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Improving the reliability of real-time output gap estimates using survey forecasts

Jaqueson K. Galimberti [a,*], Marcelo L. Moura [b]

[a] KOF Swiss Economic Institute, ETH Zurich, 8092 Zurich, Switzerland
[b] Ecogen Brasil, 04794-000, São Paulo, Brazil

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ABSTRACT

Measuring economic activity in real-time is a crucial issue both in applied research and in the decision-making process of policy makers; however, it also poses intricate challenges to statistical filtering methods that are built to operate optimally when working with an infinite number of observations. In this paper, we propose and evaluate the use of survey forecasts for augmenting such methods, in order to reduce the end-of-sample uncertainty that is observed in the resulting gap estimates. We focus on three filtering methods that are employed commonly in business cycle research: the Hodrick-Prescott filter, unobserved components models, and the band-pass filter. We find that the use of surveys achieves powerful improvements in the real-time reliability of the economic activity measures associated with these filters, and argue that this approach is preferable to model-based forecasts due to both its usually superior accuracy in predicting current and future states of the economy and its parsimony.

1. Introduction

Real-time estimates of the gap between output and its long-run trend level provide a measurement of the current state of economic activity within an economy. The information content of these estimates is of great importance for policymakers, as well as for market participants in general (Croushore, 2011, pp. 95–96, provides a review on this matter). Nevertheless, the reliability of filtering methods for decomposing a series into its trend and gap components in real time has been questioned, with empirical results pointing out that there is considerable uncertainty about these estimates at sample end-points (Orphanides & van Norden, 2002; Watson, 2007). The relevance of our study relies on the fact that improvements in the precision of these end-point estimates are imperative from the practical standpoint of the need for applied researchers, policymakers and market practitioners to infer the actual state of the economy for decision making. In this paper, we attempt to both increase our understanding of and reduce this uncertainty.

In general, previous attempts in the literature to improve the real-time filtering accuracy have been characterized by the incorporation of an increasing amount of information into the estimation procedure. The most prominent attempts have involved expanding the information set supplied to the filter in the temporal dimension, using either model-based forecasts (Gomez, 2001; Kaiser & Maravall, 1999, 2001; Mise, Kim, & Newbold, 2005) or variables observed at a higher frequency (Aruoba, Diebold, & Scotti, 2009); in the covariates dimension, with the employment of model-based multivariate representations (Altissimo, Cristadoro, Forni, Lippi, & Veronese, 2010;

* Correspondence to: KOF Swiss Economic Institute, ETH Zurich, LEE G 116, Leonhardstrasse 21, 8092 Zurich, Switzerland. Tel.: +41 44 6328529; fax: +41 44 6321218.
E-mail addresses: galimberti@kof.ethz.ch (J.K. Galimberti), marcelo.moura@ecogenbrasil.com.br (M.L. Moura).

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Marcellino & Musso, 2011; Planas & Rossi, 2004; Valle e Azevedo, 2011; Valle e Azevedo, Koopman, & Rua, 2006); or in the two dimensions jointly (Clements & Galvão, 2012; Garratt, Lee, Mise, & Shields, 2008).

Complementing this literature, we propose and evaluate the use of forecasts from surveys for improving the reliability of real-time gap estimates. Our contribution is to show that these survey forecasts do a better job of reducing the end-of-sample uncertainty than model-based forecasts. We associate the success of survey data with a better performance at providing signals of current conditions in the economy, a feature that has been demonstrated recently in other studies as well (Ang, Bekaert, & Wei, 2007; Graff & Sturm, 2012; Leduc & Sill, 2013). We therefore recommend the use of survey forecasts as a more parsimonious alternative to model-based approaches.

We focus on three filtering methods that are employed commonly in business cycle research: the Hodrick–Prescott (HP) filter (Hodrick & Prescott, 1997), an unobserved components (UC) model (Harvey, 1985), and the band-pass filter (Christiano & Fitzgerald, 2003). The HP filter, despite having been the subject of considerable criticism (Cogley & Nason, 1995; Harvey & Jaeger, 1993; King & Rebelo, 1993, among others), is still one of the tools most commonly used in business cycle analysis. In any case, the more recent and sophisticated band-pass filters are also subject to similar criticisms (Murray, 2003) as well as to the issue of the end-of-sample uncertainty, as was evidenced by the analysis of Watson (2007). UC models, on the other hand, provide a flexible framework for embedding explicit assumptions on the dynamic properties of the trend and gap components. Hence, in principle, our contribution may hold true for more general model-based filter specifications that encompass both low-pass and band-pass filters (see Gomez, 2001; Harvey & Trimbur, 2003; Proietti, 2009).

