Fiscal fan charts - A tool for assessing member states' (likely?) compliance with EU fiscal rules

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Fiscal Fan Charts - A Tool for Assessing Member States' (Likely?) Compliance with EU Fiscal Rules

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Abstract

This paper sets out a methodology for constructing fan charts for the government deficit and debt ratios over the medium-term. It relies on information contained in Stability/Convergence Programme Updates, a model of the relevant stochastic process (for example, the real GDP process) or processes, and a parameter estimate of the sensitivity of the primary budget balance to the output gap for the member state under consideration. A model of the dynamic deficit-debt relationship allows the impact of random output growth to work its way through the fiscal arithmetic in a consistent and traceable way to produce fan charts over a five-year forecast horizon.

The initial set of fiscal fan charts included here for Ireland use the indicative public finance projections set out in the 2011 Update for Ireland. The range of possible fiscal outcomes in the charts assumes no fiscal policy response to any change in the budgetary position over the period such as could arise from changes in growth rates. This assumption of "no policy change" is a standard one in the construction of fan charts. Governments will, however, generally be in a position to adjust fiscal policy towards meeting a specific fiscal target, such as reaching a deficit position of less than 3 percent of GDP in the medium-term. A second set of fan charts is included which indicates how the probabilistic range of fiscal outcomes could be affected by a tightening of fiscal policy in 2013-2015.

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Non-Technical Summary

The Stability and Growth Pact requires member states to submit annually to the EU Commission their medium-term fiscal plans and related information on economic developments in their country in the form of Stability Programme Updates (for those member states that have adopted the euro) and Convergence Programme Updates (for the others). In the wake of the sharp deterioration in government deficit and debt outturns in recent years, the Updates, and the projections contained in them, are likely to be subject to greater scrutiny than was the case heretofore.

An assessment of the sensitivity of the fiscal variables to economic conditions is a critical part of Updates. The sensitivity analysis undertaken, however, is usually limited in scope, such as examining the effects on the deficit ratio of yearly output growth rates being one percent lower than the baseline forecasts over the period covered in the Update. In our view, it is better to provide a range of possible fiscal outcomes consistent with a feasible range of macroeconomic conditions in the form of "fan charts" over the forecast period. Fan charts are used by a number of central banks, including both the Bank of England and the Sveriges Riksbank, for conveying quantitative uncertainty about macroeconomic prospects.

This paper then sets out a methodology for producing fan charts for the government deficit ratio and debt ratio. The approach taken here relies mainly on information already contained in the Update and in historical growth rate and interest rate series (or alternatively, expert judgements), a model of the relevant stochastic process (for example, the real GDP process) or processes, and a parameter estimate of the sensitivity of the primary budget balance to the output gap for the member state under consideration. It also allows us investigate and compare different policy scenarios.

The initial set of fiscal fan charts included here for Ireland use the indicative public finance projections set out in the 2011 Update for Ireland. The range of possible fiscal outcomes in the charts assumes no fiscal policy response to any change in the budgetary position over the period such as could arise from changes in growth rates. This assumption of "no policy change" is a standard one in the construction of fan charts. Governments will, however, generally be in a position to adjust fiscal policy towards meeting a specific fiscal target, such as reaching a deficit position of less than 3 percent of GDP in the medium-term. A second set of fan charts is included which indicates how the probabilistic range of fiscal outcomes could be affected by a tightening of fiscal policy in 2013-2015.

1. Introduction

EU member states are expected to adhere to certain fiscal rules. The Maastricht Treaty (1992) in particular imposes the requirement to avoid "excessive government deficits". Article 104c of the Treaty imposes two requirements in that regard.[1] The first is that the general government deficit must not exceed 3 percent of GDP and the second is that the ratio of general government debt to GDP must not exceed 60 percent.[2]

The Stability and Growth Pact (1997) also requires member states to submit annually to the EU Commission their medium-term fiscal plans and related information on economic developments in their country in the form of Stability Programme Updates (for those member states that have adopted the euro) and Convergence Programme Updates (for the others). The fiscal and macroeconomic data for the current year and following years are meant to be consistent with both budget law in the member state in question and the macroeconomic forecasts on which medium-term deficit and debt projections have been made by the national fiscal authority. The Updates then provide both an opportunity for member states to explain their fiscal targets over the next five years and a starting point for whatever multilateral surveillance process occurs at EU level.

