Finance, Potential Output and the Business Cycle: Empirical Evidence from Selected Advanced and CESEE Economies

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Traditional approaches to separate the underlying trend of potential output from cyclical developments mostly rely on the concept of nonaccelerating inflation output and are thus unable to detect upswings caused by the financial cycle, which often appear to be unsustainable in the long run. In this study, we therefore propose to extend the structural unobserved components model developed by Harvey (1989) and Harvey and Jaeger (1993) by including information on the financial cycle, i.e. private credit and house price developments, to explain the cyclical deviations from potential GDP. Thus, we are able to calculate "finance-neutral" potential output and corresponding "finance-augmented" output gaps, which take the effect of financial variables into account. We apply this novel concept to four advanced economies (AT, IE, NL, US) and four economies in Central, Eastern and Southeastern Europe (BG, EE, PL, SK) in a comparative manner. Our results show a considerable impact of the financial cycle on business cycle developments in most of the economies under review, both advanced and emerging. Remarkably, our finance-augmented output gaps exhibit a considerably higher explanatory power for the variation of observed unemployment rates in corresponding economies than standard approaches (such as the HP filter). In other words, our results considerably strengthen the case for considering the financial sector in business cycle measurement.

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The global financial crisis challenged the conventional view on potential output and emphasized the important implications of finance for understanding cyclical fluctuations. The concept of potential output typically refers to the maximum level of economic activity that can be sustained over the long term. It cannot be observed directly but has to be estimated by using a variety of approaches, from statistical filters to structural models. Such estimates are a core element of the modern consensus on rule-based economic policymaking: The difference between actual and potential output – the output gap – informs policymakers about the current state of the business cycle, allowing them to intervene in a stabilizing manner. However, potential output estimates do have a major drawback: they perform badly in real time. It is well documented, for instance, that the major approaches overestimated potential output growth in the euro area prior to the crisis (ECB, 2011; Marcellino and Musso, 2011).[2]

As has been noted by Borio et al. (2013), a common thread tying together the various concepts of potential output is the idea of sustainability. This means that

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[2] *The consensus estimate of the euro area output gap for 2007 was –0.5% in 2007 (signaling unused capacity). Now, more than five years later, it is considered to be +2.5% (signaling cyclical overheating). Output gaps are typically measured as a percentage of potential GDP.*

only a certain level of output is possible without generating unwelcome side-effects, which, sooner, or later, will lead to some form of correction. The most common undesirable side-effect of economic booms or unsustainable output in mainstream economics is inflation. Therefore, the conventional structural approaches to estimate potential output (mainly used for policymaking) all assume some form of Phillips curve, making sustainable output equal to nonaccelerating inflation output. From that, it follows that policymakers should not fear corrections to their current growth path as long as inflation remains low and stable, as was the case in advanced economies in the "Great Moderation" boom phase prior to the global financial crisis.

This consensus in macroeconomics was severely challenged by the global financial crisis, though. It is becoming increasingly clear that certain cyclical activities pass the radar of Phillips-type sustainability, such as housing bubbles and unsustainable developments in the financial sector. Indeed, housing bubbles can generate huge business cycles without creating any inflation as reflected by the average household consumer basket (which is the common notion of inflation). This follows from the fact that housing bubbles and "ordinary" inflation (as we want to call it) are of a different nature. While the obvious sustainability criterion for a wage-driven increase in consumption is "ordinary" inflation, the sustainability criterion for a credit-driven increase in investment is, at least among others, asset price inflation. Mainstream models do not distinguish between the two sets of prices, they just control for "ordinary" inflation. This is not much of a problem as long as the two sets of inflation rates are moving in a similar direction, which is, however, not always the case.

The global financial crisis is a case in point. Hume and Sentance (2009) propose two explanations for the decoupling of asset and output inflation. First, the financial upturn of the 2000s had a relatively limited impact on effective demand. Second, in cases where the demand effect was larger, inflation pressure was dampened by a deterioration of external balances (instead of reaching domestic capacity constraints). Borio et al. (2013) discuss four additional reasons why output inflation could remain low and stable against the backdrop of soaring asset price inflation, namely (i) financial booms which coincide with positive supply shocks, (ii) increases in potential output in prolonged economic upturns (as measured by conventional approaches), (iii) capital inflows leading to currency appreciation, and finally, (iv) the existence of sectoral misallocation rather than "aggregate" capacity constraints. Corresponding to our discussion on the Phillips curve above, we may add two further factors. First, inflation expectations remained well anchored throughout the 1990s and 2000s not least due to credible central banks (Bernanke, 2012), and second, changes in wage-setting institutions may have led to a lower unemployment elasticity of wages.

Hence, to improve our understanding of potential output and the corresponding output gaps, we have to take macrofinancial linkages into account (Borio et al., 2013), as the crisis has shown that a focus on inflation developments alone is too narrow to distinguish between structural and cyclical developments. The relationship between finance and growth crucially depends on the time perspective. On the one hand, there is a large body of literature that postulates a positive long-run relationship between finance and growth, which is based on the hypothesis that financial intermediation improves the efficiency of resource allocation.[3] On the other hand, the financial cycle literature argues that waves of booms and busts affect the economy in the short to medium run. The common notion refers to a self-enforcing but unstable circle between financing constraints, asset prices and economic activity.[4] The recent literature largely confirms the existence of the financial cycle and its importance for understanding the business cycle (for valuable surveys see Taylor, 2012; Borio, 2012).

It is evident that conventional univariate statistical filters (such as the Hodrick-Prescott (HP) filter) do not provide an appropriate alternative in this context. In principle, they could attenuate periodic signals at any frequency (the literature suggests 1 to 8 years for the business cycle and 8 to 30 years for the financial cycle, as measured from peak to peak). In practice, however, the frequency is likely to change from one cycle to another, making it again difficult for policymakers to estimate potential output in real time. In addition, without any identifying restriction, the filtered series does not allow for any economic interpretation.

The existence of a tremendous real-time uncertainty on estimations of potential output is an obvious problem for stabilization policy (Friedman, 1947).[5] Thus, improving the measurement and estimation of potential output to reduce uncertainty is crucial for decision-makers in central banks, governments and institutions. In this paper we address this issue by explicitly considering information on the financial cycle for estimating potential output and cyclical fluctuations. Our basic underlying hypothesis states that the current measurement of potential output ignores the cyclical effects of finance and thus considers effective demand created by financial cycles as sustainable output.

This paper provides first-time comparative evidence on the finance-neutral potential output as pioneered by Borio et al. (2013) by applying the concept to more countries, namely two sets of advanced (AT, IE, NL, US) and emerging EU economies (BG, EE, PL, SK). We also use a more general statistical framework, namely a variant of the Kalman filter following Harvey (1989) and Harvey and Jaeger (1993) which nests the extended HP filter suggested by Borio et al. (2013) as a special case. We show that our finance-augmented estimates of the cyclical components are able to explain a considerably higher share of the variation of the unemployment rates in the respective economies than the conventional HP filter, which considerably strengthens the case for considering the financial sector when measuring business cycles. Our work is in the spirit of Comin and Gertler (2006), who highlighted the empirical importance of medium-term cycles as well as the problem that conventional filters tend to sweep these oscillations into the trend.[6]

Our findings provide important input to the current discussion on the problems of stabilization policy, including not only monetary policy, but also fiscal interventions and macroprudential measures to smooth the financial cycle (in order to avoid corresponding busts and deep recessions). Our approach is appealing

[3] *See Levine (2005) for a comprehensive survey of this literature.*

[4] *See Minsky (1978) for a classical exposition.*

[5] *In his discussion of Lerner's book, Milton Friedman laid down his two famous institutional arguments against Keynesian demand management, one being the difficulty to act timely, the other (and mostly forgotten) being the difficulty to identify and predict the state of the economy in real time.*

[6] *They explained the persistence of short-run shocks by endogenous productivity in an otherwise standard New Keynesian dynamic stochastic general equilibrium (DSGE) model.*

because it neither changes nor extends existing policy rules, but instead keeps them simple and makes them more robust in real time. Moreover, in contrast to the existing consensus, our results imply the need for a symmetric countercyclical economic policy response to the financial cycle.

The paper is structured as follows. Section 1 explains the empirical approach and the data used in our study. Section 2 shows our empirical results and discusses related implications for both advanced and emerging economies, while the final section concludes and discusses the findings in the context of previous literature.

1 Methods and Data

1.1 Empirical Approach

We aim at decomposing actual real GDP series by separating the underlying trend of potential output from cyclical developments, both unobserved in practice. For this purpose, we set up a structural time series model to decompose the observed series of real GDP into unobserved components.[7] In particular, we extend the structural unobserved components model proposed by Harvey (1989) and Harvey and Jaeger (1993) to decompose the real GDP time series into a trend, a cyclical component, and an irregular component, by taking into account the developments of financial variables. Therefore, following Harvey and Jaeger (1993), we express the logarithm of real GDP y_t as

$$y_t = \mu_t + \psi_t + \varepsilon_t, \qquad t = 1,\ldots,T, \qquad (1)$$

where μ_t is potential (trend) output, ψ_t denotes the cyclical component of output and ε_t is the irregular component. In its most general form, potential output is assumed to follow a local linear trend, i.e.