Our estimation approach may be summarized as follows. We take a real-time dataset of US output-related data measures and apply the filters to the series of observations available at each vintage. We then collect the last gap estimate obtained for each of these vintages, which represent the end-of-vintage-sample estimates. To evaluate the quality of these measures, we check how closely they resemble the estimates obtained using the last vintage that we have available, here interpreted as an ephemeral final measure. Doing that, we confirm previous findings in the literature that the errors in the real-time gap estimates are of the same magnitude as those of the final gap estimates. Our proposed solution to such a sizable inaccuracy in real-time gap estimates involves simply augmenting each vintage series of data supplied to the filters with real-time forecasts, and our results are particularly in favor of the use of survey forecasts for that purpose.

We consider two different series of US output-related data as inputs to our filtering procedure: the quarterly real GDP and the monthly index of industrial production. By using these two different frequencies of observation, we are also able to infer the effects of filtering at a higher frequency (monthly) on the reliability of the real-time gap estimates, which are usually obtained at a quarterly frequency. We find that the estimation of monthly gaps can improve the accuracy of the real-time gaps considerably when using the UC model and the band-pass filter, but not as much under the HP filter.

To the best of our knowledge, this is the first work to systematically test the improvements in end-of-sample estimates of the output gap for US GDP and industrial production data from employing market participant surveys, namely, the survey of professional forecasters (SPF) and the consensus economic forecasts (CEF). Other studies, as cited above, have focused on expanding the economic series using forecasts based on time series econometric models, a technique that is model-specific and probably does not capture all of the information contained in survey forecasts, which combine information sets from several market participants.

Our empirical evidence indicates that not only are survey forecasts more parsimonious and easier to obtain than model-based forecasts, they also provide gap estimates that are more precise. Using the HP filter on the quarterly series of real GDP, for example, the frequency with which the signals of the real-time gaps (i.e., whether economic activity is above or below the trend) are estimated incorrectly is reduced from 48% using no forecast, to approximately 25% where the survey forecasts are used to augment the filter, while the statistic for model-based forecasts is still over 30%.

The remainder of this paper is organized as follows. The next section outlines the formulation of the filtering methods and raises the issue of the inaccuracy of end-of-sample gap estimates. In Section 3, we provide details of the data that are used in our empirical applications. The section also describes the preparation of the forecasts for filtering and evaluates their relative performances briefly. In Section 4, we present our main results for real-time filtering with the forecast-augmented filters, and in Section 5, we check the sensitivity of our results with respect to both the definition of the final gaps adopted as the target in our evaluation, and the number of model-based forecasts used in the comparisons. We then conclude the paper in Section 6.

2. Filtering methods

2.1. Hodrick–Prescott filter

The HP filter is one of the most commonly used tools for business cycle analysis. To decompose a series of observed values $\{y_t\}_{t=1}^{T}$ into the sum of a trend component $\{x_t\}_{t=1}^{T}$ and a gap component $\{g_t\}_{t=1}^{T}$, this filter requires the value of the first of these components to be chosen so as to minimize

$$L\left(y_t, \lambda, x_t\right) \equiv \sum_{t=1}^{T} \left(y_t - x_t\right)^2 + \lambda \sum_{t=3}^{T} \left(\Delta^2 x_t\right)^2, \tag{1}$$

where Δ^2 stands for a twice-differenced lag operator (i.e., $\Delta^2 x_t = x_t - 2x_{t-1} + x_{t-2}$), and λ is a parameter that regulates the trade-off between the fit of the trend to the data and its smoothness. This is a quadratic optimization problem, where the FOCs with respect to $\{x_t\}_{t=1}^{T}$ comprise a system of linear equations in these unknown terms, and