In the wake of the sharp deterioration in government deficit and debt outturns in recent years, the Updates, and the projections contained in them, are likely to be subject to greater scrutiny than was the case heretofore. Some member states have therefore included specific fiscal targets in their recent Updates to assure observers that national public finances will be sustainable over time. In the 2011 round of submissions, for example, Ireland and the United Kingdom have used their Updates to indicate that they expect their overall deficit ratios to improve to values of less than or equal to 3 percent of GDP over the medium-term and to outline the means by which that improvement will occur, i.e. whether it is owing to a change in fiscal policy and/or a pickup in economic growth.

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[1] We gloss over the issue that these 'requirements' have not been enforced on many occasions since the Treaty's, and Stability and Growth Pact's, adoption. We also gloss over the fact that a number of countries, Ireland included, are a long way from meeting them at present.

[2] There are let-out clauses on these requirements. First, a deficit value in excess of 3 percent can be tolerated when the deficit ratio has declined substantially and continuously and reached a level that comes close to the reference value or, alternatively, the excess over the 3 percent reference value is only exceptional and temporary and the ratio remains close to the reference value. Secondly, a debt ratio in excess of 60 percent can occur if the ratio is sufficiently diminishing and approaching the reference value at a satisfactory pace. Of course, neither of these let-out clauses comes close to describing the current situation for a number of EU member states, the PIIGS most obviously, so let us move on.

A central forecast for key public finance variables for the current and next four years is provided in the Updates (e.g. 2011-2015 in the 2011 Updates), which act as a focal point for assessment of member states' stated beliefs in their future fiscal prospects. These variables include the overall deficit/budget balance ratio and its primary balance and interest payments components. The primary balance ratio is broken down further into its cyclical and non-cyclical/structural elements. The other key fiscal item in the Updates is the end-year general government debt ratio projections. Relevant macroeconomic forecasts are also included in the Updates, of which the most important are probably those for the real GDP growth rate.

An assessment of the sensitivity of the fiscal variables to economic conditions is a critical part of Updates. The sensitivity analysis might, for example, involve two exercises being undertaken. The first would examine the effect on the public finances of real GDP growth rates being one percentage point lower than the central forecast for that variable in each of the forecast years. The second might look at the impact of the interest rate on the government debt being one percentage point higher than that in the central projection for each year. The Update then will contain the government deficit and debt ratio values that follow from these assumed changes in macroeconomic conditions.

Usually, a single, alternative deficit ratio for each forecast year for each scenario is produced. This is to be expected when you are stipulating a one-percent decline in GDP growth rates only or a one-percent rise in interest rates only (or indeed when you combine these changes) in an exercise. It is better, however, to provide a range of possible fiscal outcomes in the form of "fan charts". These are used by a number of central banks, including both the Bank of England and the Sveriges Riksbank, for conveying quantitative uncertainty about macroeconomic prospects.

The methodological approach taken here to constructing fan charts for the deficit ratio and debt ratio does not require the employment of a multi-equation macroeconometric model but relies mainly on information already contained in the Update and in historical growth rate and interest rate series (or alternatively, expert judgements), a model of the relevant stochastic process (for example, the real GDP process) or processes, and a parameter estimate of the sensitivity of the primary budget balance to the output gap for the member state under consideration. The latter is available from publications such as Girouard and Andre (2006) and European Commission (2006).