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t, \qquad \eta_t \sim NID(0,\sigma_\eta^2), \qquad (2)$$

$$\beta_t = \beta_{t-1} + \zeta_t, \qquad \zeta_t \sim NID(0,\sigma_\zeta^2), \qquad (3)$$

where β_t denotes the slope of potential output. The disturbances η_t and ζ_t allow for stochastic shifts in the trend and in the slope of the trend. The cyclical component as a mixture of sine and cosine waves can be written as

$$\psi_t = \rho\cos\lambda_c\psi_{t-1} + \rho\sin\lambda_c\psi_{t-1}^* + \kappa_t, \qquad \kappa_t \sim NID\left(0,\sigma_\kappa^2\right),\ 0 \le \rho \le 1 \qquad (4)$$

$$\psi_t^* = -\rho\sin\lambda_c\psi_{t-1} + \rho\cos\lambda_c\psi_{t-1}^* + \kappa_t^*, \qquad \kappa_t^* \sim NID(0,\sigma_\kappa^2). \qquad (5)$$

Here, ρ is a dampening factor constrained to be between zero and one, and λ_c denotes the frequency of the cycle, measured in radians, constrained to lie between zero and π. Following Harvey and Jaeger (1993), we assume that the two disturbances κ_t and κ_t^* have the same variance (σ_κ^2). Therefore, the cyclical component of GDP is modeled by means of a stochastic sine-cosine wave. This structural component renders several advantages related to the fact that we can extract its

[7] *See Harvey (1989) and Durbin and Koopman (2001) for in-depth treatments of state space models and the Kalman (1961) filter. The nontechnical discussion provided in this section is mainly based on these textbooks.*

properties and give an economic meaning to them, as shown by Harvey (1989) and Harvey and Jaeger (1993).[8, 9]

Importantly, this model nests the widely used Hodrick-Prescott (1997) filter as a special case. Restricting the parameters to $\sigma_\zeta^2 / \sigma_\varepsilon^2 = \lambda$ (where λ is the smoothing parameter of the HP filter) and $\sigma_\eta^2 = \psi_t = 0$, the cyclical component of the HP filter can be retrieved as the smoothed irregular component. In this sense, we build upon the pioneering approach by Borio et al. (2013), but apply a more general statistical framework which models both the trend and the cyclical component explicitly. In order to facilitate a comparison with the extended HP filter used by Borio et al. (2013), however, we set $\sigma_\eta^2 = 0$ in our estimations to allow the trend to be only smoothly changing (i.e. the model does not permit stochastic level shifts in trend output).[10]

In order to be able to explain some variation of the cyclical component by the financial cycle, we adapt equation (4) in the following manner.

$$\psi_t = \gamma_1 HOUSE_t + \gamma_2 CREDIT_t + \rho \cos \lambda_c \psi_{t-1} + \rho \sin \lambda_c \psi^*_{t-1} + \kappa_t, \tag{4a}$$

where $HOUSE_t$ refers to the growth rate of real house prices, and $CREDIT_t$ is the growth rate of real credit. It should be noted that in this formulation the financial variables are allowed to exert a direct effect only on the business cycle component, i.e. the output gap. Consequently, any influence of credit and house price developments on potential output can only be indirect.

Once the model is written in state space form, estimation can be carried out by means of maximum likelihood estimation via the Kalman (1961) filter and the prediction error decomposition. Following estimation of the parameters, the cyclical components are retrieved as the smoothed estimates of ψ_t, $\hat{\psi}_t$.

For each country in our sample, we subsequently estimate the smoothed cyclical and trend components given by the HP filter with $\lambda = 1600$, and those from the model described in equations (1) to (5). We then estimate variants of the model given by equations (1) to (4a) and (5) that include either real credit or real house prices, as well as a version that includes both financial variables, and retrieve the (smoothed) cycles and trends from those models.

1.2 Data Sources

Real GDP data are taken from the International Monetary Fund's IFS database. For advanced economies we measure credit as total credit to the nonfinancial sector (incl. cross-border credit), using the long series on credit to private nonfinancial

[8] *In particular, it is easy to define several of the characteristics of the cycle such as the expectations concerning the period (as a function of the estimate of the frequency), the amplitude, and the phase of the cycle (see Harvey, 1989, pp. 38–39, for further details).*

[9] *We are aware that maximum-likelihood estimations via the Kalman filter can be subject to the pile-up problem (Stock and Watson, 1998, who propose to use median unbiased estimation instead). However, our estimations of the Harvey-Jaeger model using a Kalman filter without financial explanatory variables are quite similar to Hodrick-Prescott estimations, where the signal-to-noise ratio is restricted to λ. In this sense, there seems to be no pile-up problem. The volatility of the trend is reduced when we include our financial explanatory variables in the model. They increase the estimated volatility of the cycle, as a result of which the volatility associated with the trend decreases. Therefore, we conclude that the specific behavior of the volatilities of the trend and cyclical components in our model including the growth rates of real house prices and real credit is driven by the information added by our financial indicators rather than by the pile-up problem.*

[10] *The model which allows for shifts in trend output (i.e. which does not set $\sigma_\eta^2=0$) will be implemented for an extended country sample in the near future.*

sectors provided by the Bank of International Settlements.[11] A detailed description of the dataset can be found in Dembiermont et al. (2013). As the BIS dataset does not provide credit data for most CESEE countries, we measure credit as domestic banks' claims on the resident nonbanking sector (excl. state and local governments) for these countries.[12] Our house price dataset for the CESEE countries is described in Steiner (2013), Huynh-Olesen et al. (2013) and Hildebrandt et al. (2012). For the other countries in our dataset we use data from the BIS property price statistics[13] and residential property price data provided by the ECB. We deflate all credit and house price series using IMF consumer price data. See table 1 in the appendix for a detailed overview of the data sources for all countries.

2 Empirical Results

2.1 Advanced Economies

Chart 1 shows real GDP, real house prices and real credit for Austria, Ireland, the Netherlands and the United States as index values (Q4 2007 = 100). Four stylized facts emerge: (i) Not all countries exhibited a financial cycle that peaked around 2007. For instance, the increase in Austrian house prices even accelerated after the crisis emerged. (ii) The upswing of the financial cycle in Ireland, the Netherlands and the United States started in the second half of the 1990s and accelerated further in the 2000s (showing exponential house price trends and rising credit growth). (iii) Interestingly, house prices seem to peak earlier and more sharply than credit, especially in the United States and Ireland. (iv) At first sight, interdependencies between the financial cycle (i.e. house prices and private credit) and real GDP developments seem rather heterogeneous across countries.

Our empirical results are depicted in charts 2 to 5. For each country, we estimated four different versions of the Kalman filter, one without additional explanatory variables (Harvey and Jaeger (H/J) baseline), one including credit, one including house prices, and one allowing *both variables* to exert influence on the cyclical component of GDP (top left). The latter (our preferred measure of the finance-neutral potential output) is subsequently compared to the official estimates of potential output growth by the OECD and/or the European Commission for the respective economies (top right). In the bottom half, we decompose the actual GDP growth rates into growth contributions from potential output (shaded area) and the cyclical share (the remaining difference to actual GDP growth), comparing the HP filter (left) and the "house/credit" model (right).

Several stylized facts can be highlighted. First, in all four countries, a strong boom period preceding the global financial crisis is clearly visible. In the United States, Ireland, and the Netherlands, the estimated output gaps are considerably larger, however, when the Kalman filter takes financial developments into account, while the estimates for Austria are hardly affected by the additional explanatory variables. Thereby, the considerably negative output gaps at end-2012

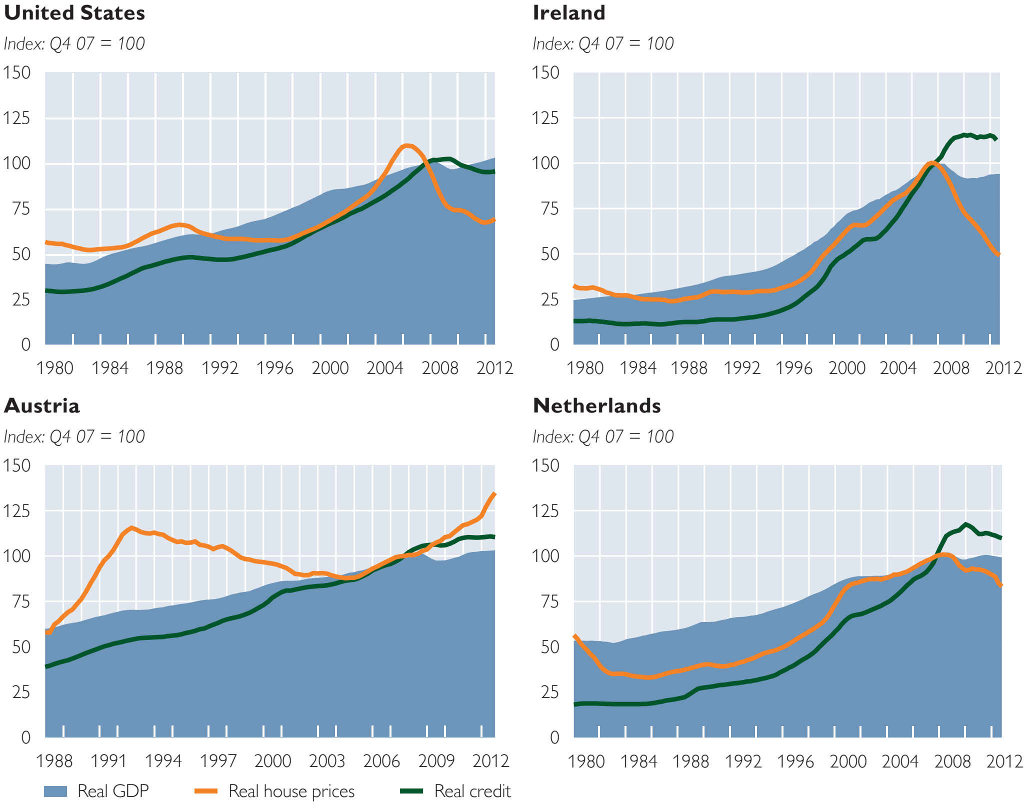
[11] *The dataset is available online at www.bis.org/statistics/credtopriv.htm.*

