFP contribution was above average close to 3 percentage points. In general, labor played a smaller role, although in some countries it was still a considerable source of growth. In addition, some countries such as Romania and Moldova experienced outward migration, which gave rise to a negative contribution of labor to potential growth.

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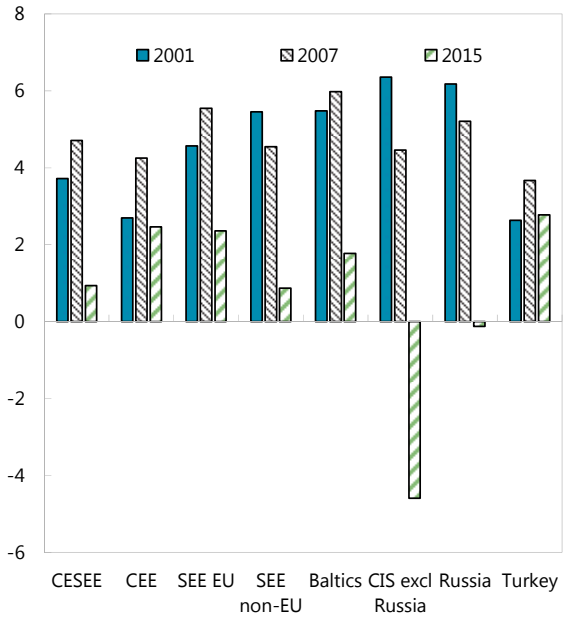
[13] Cette, Fernalnd, Mojon (2016) also highlighted that TFP slowdown in the US and Europe has begun prior to the Great Recession. They argue that the slowdown in the US reflects the fact that the surge of innovation and use of IT that started in the second half of the 1990s has run its course. However, Cardarelli and Lusinyan (2015) did not find any evidence that the productivity slowdown in IT intensive sectors was stronger.

[14] We refer to a country as having experienced potential growth slowdown before 2007Q1 if two out of three methods (MVF, MVF-FIN, and PF) indicate that the slowdown started before 2007Q1.

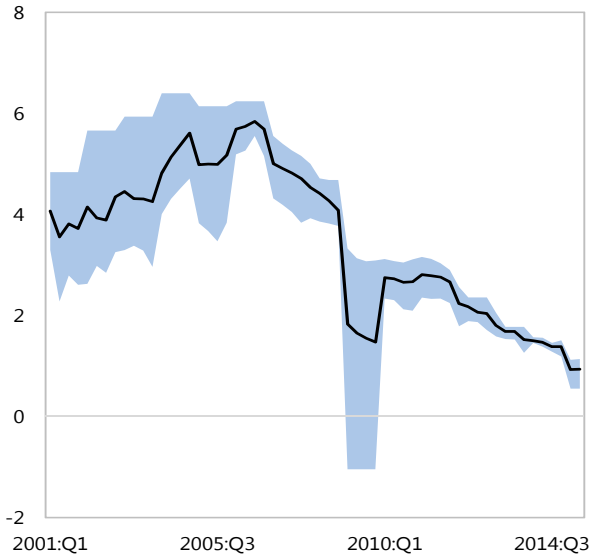
Figure 3. CESEE: Potential Growth Estimates

Average Potential Growth (*y-o-y, percent*)



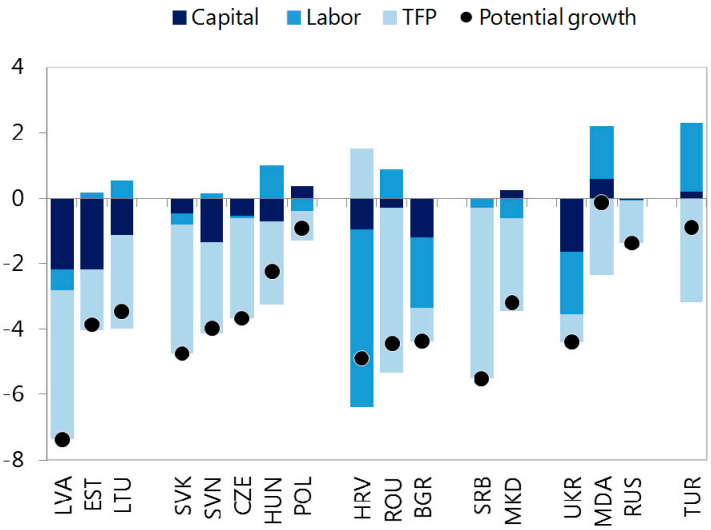
Note: Each bar represents average of three methodologies: MVF, MVF-FIN and the production function approach.

CESEE: Variation in Estimates (*y-o-y, percent*)



Note: The line and the shaded area represent the average and range of estimates by three methodologies.

Change in Potential Growth over 2013-15 versus 2002-08 (*percentage points*)



Source: IMF staff calculations.

Note: CEE = Central and Eastern Europe; CESEE = Central, Eastern, and Southeastern Europe; CIS = Commonwealth of Independent States; SEE EU = Southeastern European EU member countries; SEE-non EU = Southeastern European countries outside of the EU.

After the crisis, most countries experienced a significant TFP growth slowdown, although factors contributing to the postcrisis potential growth slowdown varied across countries of the region (Figure 3). Contribution of capital accumulation was mixed. In 7 out of 18 countries in our sample (including Bulgaria, the Baltics, and Slovenia), the contribution of capital accumulation to growth halved after the crisis. These are the countries that experienced rapid credit growth before the crisis fueled by external borrowing. These countries underwent a significant adjustment in their current account balances after the onset of the crisis, mainly on account of reduction in investments. In contrast, countries like the Czech Republic or Poland, which had not experienced excessive borrowing during precrisis years, continued to record strong contributions to the potential growth from capital accumulation.[15] Romania also experienced excessive credit boom financed by external borrowing, but a big part of credit was used to finance consumption. Therefore, an increase in the saving rate after the crisis played a big part in the current account adjustment in Romania.

External versus country-specific factors:

Based on our analysis, external/common factors appear to have been closely correlated with potential growth in CESEE countries excluding the CIS and Turkey, while in the CIS and Turkey idiosyncratic/country-specific factors have been more important, particularly after the crisis (Figure 4).[16]

- *Euro area growth*: The above average potential growth in the region before the crisis appears to have been associated with a strong precrisis potential growth in the euro area. This strong correlation persisted during the crisis as well, when potential growth in the region fell short of its long-run average over 2000-15. Among other factors, this may reflect the expansion of the technological frontier, which stalled after the crisis (see IMF, 2016a).

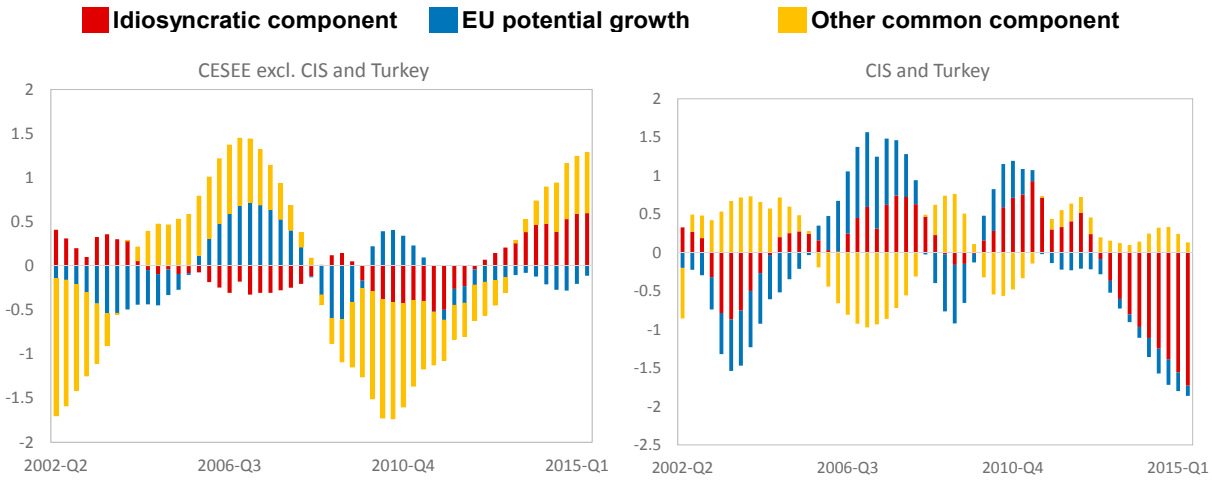
- *Other common factors*: For CESEE excluding the CIS and Turkey, "other common factors" exhibited strong co-movement with the region's potential growth before the crisis. This "other common factors" component grew much faster before the crisis, but slowed notably after the crisis, before accelerating again more recently. The region's potential growth mimicked the observed pattern in "other common factors". The positive co-movement before the crisis may reflect the expansion of global supply chains, including rapid integration of several CEE countries into the German supply chain, and growing trade links with the rest of Europe, on the back of the EU accession (8 CESEE countries joined the EU in 2004 and another two countries joined the EU in 2007). After the crisis, the significant negative contribution of "other common factors" could be due to a slowdown in global trade, structural bottlenecks, and the slow resolution of crisis legacies (NPLs, debt overhang) that held back investment in many CESEE countries as

[15] It is important to note that absorption of the EU structural funds in recent years was another factor supporting investment in CESEE EU member states.