This information allows us to produce fan charts for both the government deficit and debt ratios over the five-year forecast horizon covered in the Updates, as well as produce fan charts for the real GDP process itself; to calculate the probability that a particular fiscal target or targets will be achieved (such as reducing the deficit ratio below 3 percent by 2015); and to investigate and compare different policy scenarios (for example, the impact that an additional tightening of the discretionary fiscal stance has on the probability of achieving the 3 percent deficit target by 2015).

To our knowledge, the application of fan chart methods to the analysis of public finances so far has been quite limited. Debrun, Celasun and Ostry (2006), Di Giovanni and Gardner (2008), Celasun and Keim (2010), and Office for Budget Responsibility (2010) are among the contributions to this area. Each acknowledge that fiscal variables are stochastic in nature and each present means of taking account of the stochastic distribution (including joint distribution) of relevant macroeconomic variables to present fan charts for the government debt ratio. Where our approach adds to these contributions is in its providing a model of the dynamic deficit-debt relationship that allows the impact of random output growth to work its way through the fiscal arithmetic in a consistent and traceable way to produce fan charts for both the deficit ratio and the debt ratio for Ireland over the five-year forecast horizon covered in the 2011 Update for Ireland (Department of Finance, 2011), as well as providing fan charts for the real GDP growth rate itself.

The baseline values in these fan charts are the central forecasts contained in the Update. In the absence of any unexpected "below-the-line" items impacting the debt ratio (an issue not addressed here), the deficit ratio, the debt ratio, the interest rate on the debt and the dispersion of output growth will together determine the shape of the deficit and debt ratio fan charts. We also consider a scenario where an additional tightening of fiscal policy, beyond that underlying the Update values, of one percent of GDP is undertaken in 2013, 2014 and 2015 and examine how it impacts the fan charts.

As is the case with the sensitivity analysis included in the Update, it is assumed in the principal set of fan charts presented that there is no fiscal policy response to any change in the budgetary position owing to exogenous growth rate shocks. The Irish government is committed to bringing the general government deficit to below 3 percent of GDP by 2015 (as indicated, for example, on p. 6 of the 2011 Update). The government can adjust fiscal policy to address meeting this goal in the event of poorer growth rates than expected transpiring. It

indicates in the Update (on p.16) that "in reality such a response [to a changed budgetary position] would occur if desirable in the interests of economic or budget sustainability".

2.   Fiscal Arithmetic

We set out a methodology to quantify the range of possible outcomes for the deficit ratio and the debt ratio over a medium-term horizon. We take the central projections of relevant fiscal and macroeconomic variables for each year in an Update as our baseline values around which fan charts are constructed for the country in question.   They are denoted with the superscript U to indicate that they are taken from the Update.   Note that we do not comment on the plausibility of these (or any other projections), but instead simply take them as given for present circumstances.

The five-year forecast horizon over which fiscal projections are made in Updates defines the number of years for which fan charts are constructed and presented.   We use the familiar time subscript, $t - 1$, to denote the most recent outturn year (e.g., 2010 in the case of the 2011 Updates) and t to $t + 4$ to denote the following five years respectively that provide the forecasting horizon in the Update (e.g., 2011-2015 in the 2011 Updates).

The forecast deficit ratio, d^U, contained in the Update in any year $t + j$, where j can have a value of -1 to 4, is defined as:

$$d_{t+j}^U = s_{t+j}^U + c_{t+j}^U - o_{t+j}^U \qquad (1)$$

where s^U is the structural primary budget balance ratio (that is, the policy-determined component of the primary balance), c^U is the cyclical component of the primary budget balance ratio (the sum of it and s^U gives the primary budget balance ratio), and o^U is the interest outlay on the government debt.   The variables d, s, and o are each expressed as a percentage of nominal GDP and c is as defined below.   We also note that Updates contain annual values for the debt ratio, b, real growth rate, g, potential growth rate, p, GDP deflator, n, and the output gap (defined below).