[12] *Although the definition of this credit variable is narrower than the definition of the total credit variable provided by the BIS, the correlation coefficient between the two variables is very high.*

[13] *The dataset is available online at www.bis.org/statistics/pp.htm.*

Chart 1

Real GDP, House Prices and Real Credit in Advanced Economies

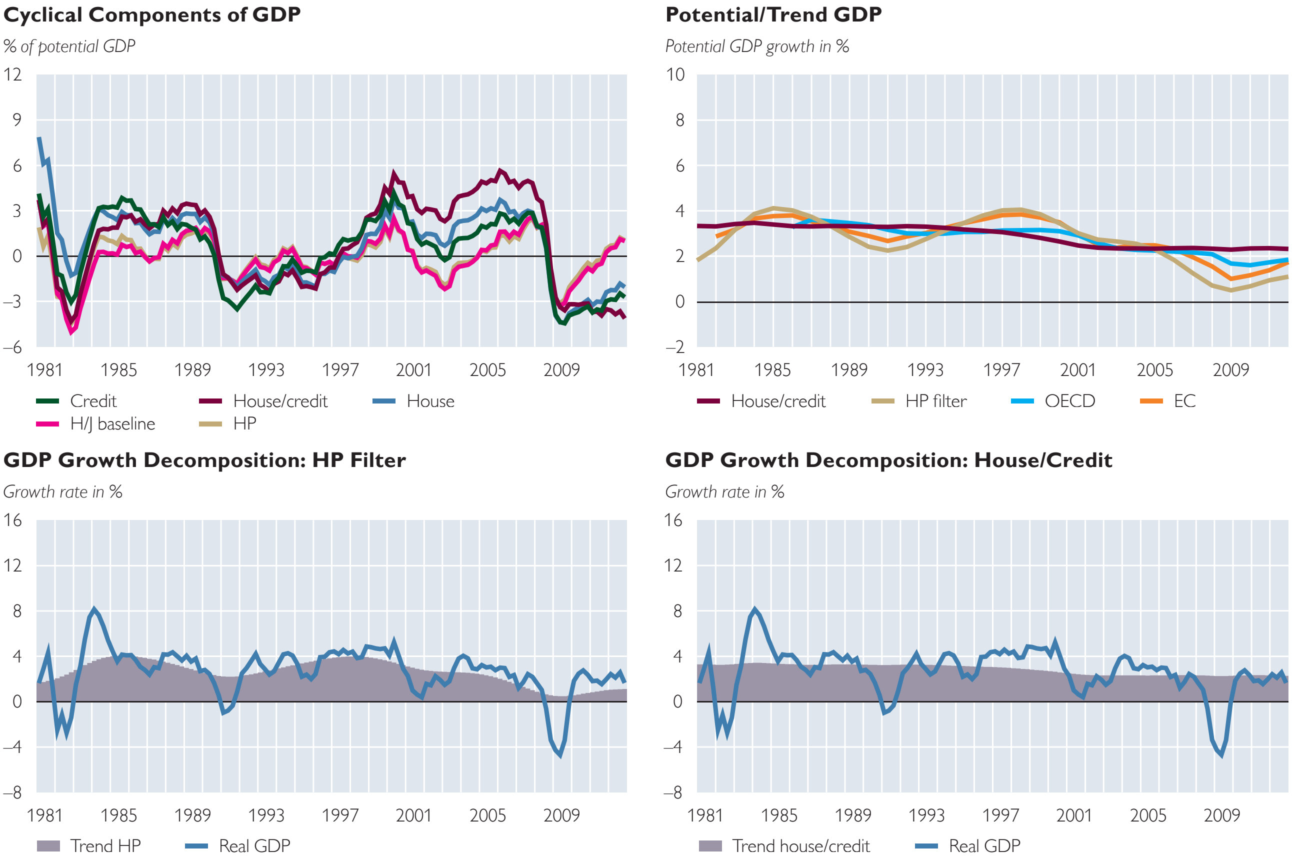


Source: OeNB.

may reflect the slow deleveraging of households and financial sectors in the corresponding countries. Second, particularly in those countries where the financial cycle played an important role for cyclical components (i.e. IE, NL, US), the growth rate of finance-neutral potential output is by far less volatile than the one suggested by the HP filter, as shown in the two lower panels for each country. Third, the OECD estimate of potential output growth is the closest estimate to our house/credit model in all four countries, while the estimates by the European Commission seem to follow a standard HP filter quite closely. Fourth, the considerable reduction of potential output growth according to our model (particularly in IE and NL) is likely to be caused by the capital channel (lower investment induced by the recession and financial constraints), the labor input channel (permanent destruction of human capital as a result of long periods of unemployment, hysteresis effects), as well as the total factor productivity (TFP) channel, once again because of lower investment and adverse effects on human capital by the recession. Finally, we also confirm the existence of "unfinished recessions" as outlined in Borio et al. (2013) in the first half of the 2000s for the United States, Ireland and the Netherlands. In those time periods, conventional approaches suggested a negative value for the output gap in the corresponding economies, while they may still have been in a boom phase according to finance-augmented cyclical components.

Chart 2

United States



Source: OeNB.

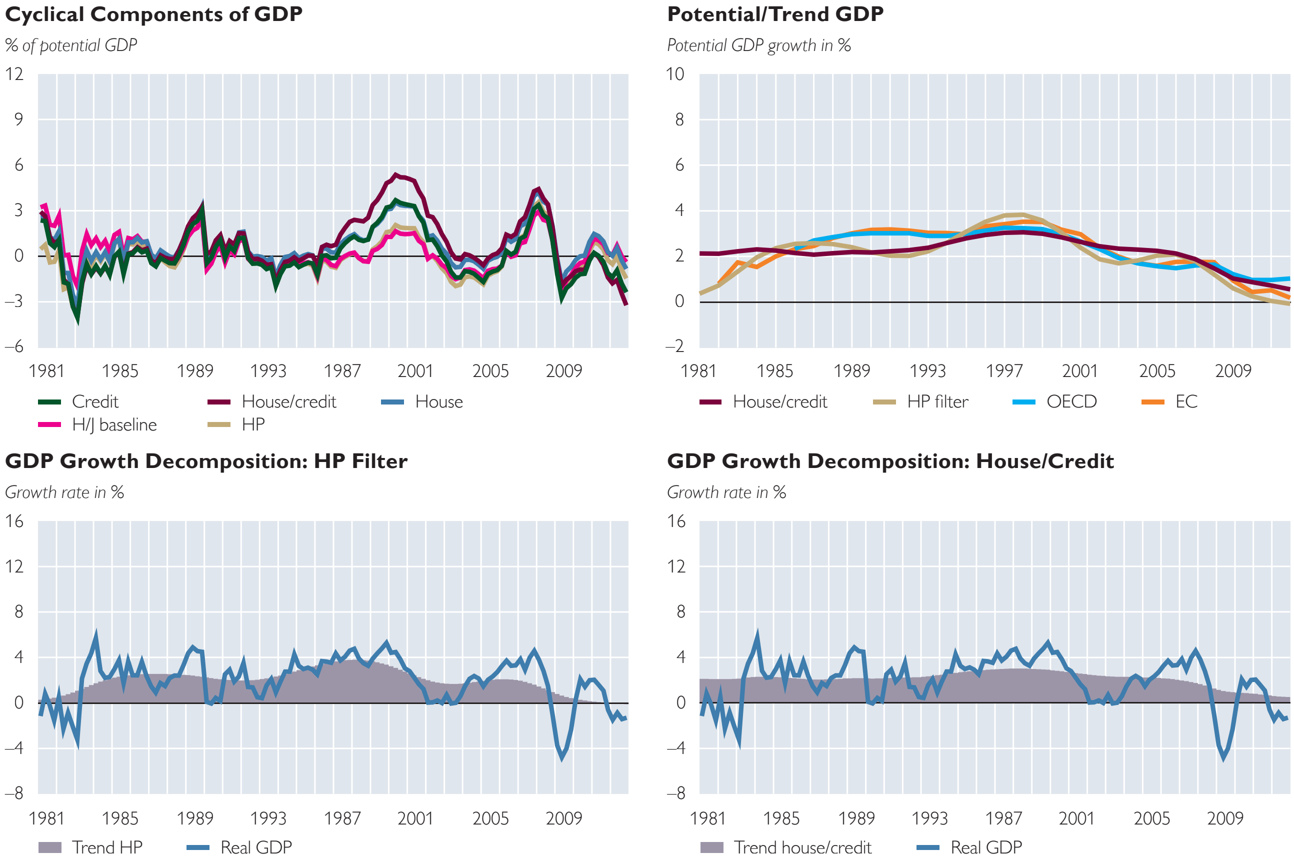
In greater detail, the estimates for the United States (chart 2) show a financial boom in the late 1980s as well as in the 2000s, following a relatively moderate financial bust in the early 1990s. In 2012, at the end of our sample, the U.S. economy shows signs of recovery and positive GDP growth rates supported by developments in the housing market; however, ongoing balance sheet adjustments make it still impossible to catch up to the potential level, i.e. the growth rate is not sufficient to close the output gap. The slowdown of potential output growth in the early 2000s that is evident from the bottom right panel (suggested by the house/credit model) is confirmed by Fernald (2012) and somehow coincides with the estimates of the OECD, while both the HP filter as well as the European Commission's estimates show a considerably higher volatility of potential output growth.[14]

The financial cycle in the Netherlands (chart 3) started in the mid-1990s driven by extensive growth rates of both credit and house prices. Following an "unfinished recession" in the early 2000s, the second financial boom was comparably weak and ended with the global financial crisis. The Dutch housing market is characterized

