

## Box 5

**THE (UN)RELIABILITY OF OUTPUT GAP ESTIMATES IN REAL TIME**

The output gap, which is defined as the difference between the actual and potential levels of output of an economy, expressed as a percentage of potential output (which is, in turn, defined as the level of output that can be achieved when the factors of production are utilised at non-inflationary levels), is an indicator commonly used to summarise the overall amount of slack present in the economy. Unfortunately, a number of problems regarding both methodological and statistical aspects of output gap estimation – and the absence of a consensus on how best to measure this indicator – mean that estimates vary, often significantly, across methods. Moreover, estimates tend to be revised substantially over time, even for each given measurement method. This box reviews the usefulness of output gap estimates, in particular from the perspective of regular economic and policy analysis in real time. It concludes that estimates of the output gap are surrounded by such high uncertainty that they are of limited use for practical monetary policy-making. They are no substitute for a more comprehensive assessment of the factors that may influence the degree of slack in the economy.

**Output gap estimation problems**

The uncertainty characterising output gap estimates stems from various sources. First, there is no agreement on how the output gap should be modelled. Different models and methods tend to produce significantly different estimates (this is called “model uncertainty”). Second, each method requires one or more unobserved parameters to be estimated. These parameters may change over time, for example as a result of structural change. Given the limitations of available estimation techniques and the relatively short sample periods available for many variables, parameters tend to be estimated with a significant degree of uncertainty (this is called “parameter uncertainty”). Finally, the data used to estimate the output gap are often revised over time, sometimes significantly, implying that there can also be large revisions in the output gap estimates (this is called “data uncertainty”).<sup>1</sup>

The problem of measurement uncertainty is even more severe for real-time estimates (i.e. estimates of the output gap for the period during which the estimation is carried out), which would typically be those of greatest interest for economic and policy analysis. The unreliability of real-time output gap estimates arises from the lack of data for the most recent period (for which a preliminary estimate based on very limited information is typically used), revisions of published data (which generally are more substantial for the most recent data), end-of-sample instability (i.e. estimates for the period at the end of the sample tend to vary considerably with the addition of one or a small number of observations, independently of data revisions) and, for estimates conditional on projections of the period ahead, revisions in the projections. A number of recent empirical studies have shown that the reliability of real-time output gap estimates is very low.<sup>2</sup> By implication, forecasts of output gaps suffer from an even higher degree of uncertainty.

1 For more details, see the article entitled “Potential output growth and output gaps: concept, uses and estimates” in the October 2000 issue of the ECB’s Monthly Bulletin.

2 For the United States see Orphanides and van Norden (“The unreliability of output-gap estimates in real time”, *The Review of Economics and Statistics*, November 2002, Vol. 84 (4), pp. 569-583), for the United Kingdom see Nelson and Nikolov (“UK inflation in the 1970s and 1980s: the role of output gap mismeasurement”, *Journal of Economics and Business*, 2003, Vol. 55, pp. 353-370), and for Canada see Cayen and van Norden (“La fiabilité des estimations de l’écart de production au Canada”, Bank of Canada Working Paper 2002-10).

## Some evidence for the euro area output gap

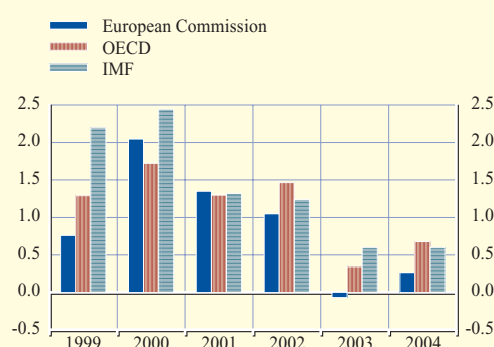
No sufficiently long historical real-time data series exist for the euro area.<sup>3</sup> However, it is possible to use estimates published since 1999 by various major international organisations to glean some insight into the magnitude of revisions in real-time output gap estimates. The revisions of the euro area output gap estimates published by the European Commission, the Organisation for Economic Co-operation and Development (OECD) and the IMF from 1999 to 2004 (obtained as the difference between the estimate published during the corresponding year and the latest estimate) are significant and often of the same magnitude as the estimated gap itself or even higher (see Chart A). The size of these revisions seems to have fallen towards the end of this period, but it should be kept in mind that the latest estimates are subject to further changes, reflecting the aforementioned problem of end-of-sample instability.