Each Update then will contain forecast values for each of the aforementioned variables from years t to $t + 4$.   These are the central scenario values in what follows, reflecting their standing as the Update's expected outturn.   We wish to generate the range of possible outturns for both d and b in years t to $t + 4$ based on the possible range of growth values

over that horizon. We also assume that potential output growth rates, p, and GDP deflator values, n, are unchanging throughout the forecast horizon from those values in the Update. It would, of course, be possible to allow these variables to change over time also, but in the current exercise we focus on changes in the growth rate, as much as anything because it is the variable that is usually subject to change in Update sensitivity analyses.

In the notation that follows, the dropping of the U superscript, when it occurs, implies that we are generating variable values that differ from those in the Update.

Year t

The baseline output gap reported in the Update for year $t - 1$, $\frac{Y_{t-1}^U - P_{t-1}^U}{P_{t-1}^U}$, allows us determine $\frac{Y_{t-1}^U}{P_{t-1}^U}$, where Y is real (GDP) output and P is potential output.

Given g_t, we are able to generate a ratio of actual output to potential output in year t as:

$$\frac{Y_t}{P_t^U} = \frac{Y_{t-1}^U}{P_{t-1}^U} \cdot \frac{1+g_t}{1+p_t^U} \qquad (2)$$

In turn, a c_t, consistent with the output gap value, can be estimated as:

$$c_t = \alpha \frac{Y_t - P_t^U}{P_t^U} \qquad (3)$$

The $\propto$ parameter is a semi-elasticity reflecting the sensitivity of the primary balance, measured as a percentage of nominal GDP, to the output gap.[3]

This new c value contributes to a new value for d_t. The other two components of d must be adjusted in year t for output growth in t being different from the central (i.e., Update) forecast. This means that both s_t and o_t must be adjusted for their denominator, nominal GDP, being different since one of its determinants, the real GDP growth rate, now has a different value. The new deficit ratio value in year t is measured as:

$$d_t = s_t^U R_t + c_t - o_t^U R_t \qquad (4)$$

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[3] The value of this parameter will differ between countries and could be subject to changes in value over time, owing, for example, to changes in tax law. In practice, estimating it is quite involved, requiring as it does the estimation and weighting of individual tax and expenditure base elasticities. Reflecting the time that can pass between new estimates of the parameter becoming available, a 2006 paper by Girouard and Andre (2006) provides the first elasticity updates by the OECD since 1999.

where $R_t = \frac{1+g_t^U}{1+g_t}$.

In estimating the new debt-to-nominal-GDP ratio in year t, b_t, the Update value for this variable requires the same growth-rate adjustment as the s and o terms, as well as the addition of the change in the cyclical component from its Update value, which increases/decreases the deficit ratio (depending on its sign) and, therefore, the debt ratio as well:

$$b_t = b_t^U R_t + (c_t^U - c_t) \qquad (5)$$

There is no additional monetary outlay on interest payments on the debt in year t since we follow the usual assumption that any addition to the debt in the current year does not generate interest payments until the following year, in this case $t + 1$, and subsequent years. To help make easier the notational representation for years $t + 1$ to $t + 4$, we note that b_t^U has been rebased in year t (owing to the change in the growth rate from its Update value) and, consequently, denote it as $\widetilde{b_t^U}$ (i.e., $\widetilde{b_t^U} = b_t^U R_t$).

Years $t + 1$ to $t + 4$

The effect of the growth rate differing from Update values on d and b values in years $t + 1$ to $t + 4$ involves three additional issues to be considered beyond those surrounding the calculations for year t.

First, a change in the growth rate in any of the previous forecast years will have a knock-on effect on the output gap in the year under consideration. The rebasing of Update s, o and b values will also have to take account of the extent to which rebasing, owing to a different growth rate, occurred in previous years.

Secondly, a higher or lower interest outlay will arise from the extent to which the debt ratio in the previous year differed from the Update value in that year. This needs to be accounted for in the interest outlay component of the deficit ratio and has to be added into the debt ratio since we assume that additional interest payments must be met by debt issuance.

Thirdly, we need to rebase the addition to the debt incurred in the previous year(s) to the change in nominal GDP between the last year and the current year.