[14] *The main arguments for the pronounced boom/bust cycle in the United States is extensively discussed in Borio et al. (2013) and Borio (2012). Thus, for brevity reasons, we refrain from a more detailed discussion of the underlying causes and mechanisms.*

Chart 3

Netherlands



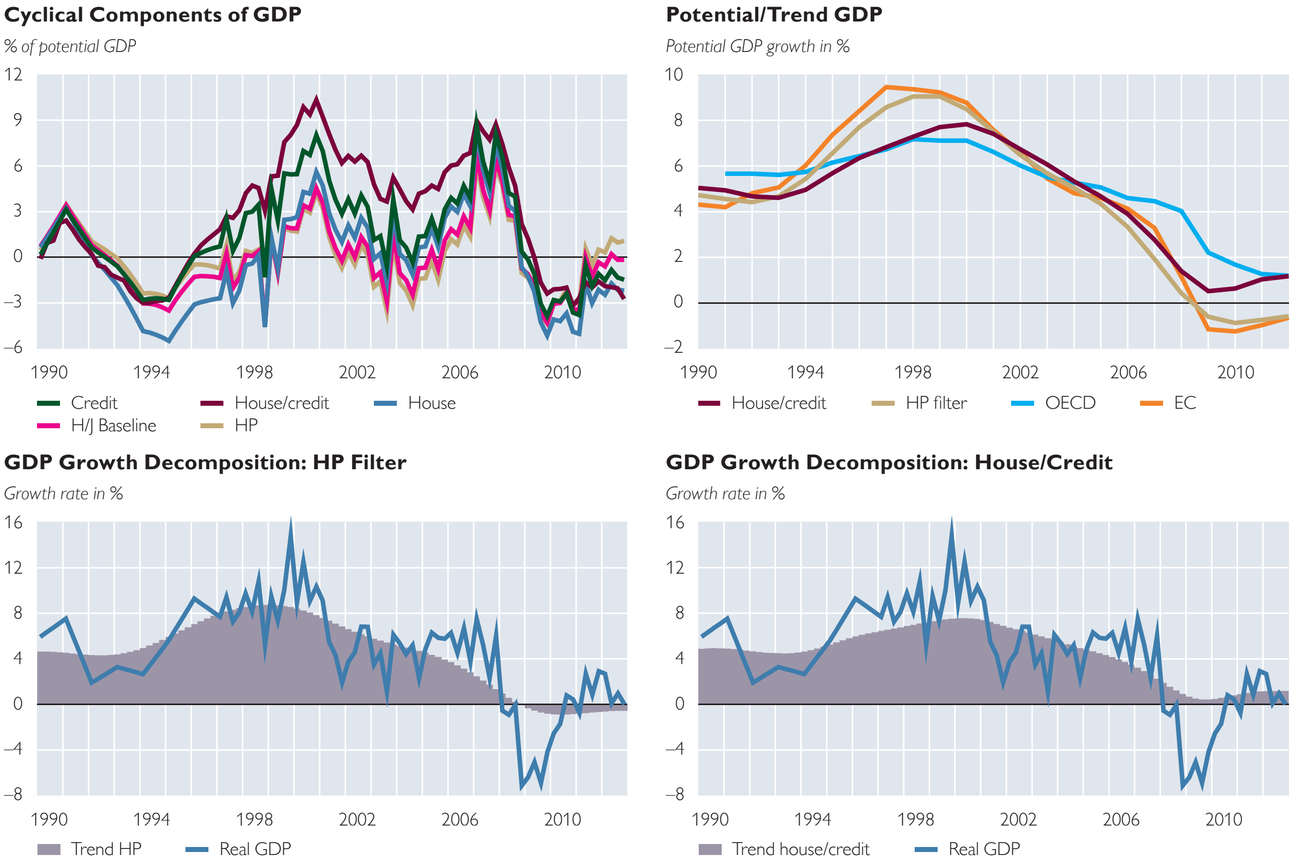
Source: OeNB.

by highly interventionist public policies, as explained by Vandevyvere and Zenthöfer (2012). Direct and indirect government intervention, generous mortgage interest deductibility and low taxation of home ownership, combined with a relatively rigid supply, led to a considerable increase in house prices, starting in the mid-1990s. Thus, innovations and liberalizations in mortgage financing played a more important role in the Netherlands than in other European countries. The considerable expansion of the debt capacity of Dutch households enabled them to take up larger amounts of debt, leading to high levels of leveraged housing wealth and even further price increases. Our evidence suggests that financial rebalancing in the Netherlands was still unfolding at the end of 2012.

Compared with the Netherlands, the influence of the financial cycle is even more pronounced for the Irish economy (chart 4). Until the early 1990s, Ireland was a relatively poor economy characterized by low-skilled manufacturing. During the 1990s, deregulation and other policy initiatives led to a rapid shift to high-skilled manufacturing, high growth in the service sector, rapid growth of the population, and finally to a housing and property boom (Kitchin et al., 2012). While the first years of this rapid growth period were characterized by export-led growth dominated by FDI inflows, the last years of the expansion involved a property boom financed by Irish banks which, in turn, were borrowing from

Chart 4

Ireland



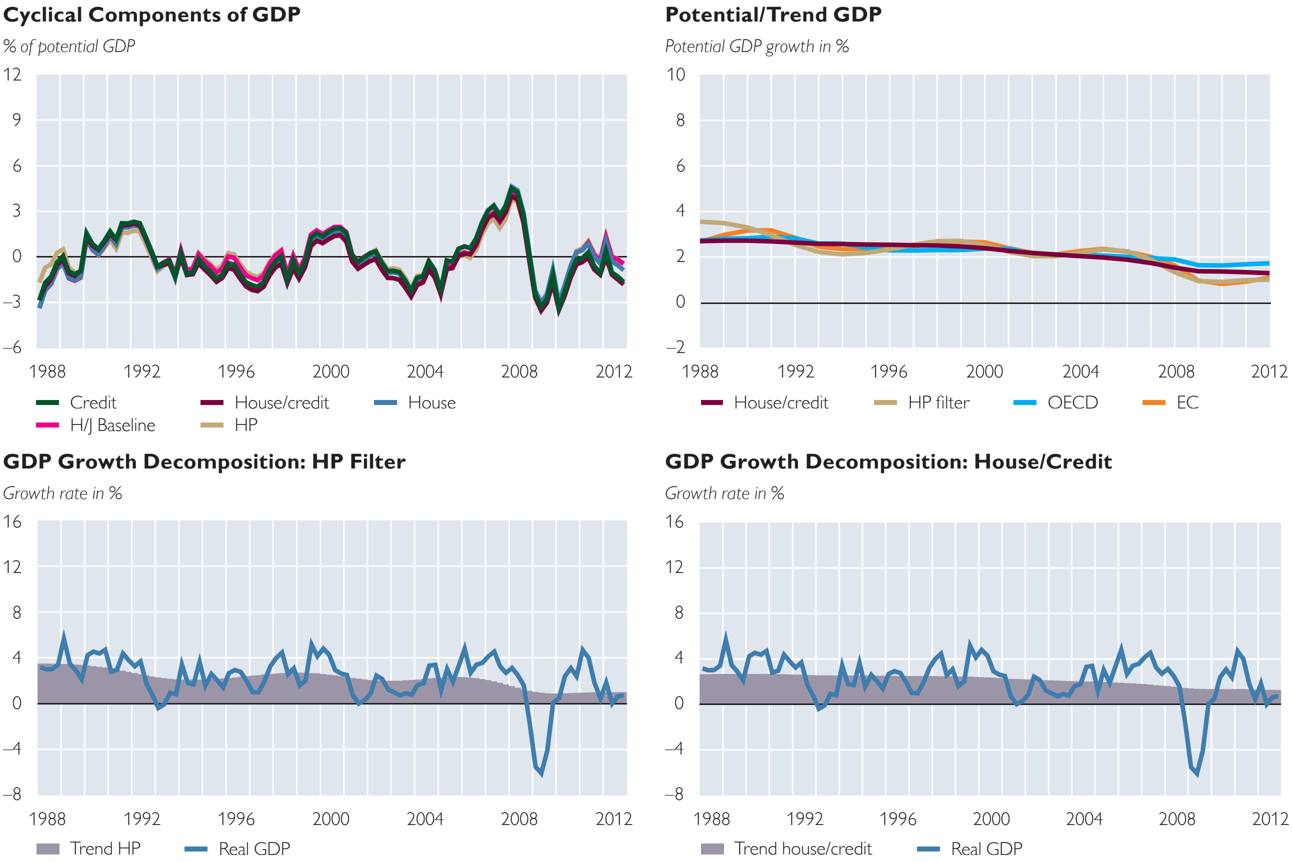
Source: OeNB.

European banks. The global crisis finally led to the burst of the property bubble, and many Irish banks with toxic property loans on their balance sheets were on the brink of bankruptcy, ultimately leading to the IMF-EU bailout in November 2010. While conventional univariate filters would suggest a recession in Ireland from 2003 to 2005, our extended house-credit model suggests an extensive boom period already starting in 1996, with the output gap staying positive up to the beginning of 2009. The final years of the boom, starting in 2005, seem to be caused by the property boom and extensive credit growth. Unsurprisingly, the high growth rates underpinned by the construction boom were not sustainable during the crisis, when the bust led to a severe recession.

Our estimates for Austria, on the contrary, do not suggest a sizeable financial cycle since the late 1980s. Not even the long, but rather gradual decline in house prices in the 1990s caused a substantial increase in negative output gaps at that time. During the crisis, the slow growth of credit constituted a drag on the economy, increasing the 2012 output gap by more than a percentage point (as compared to the HP filter). Potential output growth again proved to be more stable than the HP filtered series, suggesting a potential growth rate of below 1.5% for the Austrian economy at the end of 2012. A recent study by Schneider (2013) argues that the decreasing undervaluation of Austrian house prices since

Chart 5

Austria



Source: OeNB.