[16] Detailed methodology is presented in the Appendix D.

discussed in the IMF (2015). In more recent years, increased absorption of EU structural funds could be behind positive contribution of "other common factors".

Figure 4. CESEE: Common and Idiosyncratic Factors of Potential Growth



Sources: IMF staff estimations.
Note: CESEE=Central, Eastern, and Southeastern Europe, CIS=Commonwealth of Independent States. Variables used in the regression analysis are deviations from their mean.

B. How Large Were Output Gaps in 2015?

Given the appreciably lower than precrisis potential growth, the postcrisis growth rebound implies that the output gaps have been narrowing and appear to have been largely closed for CESEE countries, excluding the CIS, by 2015 (Table 2, Figures 5 and B2 in Appendix B). In 10 out of the 18 countries in our sample, at least two out of three methods (MVF, MVF-FIN, and PF) produce positive, albeit small, output gap estimate for 2015 (Table 2, Figure 7), suggesting that the growth pickup in recent years may have been more cyclical than structural.[17] The CIS countries are among 8 countries where at least two methods indicate negative output gaps.

At the first look, headline inflation developments are not consistent with closing output gaps. While the headline inflation has been decelerating since end-2011, our estimated output gaps have been gradually narrowing since 2010, and as of 2015 appear largely closed in CEE, SEE-EU, and the Baltics. However, it is important to note that the headline inflation over this period has been largely driven by falling import prices, notably amid sustained declines in oil prices. Also, a more granular look at the inflation components—inflation in the non-tradable services sector, which is likely to be more sensitive to slack in the economy—disinflationary pressures have been gradually dissipating (see Figure 8). In addition, unemployment rates in many countries in the region have declined to their precrisis levels. That said, both core and

[17] In most cases positive output gap estimates are below one percent, which could be treated as largely closed.

services inflation in most countries of the region were notably below inflation targets by end-2015.

However, there is significant heterogeneity among sub-regions and individual countries:

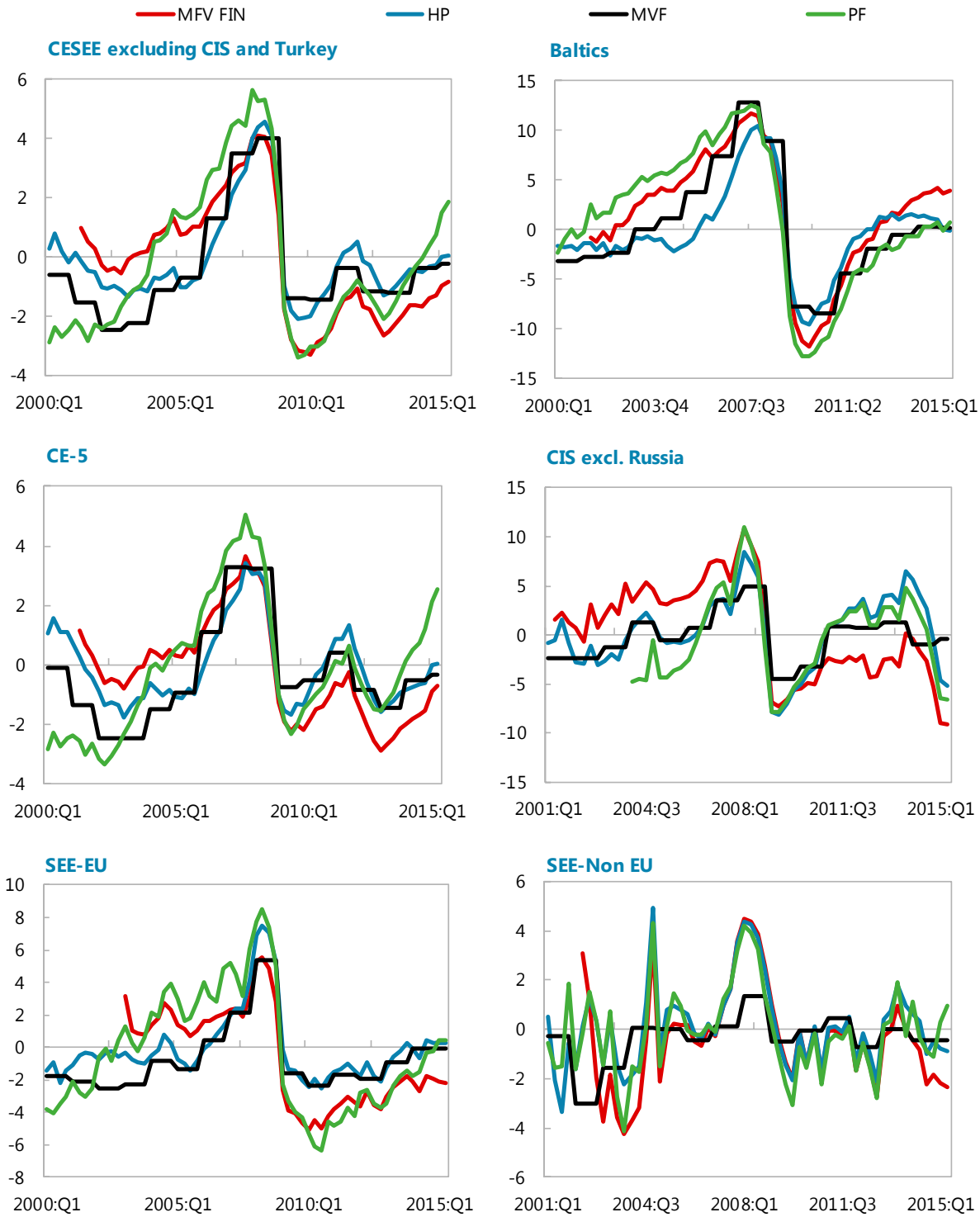
- For the *CIS countries*, almost all methods suggest negative and widening output gaps in 2015. Ukraine exhibits particularly large negative gap, followed by Russia, Moldova, and Belarus.

- Among *CESEE EU countries,* Poland, Slovenia, and Croatia are the only countries for which at least two methods produce negative but small output gaps for 2015. Output gap estimates for the Baltic countries and for the rest of the CE-5 countries are positive, albeit relatively small. In SEE-EU, two out of three methods show small positive output gaps for both Romania and Bulgaria. The results also suggest that the extent of overheating in the Baltic countries and SEE-EU prior the crisis was larger than in CEE and SEE non-EU countries. Consequently, negative output gaps in the Baltics and SEE-EU were larger after the crisis. This partly reflects credit booms that these countries experienced before the crisis.

- In the *SEE non-EU countries*, two out of three methods produce negative output gap for Serbia in 2015 while two out of three methods suggest positive output gap for Macedonia. The aggregate for this region is dominated by Serbia.

- There are some cases where estimates significantly differ across methodologies. For example, in Romania, based on the PF and MVF, the 2015 output gap is slightly positive, while according to the MVF-FIN it is significantly negative. This may reflect low synchronization of business and credit cycles owing to frictions in the financial market.

Figure 5. CESEE: Output Gap Estimates Using Different Methodologies



Note: MVF = Multi-variate filter, MVF FIN = Multi-variate filter with financial frictions, HP = Hodrick-Prescott filter, PF – Production function. Source: IMF staff calculations. CEE = Central and Eastern Europe; CESEE = Central, Eastern, and Southeastern Europe; CIS = Commonwealth of Independent States; SEE EU = Southeastern European EU member countries; SEE non-EU = Southeastern European countries outside of the EU.