The cyclical component is not rebased because it is determined by the size of the output gap in year $t + 1$. It is calculated in year $t + 1$, a la equation (2):

$$\frac{Y_{t+1} - P_{t+1}^U}{P_{t+1}^U} = \left(\frac{Y_t}{P_t^U} \cdot \frac{1 + g_{t+1}}{1 + p_{t+1}^U}\right) - 1 \qquad (6)$$

with the $\frac{Y_t}{P_t^U}$ component coming from equation (2).

Then,

$$c_{t+1} = \alpha \frac{Y_{t+1} - P_{t+1}^U}{P_{t+1}^U} \qquad (7)$$

The deficit ratio in year $t + 1$ is now as follows:

$$d_{t+1} = s_{t+1}^U R_{t+1} + c_{t+1} - \left\{o_{t+1}^U R_{t+1} + i_{t+1} \frac{b_t - \widetilde{b_t^U}}{x_{t+1}}\right\} \qquad (8)$$

where $R_{t+1} = \frac{1 + g_{t+1}^U}{1 + g_{t+1}} R_t$, $x_{t+1} = (1 + g_{t+1})(1 + n_{t+1}^U)$ and n_{t+1}^U is the GDP deflator value for year $t + 1$ (included in Table 1). The interest rate, i_{t+1}, is the nominal rate of interest charged in $t + 1$ on financing the additional debt incurred in year t.

The debt ratio in year $t + 1$ then is as follows:

$$b_{t+1} = b_{t+1}^U R_{t+1} + (c_{t+1}^U - c_{t+1}) + (1 + i_{t+1}) \frac{b_t - \widetilde{b_t^U}}{x_{t+1}} \qquad (9)$$

More generally, for all $j \geq 1$,

$$d_{t+j} = s_{t+j}^U R_{t+j} + c_{t+j} - \left\{o_{t+j}^U R_{t+j} + i_{t+j} \frac{b_{t+j-1} - \widetilde{b_{t+j-1}^U}}{x_{t+j}}\right\} \qquad (10)$$

$$b_{t+j} = b_{t+j}^U R_{t+j} + \left(c_{t+j}^U - c_{t+j}\right) + \left(1 + i_{t+j}\right)\left(\frac{b_{t+j-1} - \widetilde{b_{t+j-1}^U}}{x_{t+j}}\right) \qquad (11)$$

where $R_{t+j} = \frac{1 + g_{t+j}^U}{1 + g_{t+j}} R_{t+j-1}$; and $x_{t+j} = \left(1 + g_{t+j}\right)(1 + n_{t+j}^U)$.

3. Fan Chart Methodology

It remains to specify the one (in our case) random process involved, i.e., that which determines real GDP growth. We assume a simple, illustrative real GDP growth process of the following form [4]

$$g_{t+j} = g_{t+j}^{U} + sigma_{t+j}.Z , \quad j = 0,1,2,3,4,5 \qquad (12)$$

Where g_{t+j}^{U} is the growth rate in the Update for year $t+j$, $sigma_{t+j}$ is the assumed volatility (taken as the standard deviation) of real GDP growth in $t+j$, where j refers to years 0 (2010) to 5 (2015), Z is an iid standard normal variate, and redundant subscripts are removed for convenience.[5] The parameter $sigma_{t+j}$ governs the width of the fan chart at each horizon j. Finally, to complete the calibration, the $sigma_{t+j}$ parameters are assumed to take the following illustrative values:

$$sigma_t = 0\%, \ sigma_{t+1} = 1.3\%, \ sigma_{t+2} = 1.9\% , \ sigma_{t+3} = 2.3\%,$$

$$sigma_{t+4} = 2.6\%, \ sigma_{t+5} = 2.8\%, \qquad (13)$$

Our projections involved 20,000 simulation paths of real economic growth g over time. Each path of g is then fed through the earlier equations to produce corresponding simulated paths for all the endogenous variables, with our particular interest, of course, being on d and b. These simulated paths are then represented by the fan charts shown below.