2010 – mainly driven by the strong house price increases in Vienna – are not debt financed, and thereby consistent with our estimates of relatively higher negative output gaps for the "credit" model than for the "house/credit" model driven by low credit growth despite the recent rise in house prices.

2.2 Countries in Central, Eastern and Southeastern Europe (CESEE)

While the empirical impact of the financial cycle on business cycle fluctuations is quite substantial for most advanced economies, the effect might be different and also quite heterogeneous for economies in Central, Eastern and Southeastern Europe (CESEE), as these economies have been on a convergence path during the last decade and are at highly different stages of economic development. Furthermore, countries like Estonia or Slovakia have already introduced the euro, and Bulgaria operates a currency board with a fixed exchange rate, while the Polish złoty is still floating. Thus, even when only considering the exchange rate regime, we would expect that countries in CESEE differ widely according to their vulnerability to external shocks and capital flow reversals. A further distinct feature of financial systems in CESEE is the high share of foreign banks in total banking assets, which averages 82% in CESEE, as compared to only 37% in Latin America (Backé et al., 2010). Before the crisis, financial deepening was welcomed from the perspective of many policymakers, as economic theory suggests a positive relationship between credit-to-GDP levels and economic development. Nevertheless, the developments prior to the crisis led to a lively policy debate whether private credit growth was excessive in the CESEE region (for empirical contributions see, for instance, Backé et al., 2007; Égert et al., 2007; Backé and Wójcik, 2008; Eller et al., 2010; Backé et al., 2010; Lahnsteiner, 2013), although an assessment of equilibrium credit seems quite difficult in emerging economies, as they are still converging to a steady state. Indeed, the correction in private credit since 2008 in some economies may suggest some overshooting in the indebtedness levels in the run-up to the crisis (Lahnsteiner, 2013).

Although developments in housing markets have not attracted as much attention in the literature, a number of studies have examined the determinants of house prices in CESEE, and further, tried to assess house price sustainability (see, for instance, Hildebrandt et al., 2012; Huynh-Olesen et al., 2013; Steiner, 2013). Huynh-Olesen et al. (2013) find a relatively strong relationship between house prices and fundamentals (such as disposable income of households), but they also give evidence that the years prior to the crisis were characterized by a decoupling of house prices from these fundamentals in almost all CESEE economies. The correction during the crisis years, however, might also have been excessive in several CESEE economies, as house prices were below the level suggested by fundamentals in most countries in 2011.

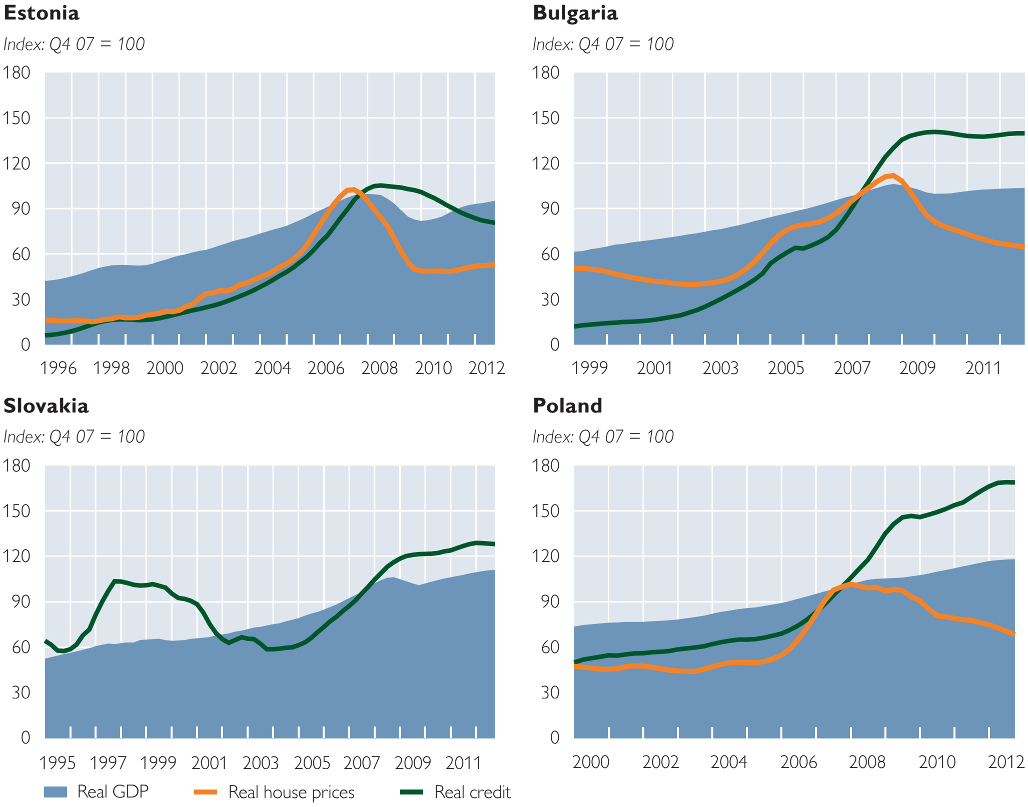
These heterogeneous developments are also obvious in our case studies for Bulgaria, Estonia, Poland and Slovakia. While the boom-bust cycle was most pronounced in Estonia (along with Latvia and Lithuania), it was also quite severe in Bulgaria (and similarly, in Romania). In Poland, such a pattern is hardly observable. The obvious acceleration in the financial cycle around 2004 (when the countries joined the EU) is also evident in the case of Slovakia. However, the recent slowdown in private credit growth has not yet affected GDP growth as sharply as in other countries in the region.[15] The developments in both financial and housing markets are also mirrored in the impact on the corresponding GDP growth rates. While Poland even managed to avoid recession in the technical sense, Estonia, for instance, faced a very sharp contraction of GDP. Bulgaria was still struggling with sluggish growth rates at end-2012, even though it started to recover rather shortly after the crisis in Estonia and the Slovak Republic.

Despite those differences, the empirical results shown in chart 6 strongly resemble the findings from the previous section. The four CESEE economies show a considerable boom period prior to the crisis, whereas the estimated output gaps for Estonia, Bulgaria and Slovakia are substantially larger when financial variables are taken into account. On the contrary, similar to our results for Austria, the estimates for Poland are hardly affected by the additional explanatory variables. Once again and similar to the advanced economies, the growth rate of finance-neutral potential output appears considerably more stable than the one suggested by the HP filter or the official estimates by the OECD and the European Commission, respectively. Compared to the advanced economies, however, two

[15] *We do not include house prices in the case of the Slovak Republic due to the short time series.*

Chart 6

Real GDP, House Prices and Real Credit in CESEE Economies



Source: OeNB.

major differences stand out. First, the differential between the estimated output gaps is even more pronounced in absolute terms (i.e. percentage points) than in the case of the advanced economies. Second, while we observed unfinished recession phenomena in three advanced countries, none of the economies in CESEE shows a similar pattern, as the boom phases started considerably later, when most countries in the region joined the EU in 2004.

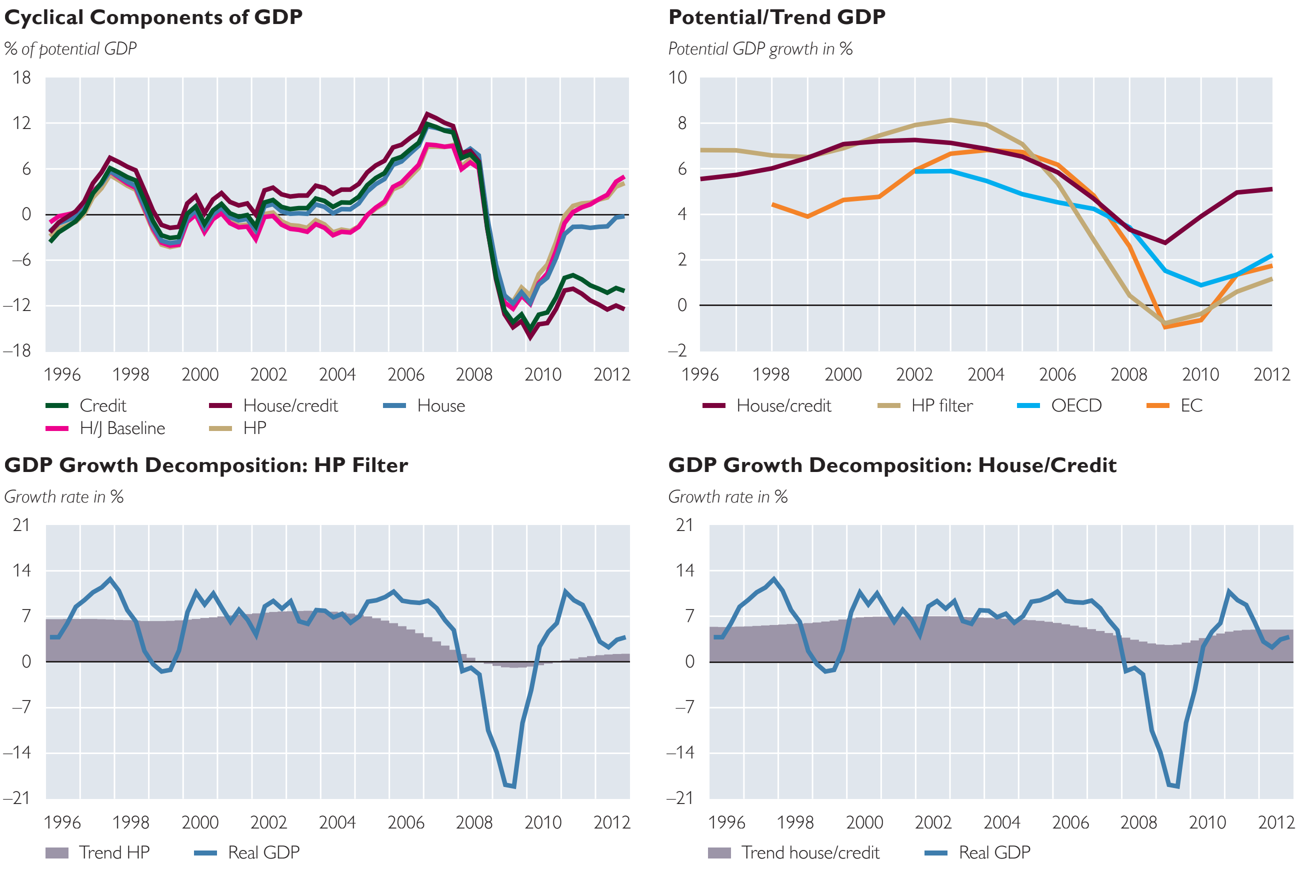
In the early 2000s, Estonia's real GDP growth was considerably higher than output growth in other CESEE countries (chart 7).[16] However, while growth was primarily driven by exports in many CESEE countries, Estonia's boom was mostly caused by an acceleration of domestic demand, particularly by a private investment boom in real estate. The investment boom was supported by capital inflows, both directly (FDI) and indirectly (cross-border loans to domestic branches of foreign banks). Both private credit as well as house prices further accelerated in the mid-2000s, when the composition of capital flows shifted to loans, and the two series peaked around 2007 and 2008. Private external debt exceeded 100% of GDP at the end of 2007, and current account deficits increased dramatically, amounting to 18% of GDP in 2007. Due to the fixed exchange rate, these capital