Table 2. CESEE: Output Gap Estimates, 2015 *(percent of potential output)*

Country	HP-filter	MVF	MFV FIN	PF	Average (excl. HP-filter)	Sign of Output Gap (based on at least two of 3 methods)
Belarus	-1.4	-0.2	-1.5	-2.6	-1.5	-
Bulgaria	0.1	-0.1	2.1	2.4	1.5	+
Croatia	-0.3	-0.7	-1.4	1.1	-0.3	-
Czech Republic	0.5	-0.8	0.8	2.7	0.9	+
Estonia	-0.3	0.5	1.5	-0.9	0.4	+
Hungary	0.8	0.6	-1.5	1.6	0.2	+
Latvia	0.2	0.3	6.3	2.0	2.9	+
Lithuania	-0.3	0.1	3.4	0.1	1.2	+
Macedonia	-0.2	-0.1	0.5	1.5	0.6	+
Moldova	-0.9	0.2	-3.2	-4.9	-2.6	-
Poland	-0.2	-0.3	-1.5	3.0	0.4	-
Romania	0.4	0.1	-3.7	0.2	-1.1	+
Russia	-1.0	-0.1	-3.6	-4.1	-2.6	-
Serbia	-1.2	-0.5	-3.0	0.3	-1.1	-
Slovak Republic	-0.1	-0.7	1.0	1.3	0.5	+
Slovenia	0.4	-0.8	-0.1	1.7	0.3	-
Turkey	-0.1	0.0	7.1	-1.1	2.0	+
Ukraine	-7.5	-0.5	-12.9	-6.5	-6.6	-

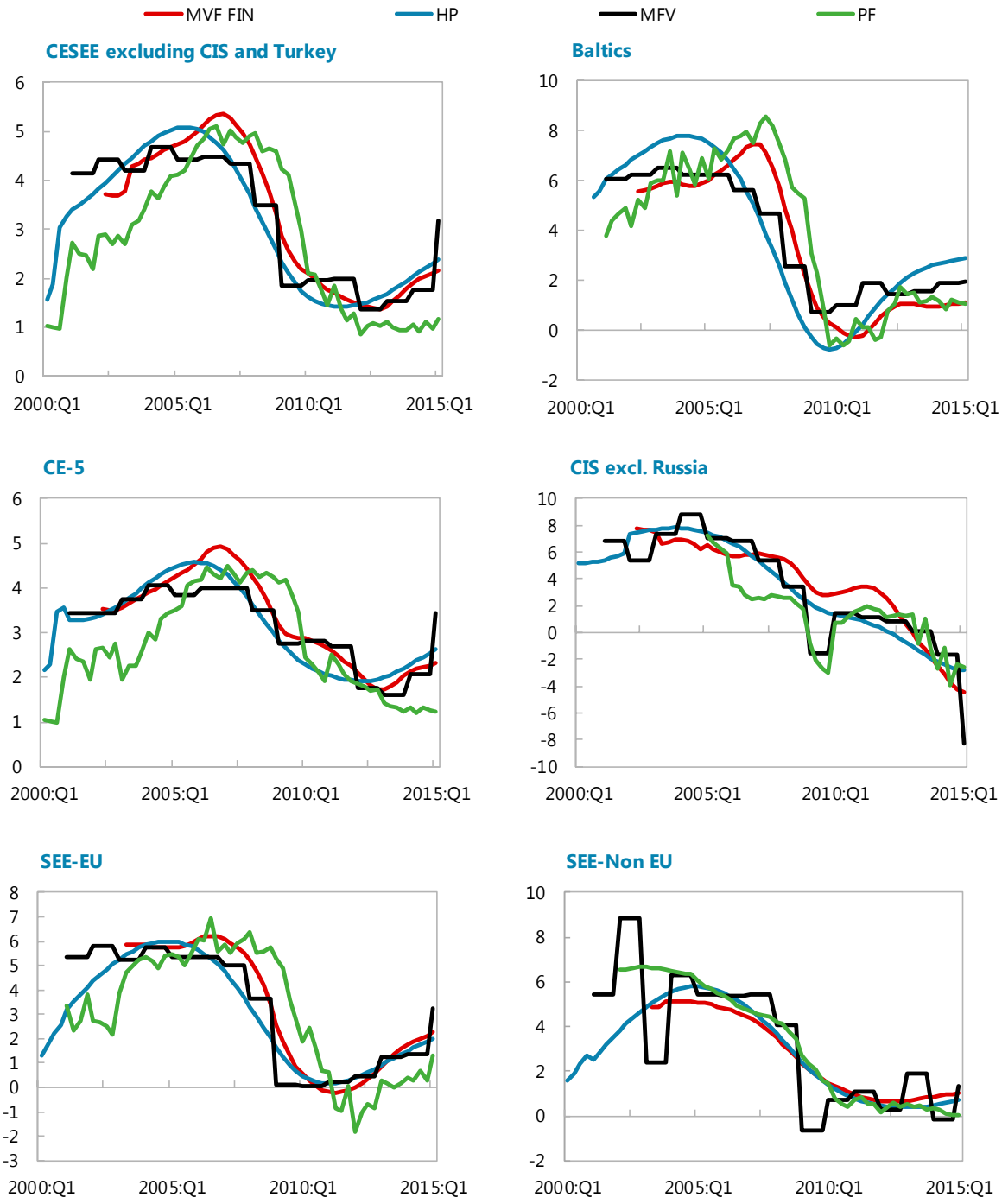
Note: This estimates are generated by applying the same methods to all countries without using any judgment to make country-specific refinements. MVF = Multi-variate filter, MVF FIN = Multi-variate filter with financial frictions, HP = Hodrick-Prescott filter, PF= Production function. MVF and HP estimates incorporate data up to 2015Q4, MVF FIN up to 2015Q2 and PF up to 2015Q3. Source: IMF staff calculations.

Table 3. CESEE: Potential Growth Estimates, 2015 *(y-o-y, percent)*

Country	HP-filter	MVF	MFV FIN	PF	Average (excl. HP-filter)
Belarus	-0.5	-3.9	-0.6	0.1	-1.5
Bulgaria	1.4	2.9	1.0	1.4	2.1
Croatia	0.1	1.2	0.7	-2.0	-0.1
Czech Republic	2.1	3.8	1.7	0.3	1.9
Estonia	2.7	1.4	2.0	1.8	1.7
Hungary	2.4	3.4	0.6	1.2	1.7
Latvia	3.2	2.9	1.2	0.6	1.6
Lithuania	2.9	1.7	0.8	1.0	1.1
Macedonia	3.2	3.6	2.9	2.8	3.1
Moldova	2.4	-0.6	2.3	3.9	1.9
Poland	3.1	3.4	3.3	1.8	2.9
Romania	2.8	3.8	3.1	2.1	3.0
Russia	-0.2	-1.4	0.3	0.7	-0.1
Serbia	0.2	0.7	0.5	-0.2	0.3
Slovak Republic	2.7	3.1	1.2	1.1	1.8
Slovenia	1.4	2.3	0.3	0.1	0.9
Turkey	3.4	3.8	3.2	3.3	3.4
Ukraine	-4.0	-10.7	-6.6	-4.4	-7.2

Note: This estimates are generated by applying the same methods to all countries without using any judgment to make country-specific refinements. MVF = Multi-variate filter, MVF FIN = Multi-variate filter with financial frictions, HP = Hodrick-Prescott filter, PF= Production function. MVF and HP estimates incorporate data up to 2015Q4, MVF FIN up to 2015Q2 and PF up to 2015Q3. Source: IMF staff calculations.

Figure 6. CESEE: Potential Growth Estimates Using Different Methodologies



Note: MVF = Multi-variate filter, MVF FIN = Multi-variate filter with financial frictions, HP = Hodrick-Prescott filter, PF – Production function. CEE = Central and Eastern Europe; CESEE = Central, Eastern, and Southeastern Europe; CIS = Commonwealth of Independent States; SEE EU = Southeastern European EU member countries; SEE non-EU = Southeastern European countries outside of the EU.
Source: IMF staff calculations.