4. An Application of the Fan Chart Method to Update Data: Ireland, 2011-2015

In this section, we provide an illustration of the fiscal fan charts method outlined above, using Ireland data. Table 1 contains central-forecast data included in a typical Update, in this case the most recent (April 2011) submission of Ireland to the European Commission (Department of Finance, 2011). We do not update any outturn data for 2010 that may have emerged since

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[4] A more sophisticated alternative is to use a two-piece normal process as used by the Bank of England and the Sveriges Riksbank in their macroeconomic fan chart projections, which allows for asymmetry in the projections. For more on these, see e.g., Wallis (2004) and Dowd (2008a), and Dowd (2008b), respectively. The simpler process assumed here, however, suffices to illustrate the fan chart approach and avoids any need to specify the degree of asymmetry between upside and downside outcomes.

[5] There are alternatives to using standard deviation as a basis for quantifying the dispersion of possible future values. These include past predictive errors, as used by the UK Office for Budget Responsibility, mean absolute deviation, etc. We could also use conditional dispersion measures that take into account, e.g., interim information.

April (for example, from the domestic national statistics authority, the Central Statistics Office) as we are seeking to present fan charts based on the information contained in, and at the time of, the Updates.[6]   This implies that the hypothetical starting year of the projections is 2010.   We also acknowledge that we are in the first instance examining the probability distribution for the future real GDP growth rate, deficit ratio, and debt ratio values on a "no-policy-change" basis.

The key fiscal variables from an EU fiscal rules perspective are the overall budget balance (deficit) ratio and the end-year debt ratio.   Ireland's 2010 outturns for these two variables were well in excess of the Treaty requirements of being less than 3 percent and 60 percent, respectively.   In response, the Irish government has promised to reduce the overall budget deficit ratio to 3 percent or below by 2015.   The official government projection is that that target will be achieved, with a 2.8 percent deficit forecast for 2015.   It also envisages a modest reduction in the debt ratio from a peak value of 118 percent in 2013 to occur by 2015. We do not comment on the plausibility of the government's deficit target or its debt ratio projections, but simply take them as given for illustrative purposes.

We give the $\propto$ parameter a value of 0.4, which is the most recent European Commission (2006, p. 119) estimate for Ireland of the sensitivity of the budget balance ratio associated with a unit change in the output gap and which appears to be that referred to on p. 29 of the 2011 Ireland Update.

We assume that the marginal interest rate on the debt (i above) has a constant value of 5.82 percent over the years 2011-2015.   This reflects Ireland's current absence from bond markets, its reliance on a programme arrangement with the EU-IMF to finance its deficit position at this time, and the uncertainty surrounding when, at what funding rates, and to what extent it will be able to re-enter bond markets.   The value of 5.82 percent is the National Treasury Management Agency's (2010) estimate of the average rate of interest on the €67.5 billion of external funding under the programme of financial support for Ireland

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[6] We also note that at the time of writing (September 2011) it is nearly five months since the 2011 Update for Ireland was issued in April 2011 and that over eight months of the calendar and fiscal year 2011 have passed. This means that observers, including the fiscal authorities, will likely be in a better position to assess the likely fiscal outturn for 2011, and possibly subsequent years, than was the case in April or last December, when the 2011 budget was presented to parliament.   Half-year Exchequer returns data available in early July could be of assistance, for example.   In constructing the fan charts, however, we assume for simplicity that no new intra-year information for 2011 is available.

agreed with the IMF and EU authorities in November 2010. Although a change to the average interest rate should follow from policy developments in the summer-autumn period of 2011, we are not aware, at the time of writing, of any official update on the average interest rate for Ireland and, consequently, adhere to the 5.82 percent value.

An assumption of no-policy-change underlies the first set of fan charts (Figures 1 and 2). In other words, the projected central path of outturns in those figures is based on the technical position set out in the Update which, in turn, is based on the implementation of measures consistent with the overall commitments in the Programme for Government and the Joint EU/IMF Programme.