[16] *The following discussion of the causes and consequences of the recent financial crisis for Estonia is mainly based on Brixiova et al. (2010).*

inflows resulted in inflation and real exchange rate appreciations, leading to a loss of competitiveness. Due to increased demand for houses but limited supply, house prices also started to increase dramatically along with private credit. While house prices were characterized by overshooting as a result of widespread speculation prior to the crisis, they may have been subject to undershooting during the correction phase (Brixiova et al., 2010). Accordingly, our results suggest that Estonia still exhibited a considerably negative output gap exceeding –10% of potential GDP at end-2012 once we control for house and credit developments. Interestingly, it seems that the lion's share of the negative output gap is due to credit developments (as credit growth is still negative), while real house prices have started to recover, albeit very sluggishly. Remarkably, our model suggests a much higher potential output for Estonia than the remaining models (including official estimates by the OECD and the European Commission).[17]

Chart 7

Estonia

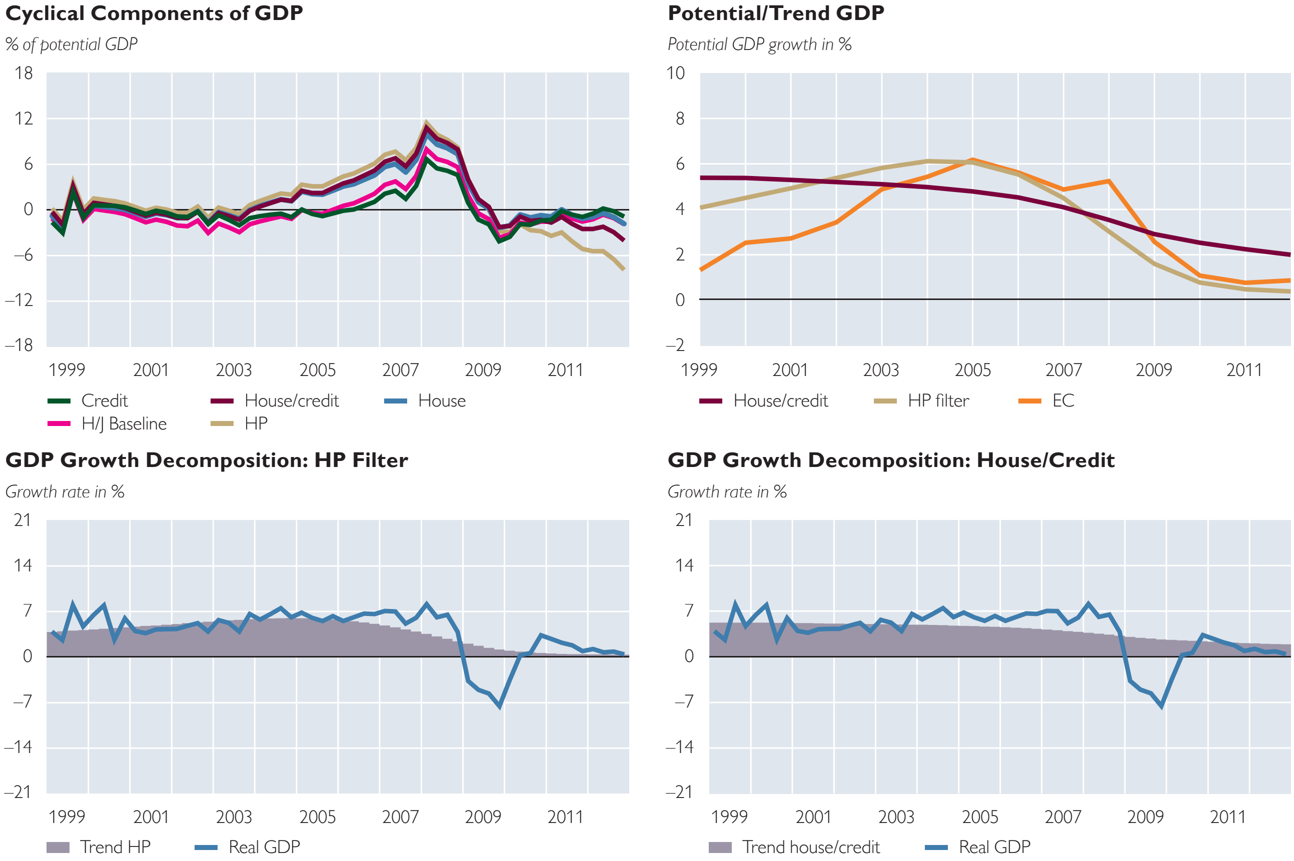


Source: OeNB.

[17] *The suggested considerable spare capacity in the Estonian economy, however, might also be due to our model specification, which does not specifically allow for level shifts in potential output reflecting, as may have been the case in Estonia, migration movements, and thus, a shrinking labor force. Technically, as described in the method section, we set $\sigma_\eta^2=0$ in equation (2) for the sake of simplicity. More sophisticated models including shifts in potential output (and other extensions in the specification) are planned to be implemented.*

Chart 8

Bulgaria



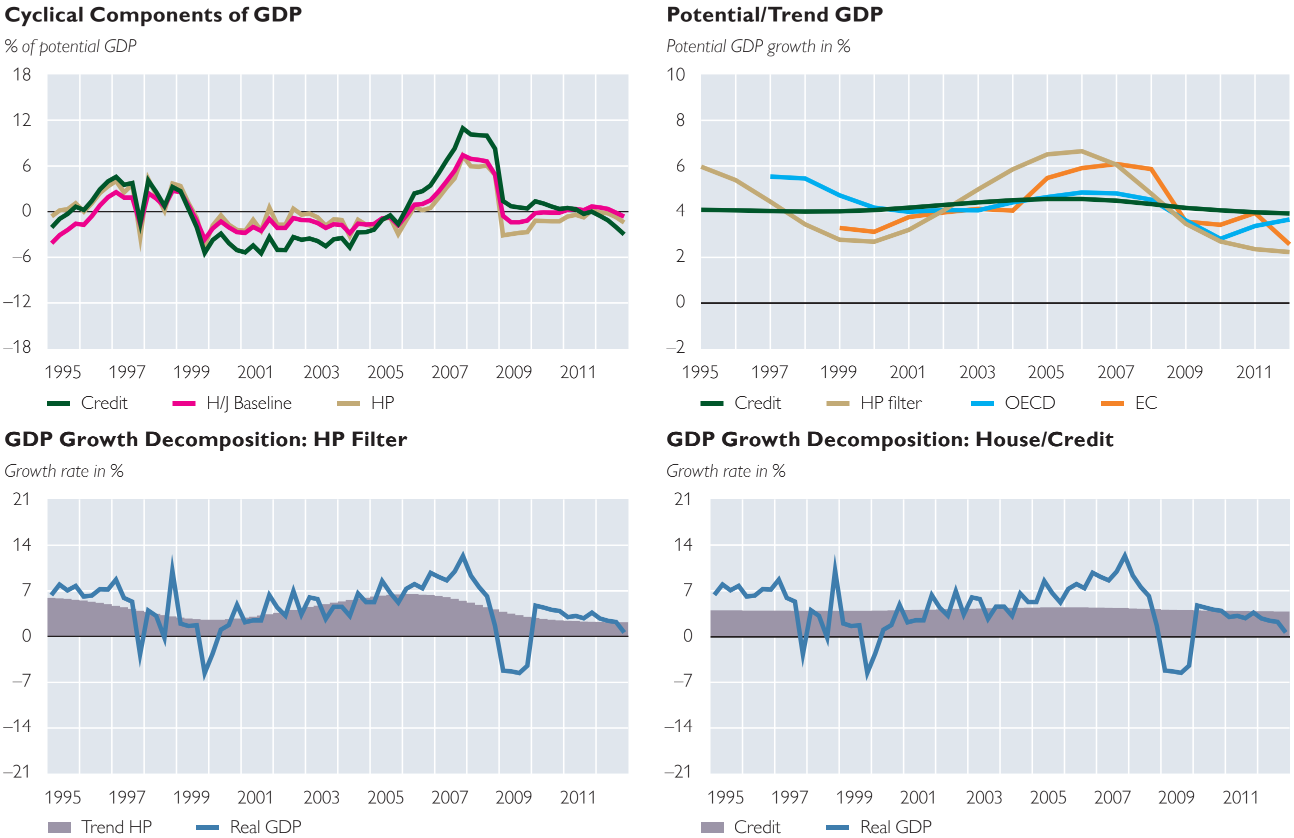
Source: OeNB.