Figure 7. Output Gaps in 2015

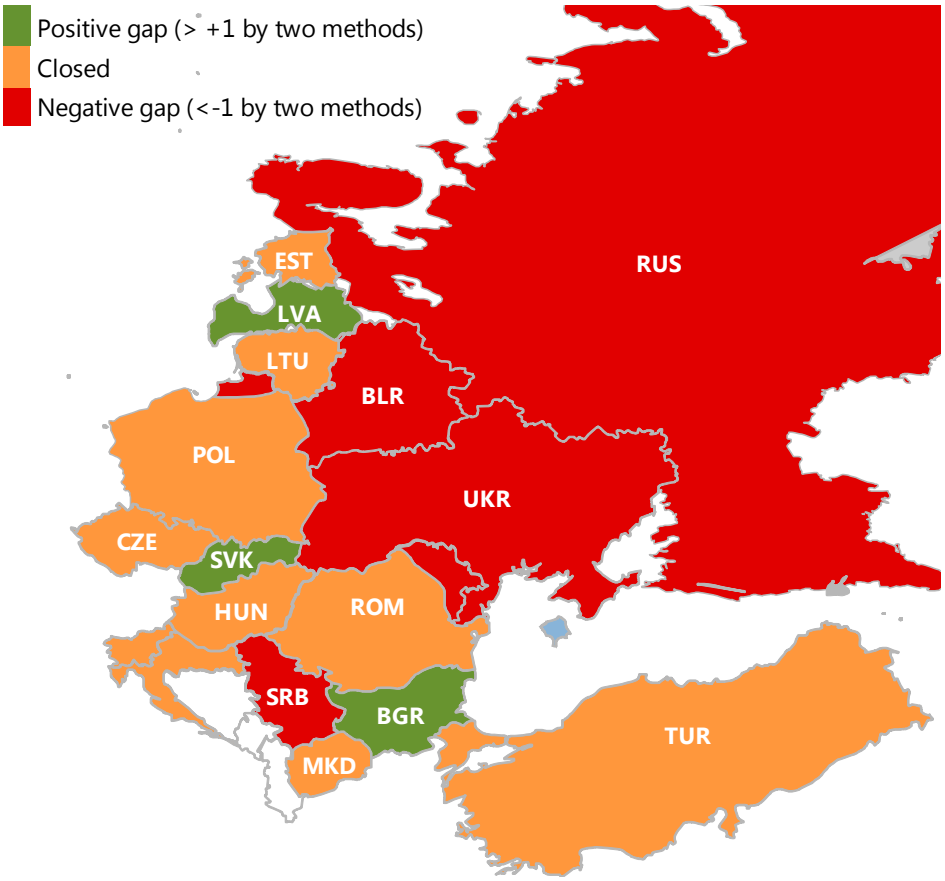
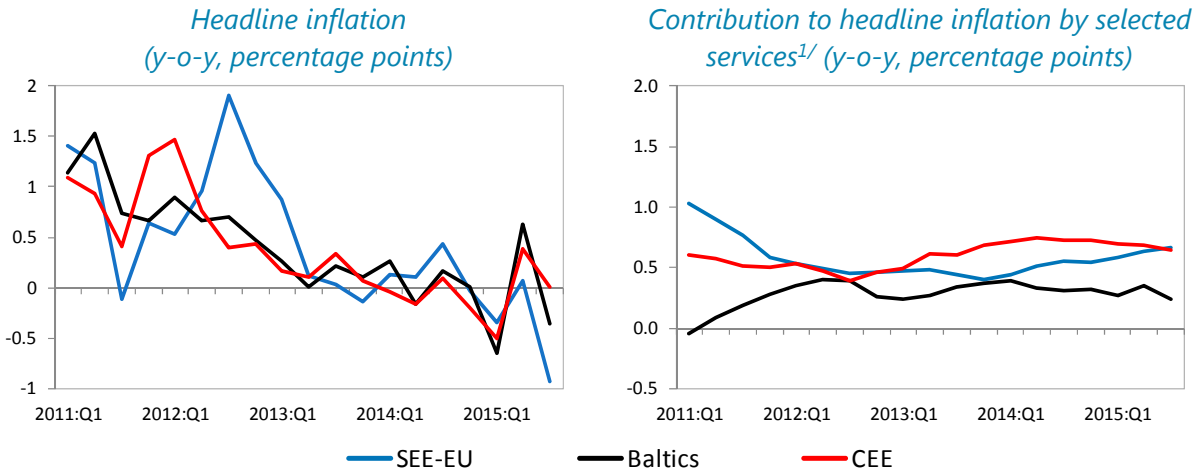


Figure 8. Inflation rates



Note: 1/ Selected services include Hotels, Restaurants, Recreation, and Culture. CEE = Czech Republic, Hungary, Slovenia, and Slovakia and SEE-EU = Bulgaria, Croatia, and Romania.
Source: IMF staff calculations.

IV. CONCLUSIONS

Estimating potential output, which is not observable, is a challenge. It is even more complicated in the case of CESEE countries, which experienced significant structural changes over the past two decades. In this paper, we provide a consistent set of potential output estimates for 18 CESEE economies using a range of methods. The main conclusions are as follows:

- Our estimates—based on all approaches—suggest that potential growth in the region has declined appreciably. TFP has been an important factor behind this pattern: boosting precrisis trend growth, while weighing down on it in recent years. However, deeper analysis is needed to better understand what is behind the TFP growth slowdown, which is a global phenomenon. Slow capital accumulation has also contributed to the weaker potential growth in several countries. The contribution of labor varied, from growth-supportive in CEE, Turkey, and Russia, to weighing negatively on potential growth in SEE and other CIS.

- Potential output growth in CESEE countries (excluding the CIS and Turkey) has been largely associated with trading partners' potential growth and other common factors. In the CIS countries and Turkey, idiosyncratic factors have been more important, particularly after the crisis.

- As of 2015, output gaps appear largely closed in many CESEE countries. Owing to imported low inflation and appreciably lower oil prices, the headline inflation may be masking emerging domestic inflationary pressures. Wage inflation and non-tradable services inflation however, suggest dissipating disinflationary pressures, which is consistent with falling unemployment rates and increasing capacity utilization. That said, core inflation in most of the region is still considerably below inflation targets.

In the environment of a still sluggish global recovery, boosting potential growth in CESEE may be particularly challenging. Well-targeted structural reforms are needed to raise potential growth. At the same time, expansionary fiscal and monetary policies (subject to the availability of policy space) by boosting employment and demand could help mitigate potential hysteresis effects and support structural reform in lifting potential output (IMF, 2016b). In addition, some countries may need to use active labor market policies to increase labor force participation and mitigate the negative impact of shrinking labor force on potential growth (IMF, 2016a).

