Box B: Fan Charts for Components of GDP and Employment

This Box examines the use of fan charts to show the uncertainty surrounding forecasts for different parts of the Irish economy. Fan charts can be a useful tool for graphically representing the magnitude of historical forecast errors. While previous *Fiscal Assessment Reports* (IFAC, 2012b) have outlined the use of fan charts for forecasts of GDP, this Box highlights the use of these charts for employment, personal consumption, investment and government consumption.[1]

While there is uncertainty around forecasts of current and future levels of a series, there is also some uncertainty around the historical values given that substantial revisions can often occur (Casey and Smyth, 2016). With this in mind, there are fans surrounding the historical data as well as the forecasts for future periods, as there is still some uncertainty around the eventual outturns.

Various methodologies can be used in constructing fan charts. The approach taken here is to examine previous forecast errors at different time horizons. 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 the mechanical use of macroeconomic models. This standard approach assumes that the probability distribution around the central forecast remains constant over time.

If forecast errors have been larger (in absolute terms, on average) at a particular horizon, then the fans will be wider, representing the larger range of likely outcomes. The forecast errors that are used are those from previous SPU and Budget publications. Using forecasts going back to 2000, the Root Mean Squared Error (RMSE) can be calculated not just for GDP, but for other parts of the forecast. Fan charts have been constructed for employment, personal consumption, investment and government consumption. The largest errors are found to be for investment, which has often been noted to be difficult to forecast and this is also the case in Ireland (Bergin *et al.*, 2013 and Conroy and Casey, 2017).[2] As investment has the largest errors, it has the widest fans surrounding the central forecast, reflecting the elevated level of uncertainty associated with the forecast. However, from examining the charts, it is clear that there is also considerable uncertainty surrounding forecasts of government consumption and to a lesser extent, personal consumption. Historical forecast errors for employment growth are lowest of all, as reflected by the narrower fans around the central forecast.

A sample has to be chosen over which to calculate average forecast errors. Both 2008 and 2009 are excluded, as these financial crisis years have forecast errors well above would levels expected in normal times. This approach is in line with that taken in producing the fan charts of GDP.[3] The central forecasts on which the fan charts are built are those taken from *SPU 2017*. The point estimates given in the SPU are taken as the median forecast.

Two simplifying assumptions are used. The forecast distribution is assumed to be symmetric, with the point forecast representing the median (and mean and mode). This

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[1] Ideally one would examine underlying investment (i.e., excluding aircraft and intangible assets); however, historical forecasts have not been made on an underlying basis, therefore historical forecast errors cannot be calculated on an underlying basis.

[2] In addition to the normal difficulties of modelling investment in a small open economy, the Irish data now presents additional complications presented by investment in intangible assets and aircraft which are almost exclusively imported (as documented in Box C IFAC (2016)) and are often driven by firm specific factors.

[3] See Annex A of IFAC (2012) for details of the methodology employed.

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, though over a sufficiently long sample period, this assumption may be inappropriate, e.g., extreme events may be more common (fat tails).[4] 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.

Like the fan charts produced for aggregate GDP, the additional fan charts presented here form only one aspect of the endorsement process. In keeping with this, there is no specific range in the fan chart that is deemed to be an "endorsable range". A number of other considerations are made when deciding whether or not to endorse a set of macroeconomic projections from the Department of Finance. These include an assessment of the methodologies employed by the Department and any patterns in recent forecast errors.

Two example fan charts which have *SPU 2017* projections as the central scenario are shown below, while further fan charts and a table detailing the root mean squared errors are given in Appendix D.