Figure 1 shows fan charts for the real growth rate g, the deficit/GDP ratio d, and the debt/GDP ratio b. The g chart is governed by the process set out in (12) and (13), whereas the shapes of the fiscal fan charts are governed not just by the g process, but also by the budgetary arithmetic dynamics set out in equations (2)-(11). The coloured areas in each fan chart represent the 90 percent prediction regions for each future year, and the heavier the shading, the higher the probability of any particular outcome occurring. Put differently, if one drew a vertical line through any fan chart, the resulting 'slice' gives us the projected pdf between the 5 percent and 95 percent probability range. It is also possible to calculate the probability that a particular fiscal target will or will not be met using the information provided in the deficit and debt fan charts.

Figure 2 shows the projected terminal (i.e., year 2015) densities for each of g, d and b. These density charts also show the projected risk bounds for each of these variables, i.e., the lower 5 percent bound, the mean, and the upper 95 percent bound. So, for example, the upper chart indicates that the projected mean real GDP growth for 2015 is 3 percent, and its 90 percent prediction interval (i.e., the range between the lower and upper bounds) is [-1.57 percent, 7.48 percent]. The other risk bounds have comparable interpretations.

5.   An Alternative Path of Fiscal Adjustment

The projections given above are based on the fiscal forecasts included in the 2011 Update interpreted as central projections. It would be possible, however, for the government to undertake even greater fiscal "consolidation" in the years ahead by increasing taxation and/or reducing government expenditure to a greater extent than the 2011 Updates provide for. The merits of such a course of action have been debated in the literature. One view is that fiscal

consolidation will have contractionary effects on output, while an alternative perspective is that it is sometimes associated with increases in private consumption occurring soon after the fiscal policy is enacted (this view is found in the "expansionary fiscal contraction" literature that is most closely associated with Giavazzi and Pagano (1990, 1996)).

Macroeconometric models provide one means of ascertaining how further fiscal consolidation will impact on output and fiscal variables, implying that a set of forecasts consistent with the new policy stance can be presented. In constructing fan charts, they would substitute for the central forecasts utilised in the previous section. Here, we draw on Guajardo, Leigh and Pescatori (2011) to assess the effect of fiscal consolidation on output. They examine the historical record of budgetary policies in the OECD economies so as to identify changes in fiscal policy that were motivated by a desire to reduce the budget deficit and not to respond to economic conditions. Having pinpointed and quantified such specific fiscal policies (they find 173 occurrences in OECD countries between 1978 and 2009), they estimate the effect that such fiscal consolidation has on economic activity in the first three years after the policy is enacted. They find that a permanent fiscal consolidation of one percent of GDP in the budget balance in each of three consecutive years has a cumulative effect on the level of real GDP as follows: it reduces it by 0.315 percent in the year the fiscal measure is first introduced (year 1), by 0.615 percent in year 2, and by 0.516 percent in year 3.[7]

We used these estimates as a basis for assessing how a policy of improving the fiscal balance by one percent of GDP in 2013, 2014 and 2015, beyond that already written into the fiscal adjustment programme embedded in the 2011 Ireland Update numbers, might impact the baseline fiscal and growth rate values in those three years. We, thus, assumed that the Update structural primary balance ratio, s^U, was increased by one percent in each of the three years 2013-2015. We show in the appendix how the variable values for this alternative fiscal scenario are calculated. They are shown in Table 2 and provide a new set of baseline deficit and debt values around which fan charts can be presented.

Figures 3 and 4 give the fan chart and density charts for this revised scenario. Comparison of Figures 2 and 4 shows that the revised policy scenario pushes up 2015 economic growth projections a little, generates a more substantial improvement in the 2015 deficit/GDP

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[7] These specific numerical values have been kindly provided to us by the authors and are the basis for the point estimates in Figure 2 of their paper.

projections (e.g., the mean deficit ratio falls from 2.82 percent to 2.07 percent) and leads to a small improvement in the 2015 debt/GDP projections.   Thus, the tighter fiscal policy improves the 2015 economic growth and fiscal outlooks.