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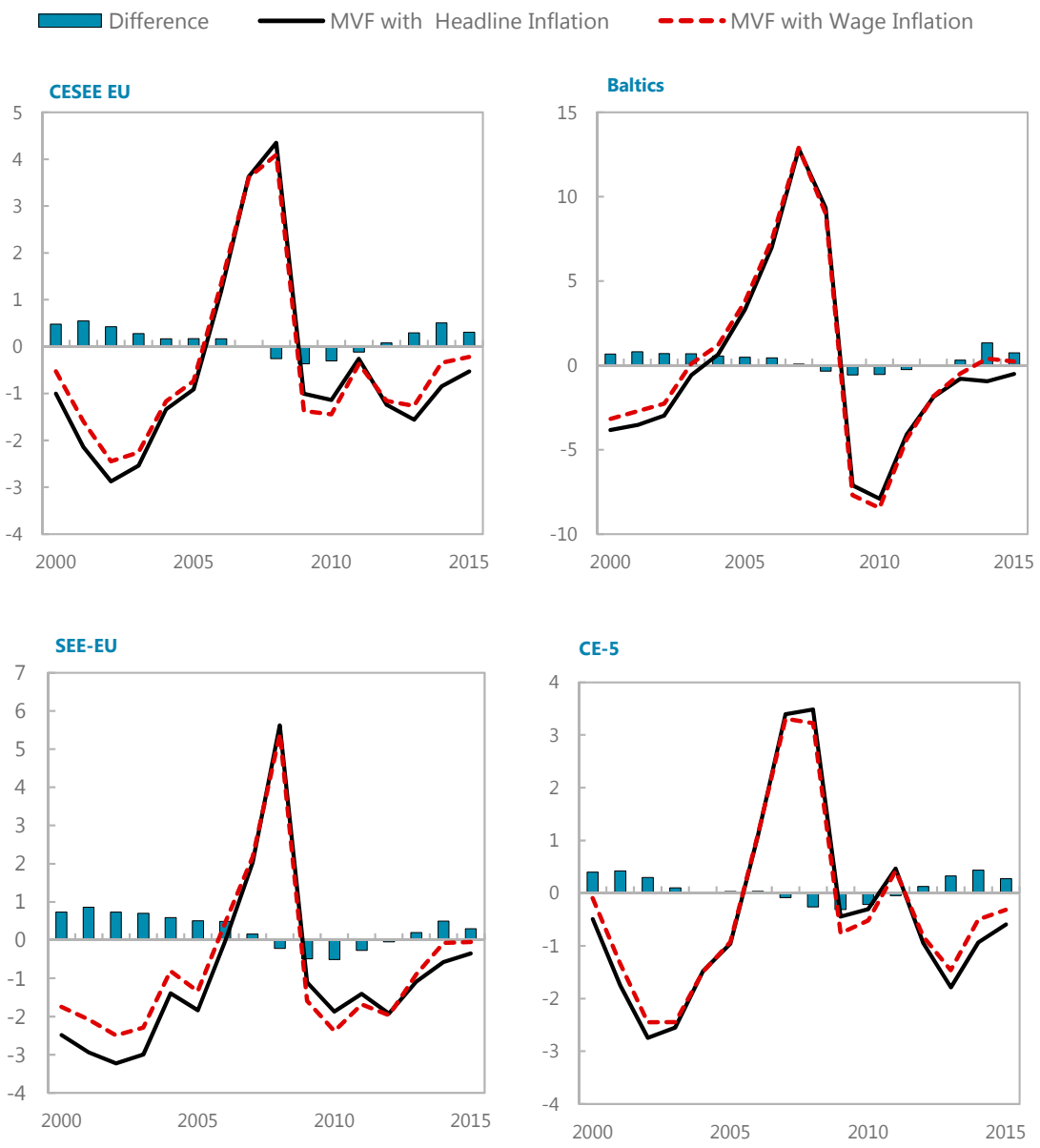
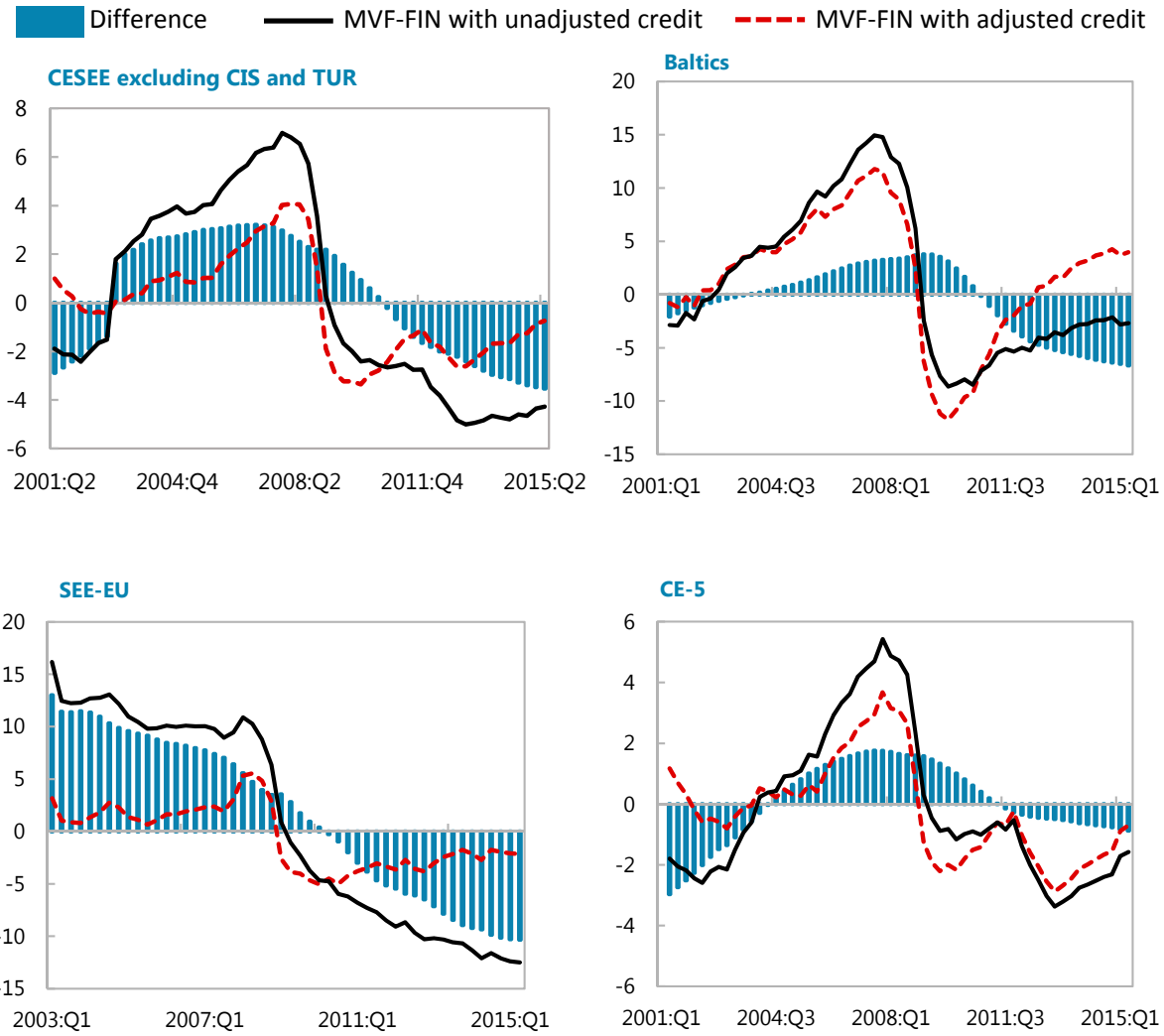
Appendix A. A comparison of output gap estimates using different indicators to identify business and financial cycle

Figure A.1. Differences in Output Gap Estimates based on MVF Using Headline vs. Wage Inflation *(Percent of potential output)*



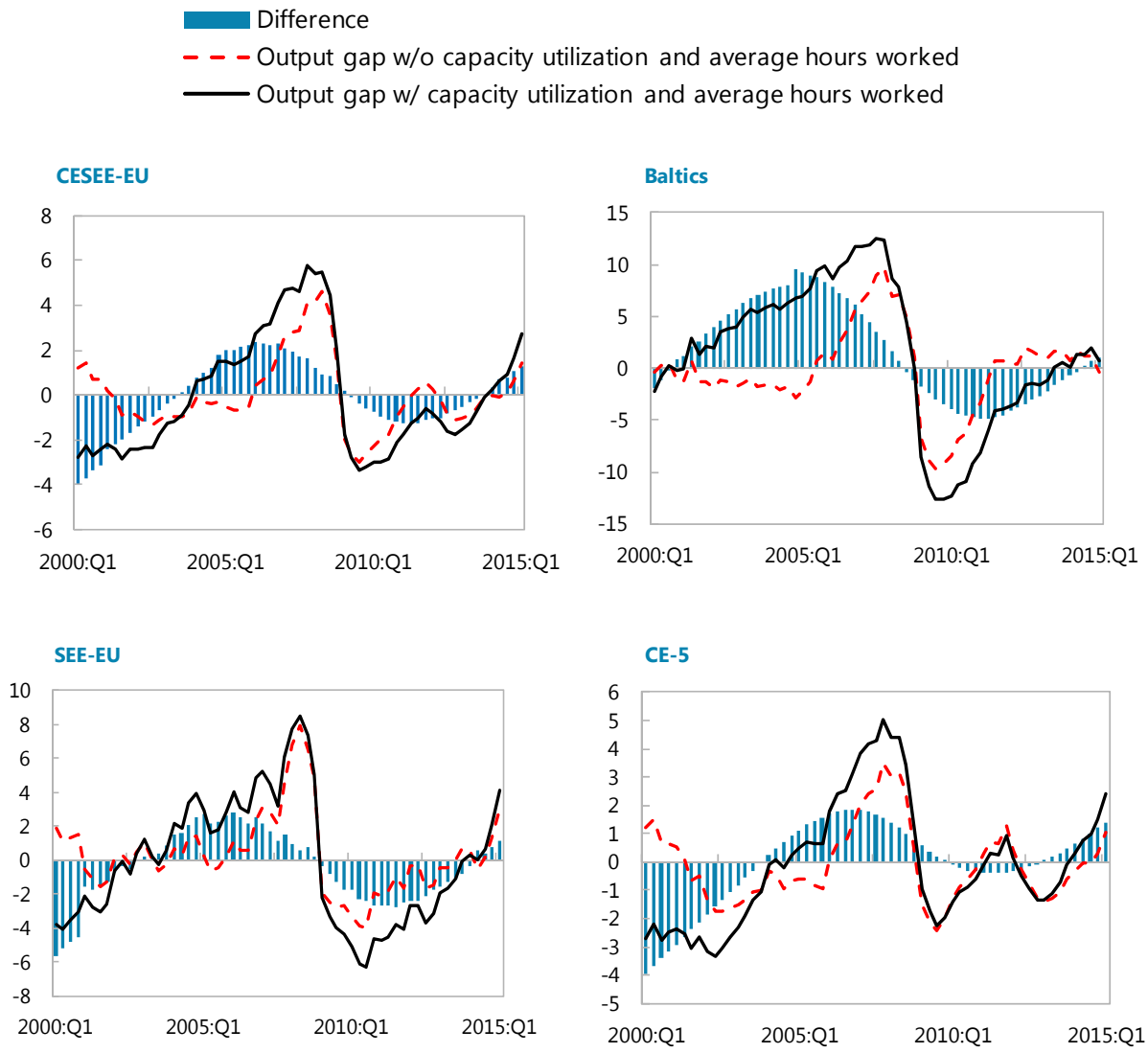
Note: CESEE EU = EU countries in Central, Eastern and South-Eastern Europe; Baltics=Estonia, Latvia, Lithuania; CE-5 = Czech Republic, Poland, Hungary, Slovakia, Slovenia; SEE EU = EU countries in South Eastern Europe.
Source: IMF staff estimations using MVF model.