Bulgaria (chart 8) also experienced a considerable boom-bust cycle, although it was not as severe as in the Baltic states. While real house prices also decreased by approximately 40% after the crisis, real private credit still increased substantially until 2009 and virtually stagnated thereafter. While Bulgaria attracted even more net capital inflows than Estonia in the period 2003 to 2007, the composition was quite different. FDI accounted for more than three-quarters of total net inflows in Bulgaria, but not even for half of the inflows to Estonia. Thus, the composition of Bulgarian capital inflows largely relying on FDI made the "sudden stop" less severe for Bulgaria. Nevertheless, also Bulgaria experienced a substantial boom-bust cycle with a severe recession during the global crisis. While both official estimates (European Commission) and univariate filters (HP) suggest almost zero potential GDP growth since 2010, our model implies a still positive potential growth rate of roughly 2% at end-2012, despite a substantial decrease starting around 2006.

While the Slovak Republic (chart 9) recovered from the crisis relatively quickly, our results still point to a nonnegligible impact of the financial cycle on GDP developments. The raw series for private credit mirrors the change of government in 1998, when a reform-oriented coalition came into office. Reforms included the restructuring of enterprises and banks as well as large-scale privatizations

Chart 9

Slovakia



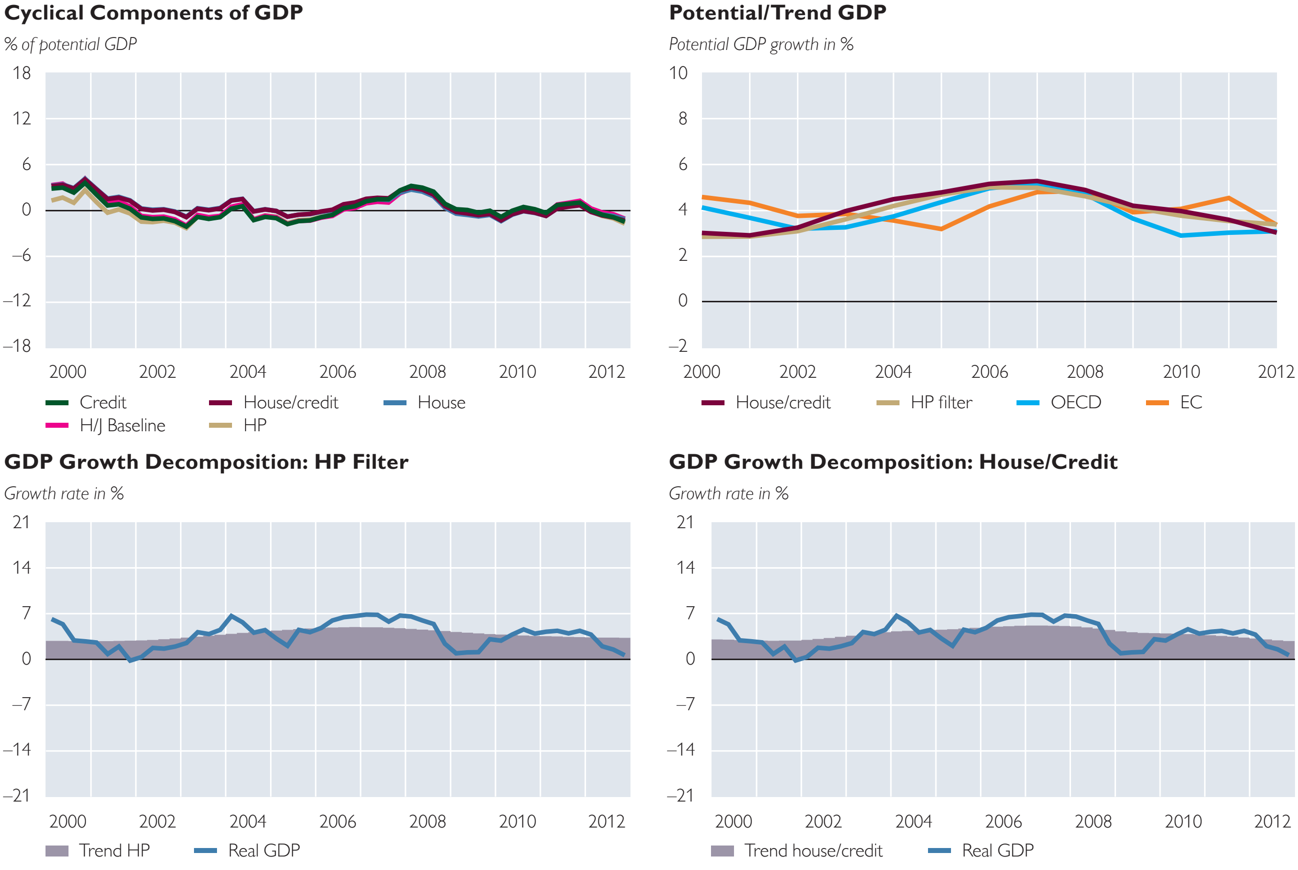
Source: OeNB.

open to foreign investors. A side-effect of this process was a substantial deleveraging in terms of private credit, opening the path towards EU membership (European Commission, 2011). Interestingly, GDP growth was not much affected during the reform years, but economic development accelerated after EU accession. Private credit doubled in four years, and Slovakia experienced buoyant GDP growth, even exceeding 10% before the crisis. Relative to other approaches, our results suggest a larger negative output gap before EU accession, and subsequently, a substantially larger positive output gap in the boom phase prior to the crisis.

Poland's resilience during the crisis is remarkable from several perspectives (chart 10). Pre-crisis credit growth was rather low compared with other CESEE economies, possibly (among other things) given Poland's history of nonperforming corporate loans in the late 1990s and early 2000s (IMF, 2007). However, net capital inflows were also lower than in other countries, not least due to the flexible exchange rate. Nevertheless, those capital inflows led to a substantial appreciation of the złoty before 2008, and a sharp depreciation during the crisis, when capital flows reversed. These exchange rate developments dampened the boom and stabilized the economy during the downturn, as the depreciating exchange rate increased Poland's competitiveness. The exchange rate, however, is not the only explanation why the country suffered less from capital outflows. Poland may

Chart 10

Poland



Source: OeNB.

in fact have benefited in particular from the Vienna Initiative, which encouraged Western European lenders to maintain their exposures to CESEE. Moreover, a larger domestic market as compared to other CESEE economies made Poland less dependent on external developments, and a strong countercyclical fiscal policy helped to avoid a recession in the technical sense. The results from our models are therefore not surprising: Traditional approaches (such as the HP filter) show no significant deviation from our estimated output gaps, and even the swings in potential output growth develop more or less similar over time.

2.3 Discussion

The empirical results suggest that the measurement of potential output needs to take a much broader view of sustainability. To verify our empirical results, we conduct a simple plausibility check by testing whether our model is able to replicate some standard propositions of structural models. More precisely, we analyze the simple correlation between cyclical components of standard filters (HP filter) and the Kalman filter "house/credit" model and the corresponding (annual) unemployment rates in our country sample.[18] While we did not use information from the labor

[18] *Annual data for unemployment rates are taken from the AMECO database by the European Commission.*

Chart 11

Cyclical Deviations and Unemployment Rates (I)

United States (1990-2012)

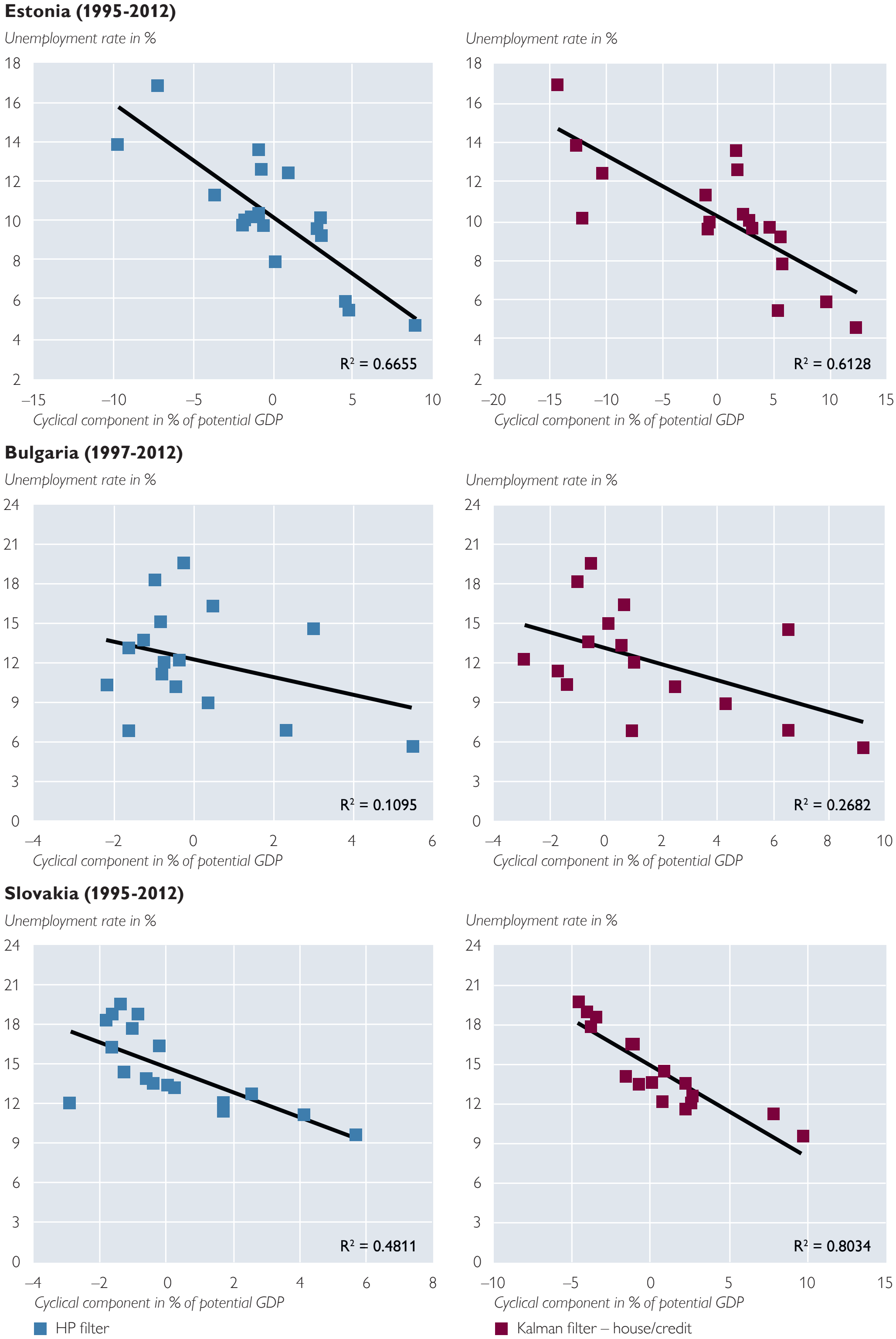
Netherlands (1990-2012)