As shown in Chart B, the range of estimates (both real-time and latest) tends to be relatively large, often larger than 1 percentage point, providing an example of model uncertainty. It can also be observed that the range of real-time estimates often does not overlap with the range of the latest estimates, suggesting that the reliability of real-time estimates is rather low. Only for 2003 and 2004 do the ranges overlap, but further revisions to the most recent data are likely to imply a movement over time of the latest estimates away from the real-time estimates.

The degree of imprecision of real-time output gap estimates can also be assessed by comparing the sign of the real-time estimates with the sign of the latest available estimates. As regards the

**Chart A Revisions in output gap estimates**

(in percentage points)

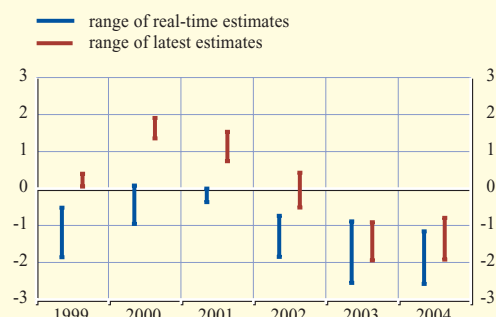


Source: ECB calculations based on data from the European Commission, the OECD and the IMF.

Note: The chart shows the difference between the latest estimates (autumn 2004 by the European Commission and the IMF and December 2004 by the OECD) and the estimates published during the corresponding year (spring estimates by the European Commission and the IMF and June estimates by the OECD).

**Chart B Ranges of real-time and latest output gap estimates**

(in percentage points)



Source: ECB calculations based on data from the European Commission, the OECD and the IMF.

Note: The chart shows the ranges of the estimates published by the three organisations. The ranges of the estimates published during the corresponding year (spring and June) are shown in blue while the ranges of the latest estimates (autumn 2004 and December 2004) are shown in red.

<sup>3</sup> For some evidence on the reliability of euro area output gap estimates see Proietti, Musso and Westermann ("Estimating potential output and the output gap for the euro area: a model-based production function approach", European University Institute, Florence, Economics Working Paper ECO2002/09), Rünstler ("The information content of output gaps in real time: an application to the euro area", ECB Working Paper 182, September 2002), and Camba-Méndez and Rodríguez Palenzuela ("Assessment Criteria for Output Gap Estimates", *Economic Modelling*, May 2003, Vol. 20, No 3, pp. 528-561).

level of the output gap, the latest estimates have a different sign to that of the real-time estimates in around half of the cases (see the table below). More precisely, while the euro area output gap was generally estimated in real time to be negative from 1999 to 2004, for about half of these years it was subsequently estimated to have been positive. Large differences can be observed for the years at the beginning of the period but further revisions to the latest estimates may imply that, for these years also, the sign of the final estimates is different to that of the real-time estimate. Uncertainty regarding the sign of the estimated changes in the output gap seems to be slightly more limited, but here too the degree of uncertainty appears still to be significant.

**Comparison of the sign of real-time and latest output gap estimates (for levels and annual growth rates)**

	sign of output gap levels			sign of output gap growth rates		
	European Commission	OECD	IMF	European Commission	OECD	IMF
1999	opposite	opposite	opposite	opposite	opposite	opposite
2000	opposite	opposite	opposite	same	same	same
2001	same	opposite	opposite	opposite	opposite	same
2002	opposite	same	same	same	same	opposite
2003	same	same	same	same	same	same
2004	same	same	same	same	same	opposite

Source: ECB calculations based on data from the European Commission, the OECD and the IMF.

Overall, there is strong evidence that euro area real-time output gap estimates tend to be of low reliability. This is consistent with the evidence for other economic areas. While it cannot be excluded that, in some contexts, such as modelling or forecasting, estimates of the output gap can play a useful role (as long as the degree of uncertainty is taken into account), it is clear that for economic and policy analysis they should not be given undue emphasis. On the contrary, rather than focusing on one or a few summary indicators, the real-time assessment of the degree of slack in the economy and, more generally, the economic analysis of the risks to price stability should be based on a wide set of indicators.