Figure A.2. CESEE: Differences in Output Gap Estimates based on MVF-FIN with and without Adjustment for Financial Deepening *(Percent of potential output)*



Source: IMF staff estimations using MVF-FIN model.

Figure A.3. CESEE EU: Output Gaps Using Production Function Approach with and without Capital and Labor Intensities *(Percent of potential output)*



Sources: IMF staff calculations using production function approach.
Note: CESEE EU = EU countries in Central, Eastern, and South-Eastern Europe; CE-5 = The Czech Republic, Poland, Hungary, Slovakia, and Slovenia; SEE EU = EU countries in South-Eastern Europe.

Appendix B. CESEE Countries' Potential Growth and Output Gaps

Figure B.1. CESEE: Potential Growth Estimates

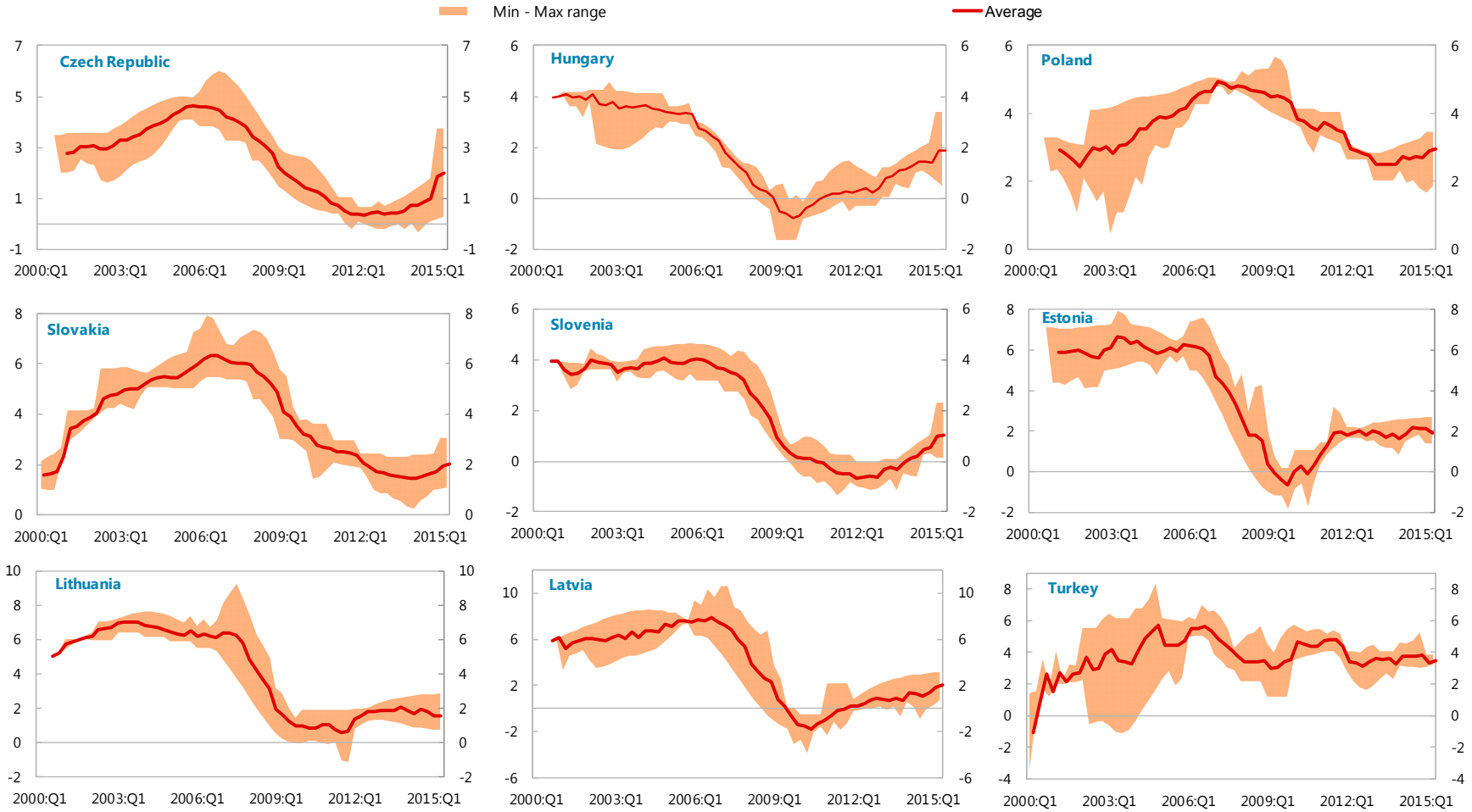
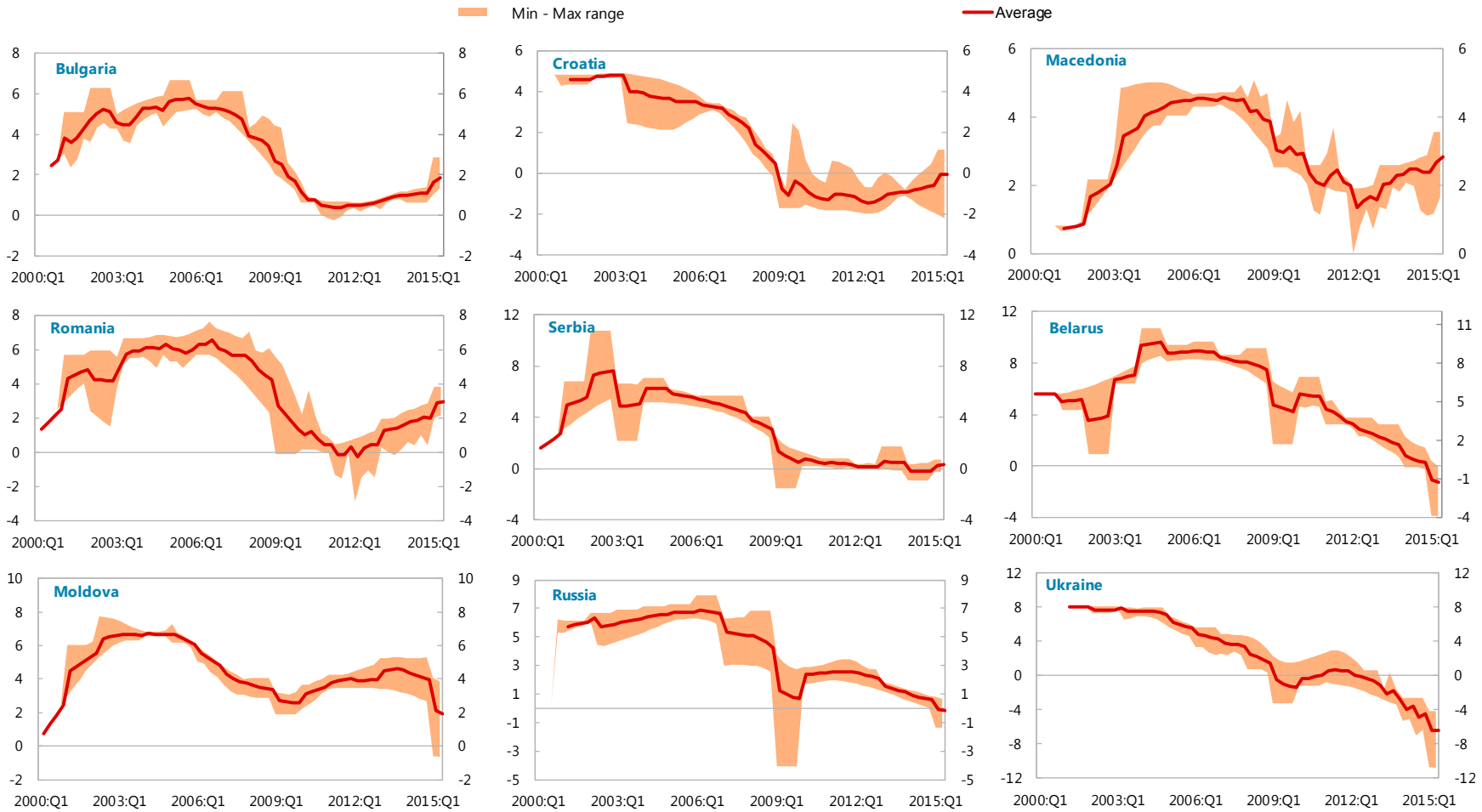


Figure B.1. CESEE: Potential Growth Estimates (concluded)



Source: IMF staff calculations. Average and Min-Max range correspond to four methodologies described in the paper, namely HP filter, MVF, MVF FIN, and Production function.