Ireland (1990-2012)

Source: OeNB.

Chart 12

Cyclical Deviations and Unemployment Rates (II)



Source: OeNB.

market to estimate the output gaps, the explanatory power in a bivariate correlation analysis between unemployment rates and output gaps should increase if the inclusion of financial cycle variables improves the measurement of cyclical fluctuations. Chart 11 displays scatter plots illustrating a simplified form of Okun's law (defined in levels of the unemployment rate). In particular, it shows the scatter plots for three advanced economies where the financial cycle significantly determined cyclical fluctuations (i.e. excluding Austria). In the left-hand panels, unemployment rates are linked to standard HP-filtered output gaps, while the right-hand panels show the alternative model, i.e. the Kalman filter including credit growth and house prices. Each dot represents a yearly observation, i.e. an annual average of both the unemployment rate and the corresponding cyclical component of GDP.

In all three countries, the correlation between unemployment rates and output gaps substantially increases when the cyclical components consider developments in credit growth and house prices. In the United States, the coefficient of determination almost doubles from 34% to 65%. The same pattern is observable in the Netherlands, though the increase is not as pronounced as in the United States. The most striking example, however, is the case of Ireland, which probably experienced the most pronounced boom and bust in terms of the financial cycle. While the connection of HP-filtered output gaps and unemployment rates is almost non-existent, the inclusion of credit growth and house prices increases the explanatory power of this bivariate link to 84%. Thus, the omission of financial cycle variables in business cycle measures may lead to severely biased output gap estimations.[19] The same pattern is observable for CESEE economies (chart 12), i.e. the increase in explanatory power is quite distinctive in the case of Slovakia and also considerable for Bulgaria. Estonia is the only country where the explanatory power marginally decreases when considering financial sector variables. As discussed in the previous section, this may be due to a specific restriction in our model (we do not yet allow for level shifts in trend output) that may be particularly relevant for Estonia (where a large part of the workforce left the country).

Our approach to measure cyclical fluctuations might also be of considerable value for calculating structural budget balances, as public finances in Europe are very much affected by automatic stabilizers.[20] A very simple analysis linking public budget balances and output gaps in a scatter plot and comparing the explanatory power of the HP filter with that of the house/credit model shows that the connection between public deficits and output gaps increases significantly when the latter takes financial variables into account.[21] Thus, the explicit consideration of financial cycle variables might also lead to a better understanding of cyclical vs. structural adjustment in the current phase of rebalancing both in the euro area and in CESEE. In particular, differing estimates for the cyclical components shed new light on the debate on the speed of austerity in crisis countries and might also lead to a

[19] *While we compared the output gaps of our Kalman house/credit model with an ordinary HP filter, the results are qualitatively similar when compared to the other benchmark model, i.e. the Harvey/Jaeger (1993) model excluding credit growth and house prices.*

[20] *One has to keep in mind that fiscal policy variables reflect both (i) automatic stabilizers and (ii) discretionary policy measures, i.e. deliberate changes in the fiscal policy stance. Nevertheless, improved measures of cyclical components should lead to a higher correlation with overall public budget balances, although it only reflects the cyclical component (i.e. automatic stabilizers) of fiscal policy.*

[21] *For brevity reasons, we do not report these scatter plots in this paper.*

reassessment of public deficit objectives in the current bust phase in these countries. More specifically, structural adjustment needs might in fact be considerably lower than estimated so far.

3 Conclusion

In this study, we proposed to extend the structural unobserved components model developed by Harvey (1989) and Harvey and Jaeger (1993) by including information on the financial cycle. We include the growth rates of private credit and house prices in the state equation corresponding to the cyclical component of GDP to explain cyclical deviations from potential GDP that are driven by the financial cycle. Our paper builds on earlier work by Borio et al. (2013), who extend the common HP filter with information on the financial cycle. Our approach nests the HP filter as a special case and applies this novel concept to four advanced (AT, IE, NL, US) and four CESEE economies (BG, EE, PL, SK). In a comparative manner, we are able to calculate finance-augmented output gaps which take the effect of financial variables into account.

Our results show a substantial impact of the financial cycle (i.e. house prices and private credit) on business cycle fluctuations, particularly before and during the global financial crisis. On the one hand, this finding confirms the importance of incorporating financial information in the estimation of potential output and the corresponding output gaps. More specifically, potential output growth is estimated to be more stable than shown by conventional approaches, and indeed more consistent with the grounding idea of potential output, i.e. the sustainability of economic development. On the other hand, in some countries, traditional approaches (such as the HP filter) are essentially in line with our estimation, leading to the conclusion that even in the recent crisis there were some countries (e.g. Austria, Poland) that did not experience pronounced boom-bust cycles. As pointed out by Borio et al. (2013), incorporating finance variables to estimate potential output and corresponding cyclical deviations allows us to indicate boom periods caused by financial developments even if inflation remains low and stable. By including additional information, it is also possible to estimate output gaps more robust in real time.[22]

This study reported some first results from a still ongoing research agenda and leaves several possibilities for future research. First, while we included private credit and house prices as explanatory variables in an otherwise univariate filter, there are several other variables which could reasonably be considered to capture the financial cycle, including (i) long-term interest rates or (ii) equity prices. Particularly in emerging market economies, (iii) cross-border capital flows might also be relevant, as a domestically driven credit boom is not threatened by the "sudden stop" of capital flows, which might cause a financial bust.[23] However, even variables such as the (iv) inflation rate, the (v) unemployment rate or (vi) current account balances could be taken into account to improve the explanatory power of

[22] *We did not compare the performance of the various approaches in real time in this paper. However, preliminary results show that our "finance-augmented" output gaps are much more robust than traditional approaches. This finding is also confirmed in Borio et al. (2013).*

[23] *A further important distinction would be whether cross-border loans are primarily financed by parent banks (leading to more stable funding resources) or rather by wholesale funding.*

the model and to reduce the underlying uncertainty of measuring output gaps. Such a framework would somehow represent a hybrid approach between statistical filters and production function approaches, although it would still be purely data-driven. Furthermore, several nonlinearities could be considered in such a context, i.e. it seems likely that the effect of the variables deepens with increasing distance from a sustainable equilibrium, or that the impact differs in boom (upturn) and bust (downturn) periods. These suggestions also lead us to the main limitation of our study. The results are based on a reduced form "ad hoc" approach rather than on a theoretical model showing the underlying transmission channels and mechanisms of how finance interacts with the real economy. Nevertheless, the results presented in this paper show that neglecting financial variables in business cycle measurement might lead to severe measurement errors and large ex post revisions. Our approach is able to indicate unsustainable developments despite low and stable inflation rates in boom phases, and also enhances our understanding of cyclical vs. structural adjustments in bust/recession phases, which is of high importance in the current recovery phase. A thorough understanding of the financial cycle and its impact on business cycle fluctuations is necessary to conduct monetary, fiscal and also macroprudential policies in a stabilizing and efficient manner.

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Appendix

Table 1

Data Sources

	Real GDP	Credit	House prices	Estimation from
Austria	IMF	BIS	OeNB (Q3 86)	Q4 86
Bulgaria	IMF (Q1 90)	IMF (Q4 91)	BIS (Q1 93)	Q2 97
Estonia	IMF (Q1 93)	IMF (Q1 92)	OeNB (Q2 94)	Q3 94
Ireland	IMF	BIS	ECB	–
Netherlands	IMF	BIS	ECB	Q2 79
Poland	IMF (Q1 81)	IMF (Q4 85)	OeNB (Q4 98)	Q1 99
Slovak Republic	IMF (Q1 93)	IMF (Q1 93)	OeNB (Q1 02)	Q2 93
United States	IMF	BIS	BIS	Q2 79

Source: OeNB.

Note: The time series start in Q1 79 unless indicated otherwise or at the date given in brackets. All time series end in Q4 12. OeNB refers to the house price data described in Huynh-Olesen et al. (2013), Hildebrandt et al. (2012) and Steiner (2013).