Annex A: Fan Charts to Represent Forecast Uncertainty

Central forecasts provide a limited picture of the future evolution of the economy. Some of the factors that influence the economy are inherently hard to forecast – such as geopolitical events – while understanding of the economy is not precise enough to predict future economic outturns exactly.

Despite the inherent uncertainty in forecasting, "point forecasts" (i.e. a single number) have long been used in economic publications. However, even with the best forecasting techniques, for a variety of reasons, it is highly improbable that actual outcomes will coincide with the forecasts. The "fan chart" is a common way of representing the uncertainty in economic forecasting. It has been widely used by central banks over the past fifteen years (Britton, Fisher and Whitley, 1998, Cronin and Dowd, 2011).

GDP Fan Chart Methodology

There are a number of different methods that can be used to construct fan charts. These include explicit models of uncertainty or deriving errors based on past forecast performance. In using past forecasts, this can be achieved either using actual errors from forecasts made in the past or through recursive estimation of a macroeconomic model.

The GDP fan charts in this report are constructed around the *SPU 2012* nominal GDP forecasts on the assumption that this is the median forecast. The *SPU 2012* forecast is assumed to be at the centre of the fan chart. In fact, there is no clear guidance as to what *SPU* point estimates represent: whether this is the median, the mean or the modal forecast.

The fan charts constructed show uncertainty based on the one- two- and three-year ahead forecast errors from Department of Finance forecasts made between 1999 and 2005. Due to the unprecedented errors associated with the recent housing and banking crisis, the forecast errors are calculated for the sample from 1999, when the *SPU* began, to 2005.[59] It is judged that the forecast errors during the crisis are the result of rare and extreme events that would not typically be expected to occur during the short period covered by the data.

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[59] The forecast made in 2005 for 2008 is excluded.

Using errors from actual forecasts is the standard approach (Office for Budget Responsibility, 2011), in part because of the reliance on judgement in making macroeconomic forecasts rather than mechanical use of macroeconomic models. The standard approach assumes that the probability distribution around the central forecast remains constant over time.

Errors are defined in terms of the difference between the cumulative growth rate in nominal GDP for a particular horizon (i.e. one-, two- and three-years ahead) in annual Department of Finance forecasts and the current estimate published by the CSO. For example, the error made in the *SPU* published in 2000 for 2003 (3-years ahead) is the difference in the cumulative growth rate over the period and not the one-year growth rate for 2003 itself. This approach is necessary, especially for projections at longer horizons, because of the persistence of forecast errors. This approach differs from standard methods, which use the unconditional growth forecast errors.

A key problem in constructing forecast errors for Ireland based on past forecasts is the scarcity of such forecasts, especially for forecast horizons beyond a two-year horizon. The SPUs provide the only consistent time series of official forecasts for 3-years ahead. These begin in 1999 and are at annual frequency. In recent years, the timing of the *SPU* has changed from December to April, which complicates comparisons across time periods. Each *SPU* contains at least an estimate/projection for the outturn in the current year and projections for the three following years.

The nature of these annual forecasts and the relatively short sample period means that there are a small number of observations on which to construct the fan chart, particularly bearing in mind that there are no outturns for the most recent and furthest ahead forecasts. It would be easier to construct fan charts if forecasts were more frequent. These difficulties create a "small sample" problem in gauging the density of errors. First, the small number of observations makes it difficult from a statistical perspective to estimate the density accurately due to sampling variation. Second, given the persistent errors made in the forecasts, past errors are dominated by a number of episodes, in particular around turning points in the economy (see Chapter 2).

The forecast distribution is calculated by assuming the distribution is symmetric around the point forecast (which is therefore both the median and the mean). This assumption is mechanical and should not necessarily be taken to imply that the Council judges risks to be symmetric. It is further assumed that errors follow a Normal distribution, which is a simplifying assumption. The variance

of the distribution is calculated from the observed forecast errors. The fan charts constructed in this report are shown only between the 10th and 90th percentiles because of the difficulty of accurately representing relatively rare and extreme events based on a limited time span.

The fan charts are constructed to give a representation of the uncertainty around forecast outcomes. They are not based on an explicit testable model of uncertainty and include some simplifying assumptions. Nevertheless, the fan charts do reflect the past experience of forecast errors and the uncertainty these would suggest around future forecasts.

Fan Charts for the Public Finances

Public finance fan charts can be constructed based on the macroeconomic forecast uncertainty around GDP using the fiscal feedbacks model to represent the implied uncertainty for the key public finance aggregates (see Chapter 3).

The public finance fan charts represent uncertainty around the public finances from the GDP forecasts only. They take no account of variability in the relationship between GDP and the public finances, nor other factors which could impact on the budget balance.

Furthermore, it is assumed that there is no explicit policy feedback from macroeconomic conditions to discretionary changes in the fiscal policy stance. This assumption is clearly unrealistic, although past macroeconomic forecast errors implicitly include the average of past fiscal adjustments with respect to economic outturns.