Figure B.2. CESEE: Output Gap Estimates

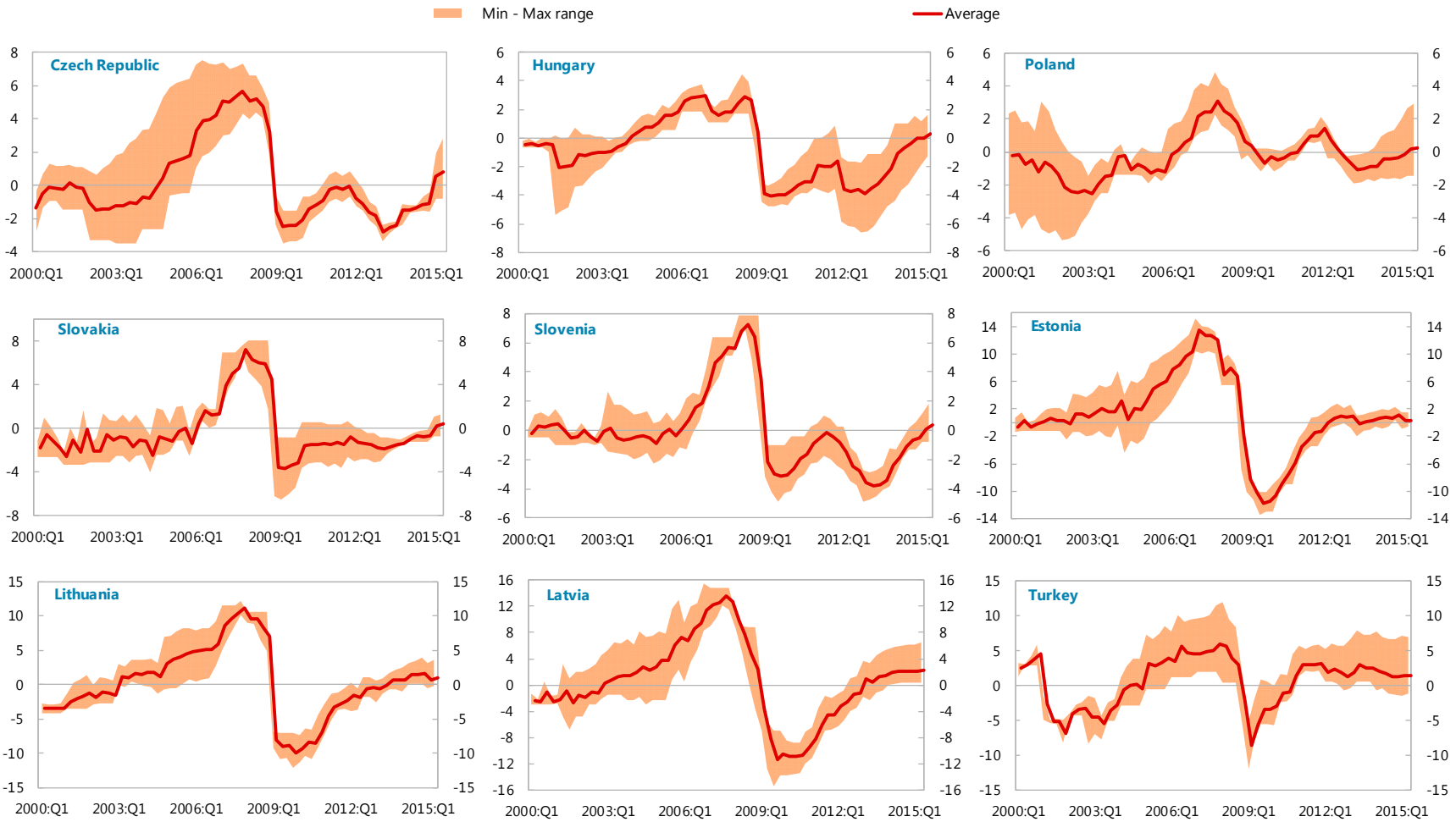
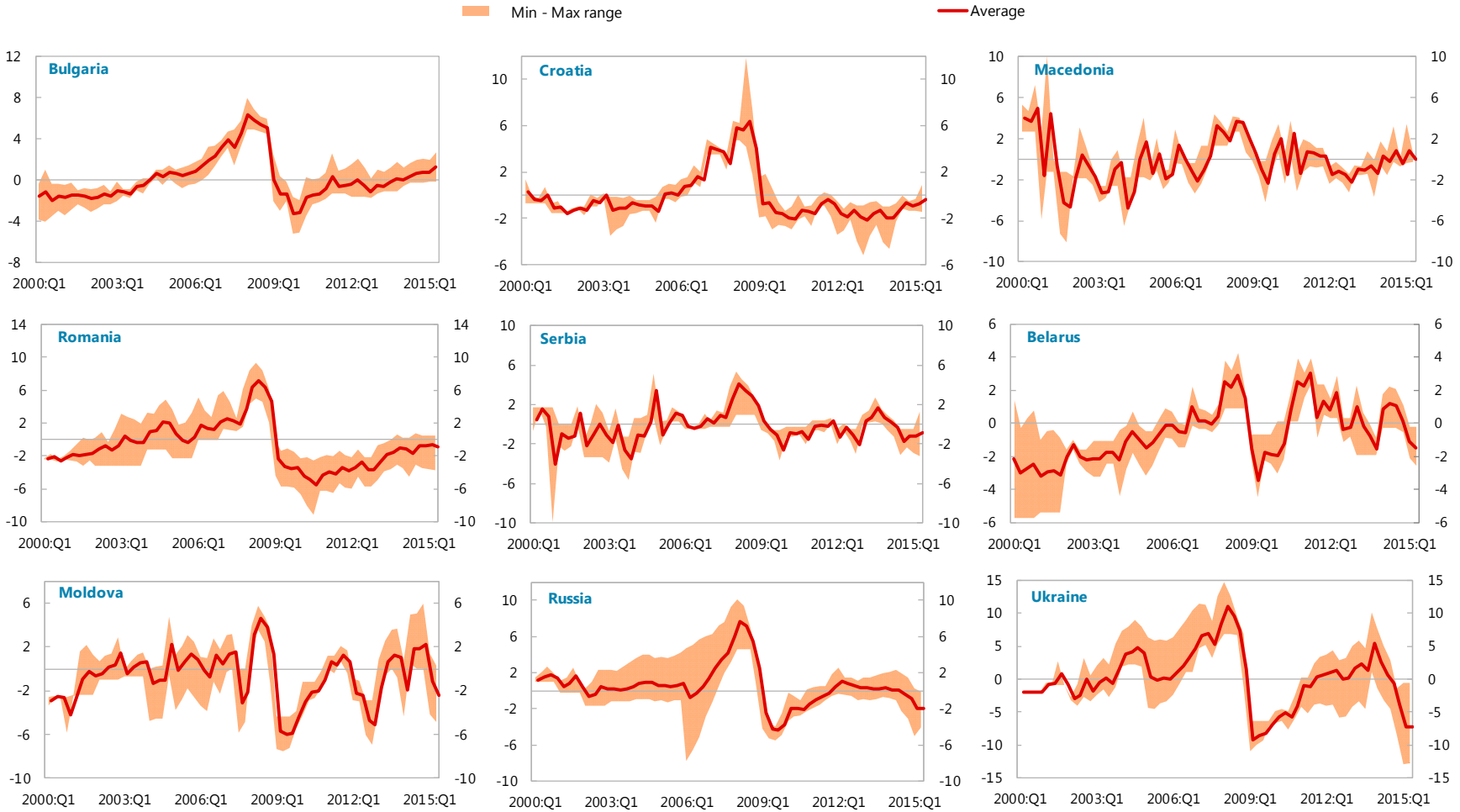


Figure B.2. CESEE: Output Gap Estimates (concluded) 1/



Source: IMF staff calculations. Note: Average and Min-Max range correspond to four methodologies described in the paper, namely HP filter, MVF, MVF FIN, and Production function.