Figure B.1: Real Consumption Fan Chart
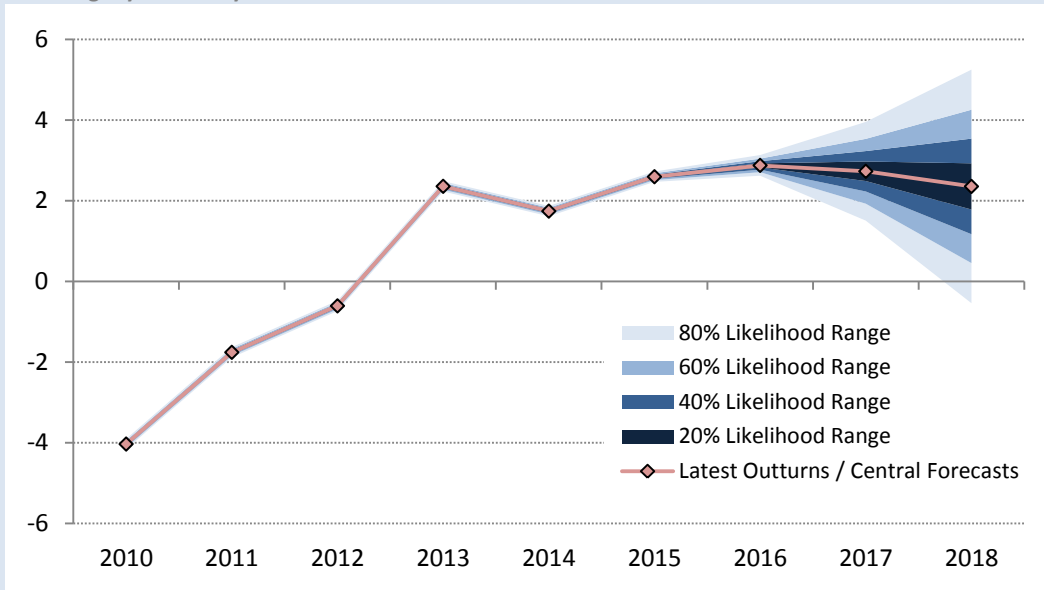% change year-on-year
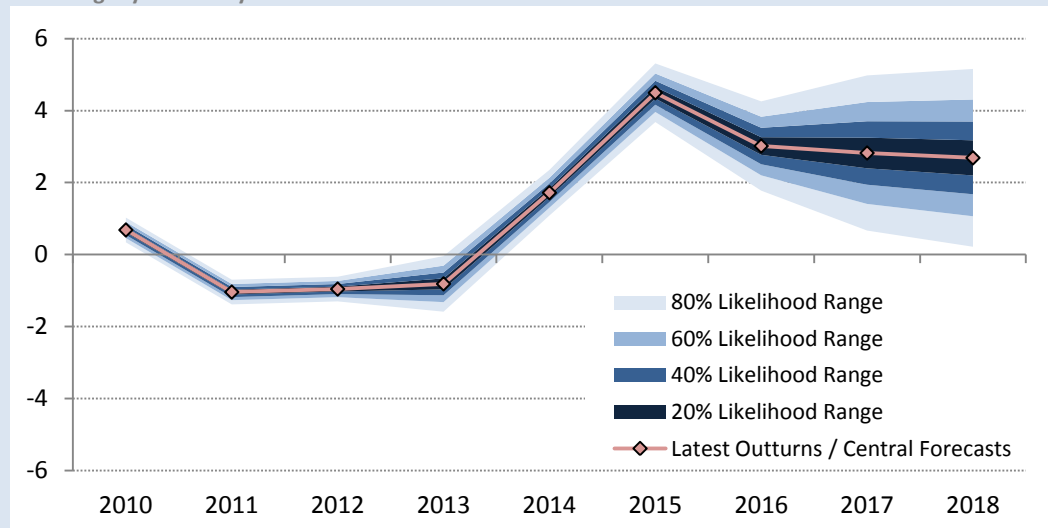
Sources: SPU 2017; and Internal IFAC calculations.
Note: Distributions or 'fans' around historical growth estimates are based on previous revisions to real consumption data. Forecast errors based on 2000-07; 2010-15 sample.

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[4] Given recent economic history in Ireland, this is quite a strong assumption.

Figure B.2: Employment Fan Chart
% change year-on-year

Sources: SPU 2017; and Internal IFAC calculations.

Note: Distributions or 'fans' around historical growth estimates are based on previous revisions to employment data. Forecast errors based on 2000-07; 2010-15 sample.