Appendix C. CESEE Countries' Potential Growth Decomposition (using production function approach)

Figure C.1. CESEE: Potential Growth Contributions *(Percentage points)*

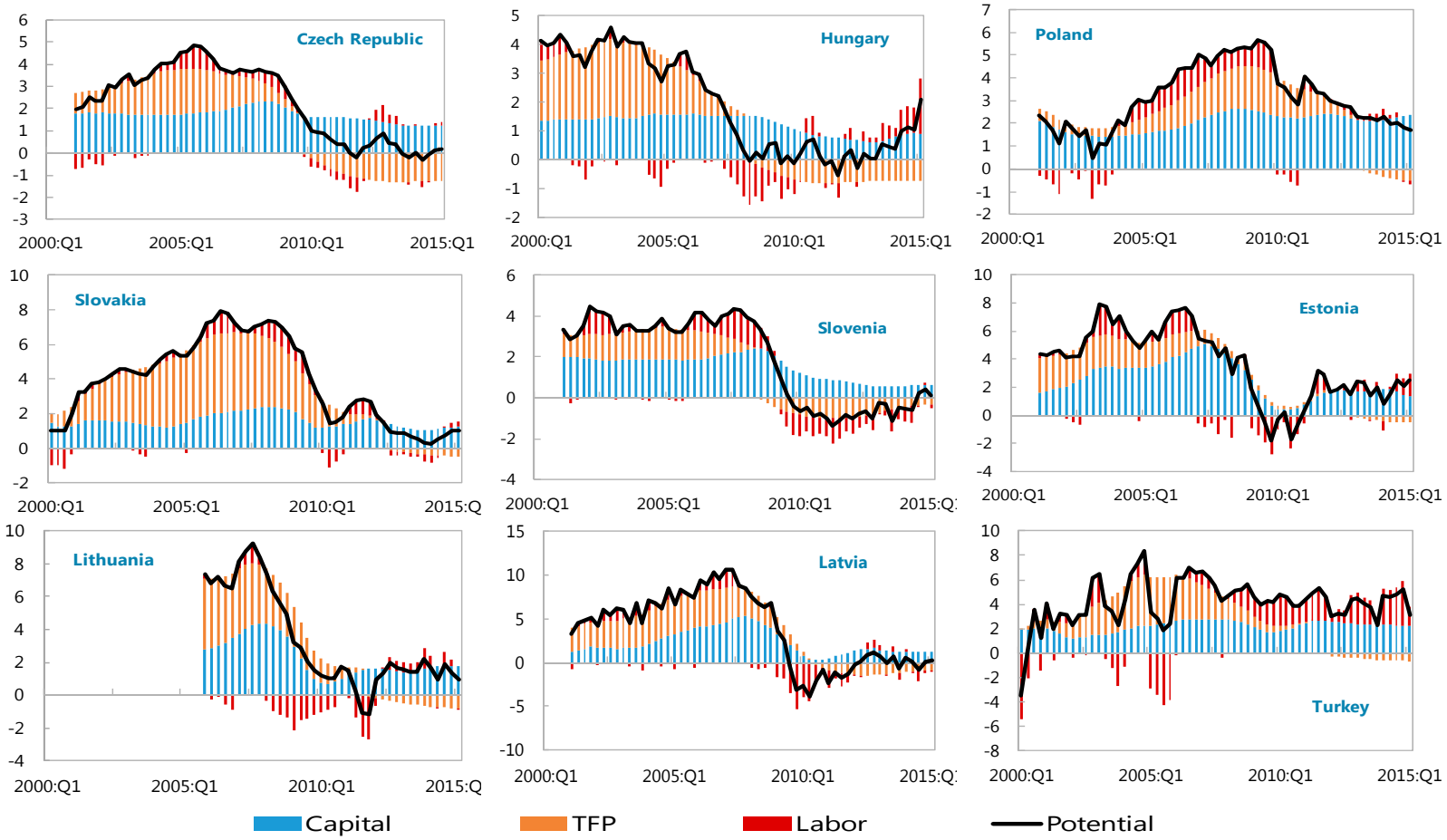
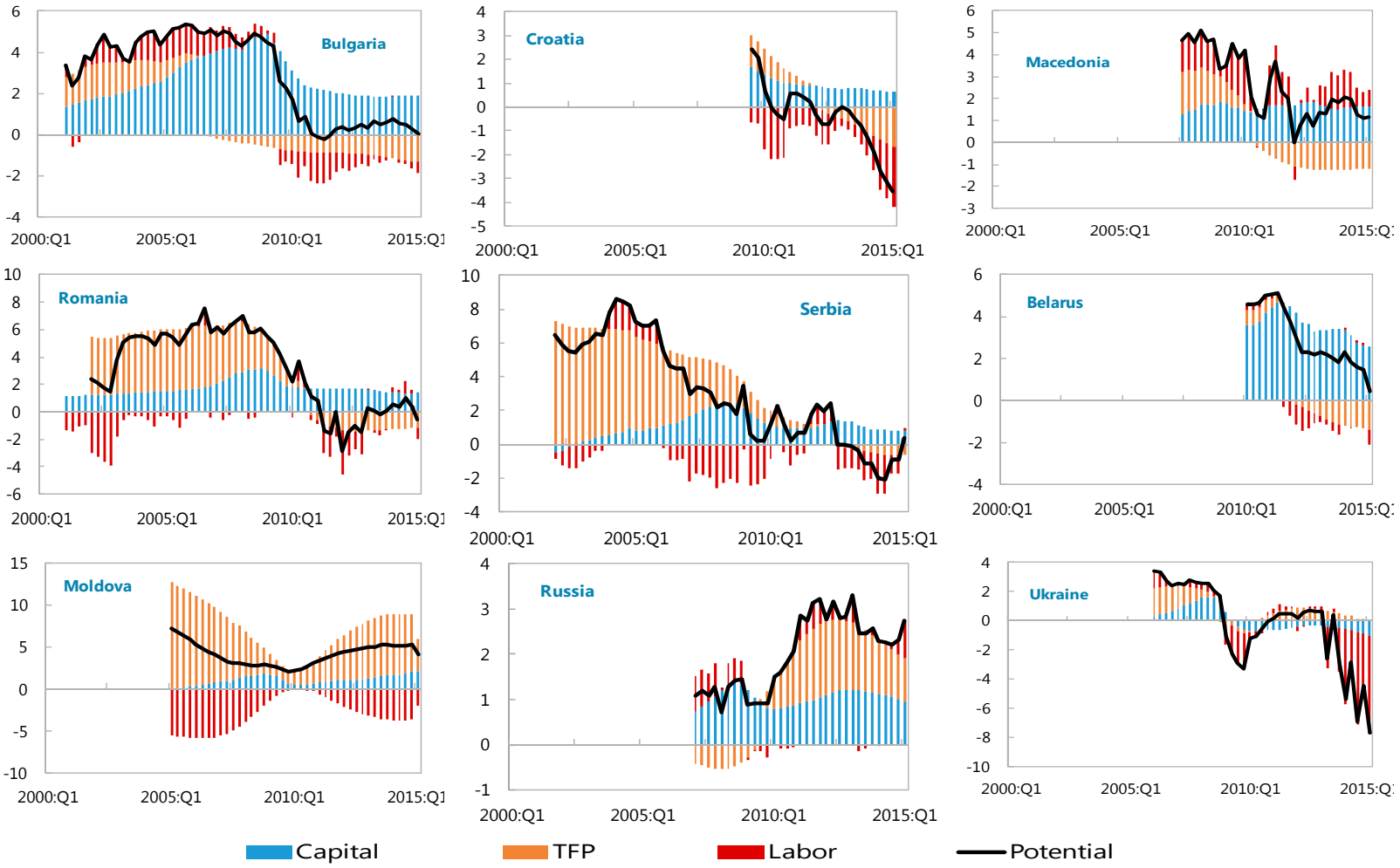


Figure C.1. CESEE: Potential Growth Contributions (concluded) *(Percentage points)*



Appendix D. Decomposing Potential Growth into Common and Idiosyncratic Components

This appendix describes the framework that we used to decompose potential growth into common/external and country-specific/idiosyncratic factors. For this purpose, we run the following regression for each CESEE country separately:

$$g_t = a_0 + a_1 g\_COM_t + a_2 g\_PAR_t + \varepsilon_t$$

Where g_t is potential growth at time t, g_PAR_t is weighted average potential growth of trading partners at time t (weighted by exports), $g\_COM_t = \frac{1}{N}\sum_{i=1}^{N} g_{i,t}$, $i = 1, \ldots, N$ is average potential growth across countries in the sample at each point in time. This represents other common component of potential growth, N is the number of countries in our sample, ε_t is country-specific component of potential growth, and a_s are parameters that need to be estimated. Vectors of a_1 and a_2 across all countries in our sample represents common factor loading vectors. To control for country fixed and time effects all data are demeaned and detrended in advance.

Appendix E. Data Sources and Variables Used for each Methodology

Variable	Source	HP filter	MVF	MVF-FIN	Production Function
Real GDP	World Economic Outlook, April 2016	✓	✓	✓	✓
Unemployment rate	World Economic Outlook, April 2016		✓		
Headline inflation	World Economic Outlook, April 2016		✓		
Wage inflation	Eurostat, Haver Analytics		✓		
Credit growth				✓	
Credit growth adjusted for financial deepening (credit gap)	IMF (2015)			✓	
House price indices	Haver Analytics			✓	
Capital stock	Haver Analytics, Penn World Tables 8.1.				✓
Average hours worked	Haver Analytics				✓
Capacity utilization	Haver Analytics				✓
Labor force participation rate	Haver Analytics				✓
Number of employed persons	Haver Analytics				✓