One useful feature of fan charts is that it is possible to present multiple fan chart projections simultaneously in the same graph based on different scenarios.   In Figure 5, we present the deficit and debt ratio fan charts from the "no policy change" scenario of Figure 1 and the alternative policy path of Figure 3.   The charts allow us to directly compare both scenarios. En passant, one will note that the fan chart projections for the debt ratio are always well above 60 percent, indicating that there is no real hope of reaching the Maastricht requirement of the debt ratio falling below 60 percent over this period.

6.   Conclusion

We have presented a methodology for constructing fan charts for the government deficit and debt ratio and, underlying these, for the real GDP growth process that we have assumed here drives all three fan charts.   While the focus has been on using the information contained in member states' Updates to construct the fan charts, it seems plausible to us that a broader range of fan charts could be produced.   For example, we can envisage the impact of alternative fiscal policies (as in the example just considered), but we can also construct fan charts that take account of other sources of randomness, most obviously, the possibility of the financing costs of government debt being affected by stochastic interest rates.   It should also be possible to develop fan charts for cyclically-sensitive components of the budget deficit, such as personal taxes, corporate taxes, indirect taxes and social contributions (the European Commission (2006) provides budgetary elasticity values for these items); we can also construct fan charts for the economic cycle itself.   Fan charts could also be produced over a longer horizon than the five-year period used here, and these would be especially suitable for investigating longer term effects such as the effects of demographic changes on budgetary outlays on state-provided pensions.   Indeed, fan charts for longevity and its impact on the costs of pensions already exist, but the work of integrating these into longer term budgetary analyses is in its infancy.

Finally, it should be noted that all fan chart projections are a species of scenario analysis: they do not give forecasts per se, but only stochastic projections of what *might* happen *if* certain scenarios unfold.   This caveat should always be kept in mind, especially in the

current highly unstable economic environment and the not exactly encouraging track record of many EU member state governments' own past predictions, let alone 'commitments'. After all, they were all 'committed' to the requirements of the Maastricht Treaty – and apparently still are.

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Appendix: Impact of a Fiscal Tightening in 2013-2015 on the Fiscal and Growth Rate Variables

We assume a tightening of the structural primary budget balance beyond that already planned in the Update of one percent of nominal GDP in 2013, 2014, and 2015. This has the effect of reducing real GDP by 0.317 percent in 2013, by 0.615 percent in 2014, and by 0.516 percent in 2015.

2013

The new baseline deficit ratio, taking account of the fiscal tightening, in 2013 is now calculated as follows:

$$d_{2013} = (s_{2013}^U + 0.01)R_{2013} + c_{2013} - o_{2013}^U R_{2013}$$

where, in this case, $R_{2013} = (1 - 0.00317)^{-1}$ and c_{2013} is calculated by noting that the output gap is now:

$$\frac{Y_{2013} - P_{2013}^U}{P_{2013}^U} = \left(\frac{Y_{2013}^U(1 - 0.00317)}{P_{2013}^U}\right) - 1$$

and, therefore:

$$c_{2013} = \alpha \frac{Y_{2013} - P_{2013}^U}{P_{2013}^U}$$

The growth rate, g_{2013}, which is used below, is $\{(1 + g_{2013}^U)(1 - 0.00317)\} - 1$

The new baseline debt ratio in 2013 is:

$$b_{2013} = (b_{2013}^U - 0.01)R_{2013} + (c_{2013}^U - c_{2013})$$

2014

$$d_{2014} = (s_{2014}^U + 0.01)R_{2014} + c_{2014}$$

$$- \{o_{2014}^U R_{2014} + i_{2014}\left(\frac{b_{2013} - \widetilde{b_{2013}^U}}{x_{2014}}\right)\}$$

where $x_{2014} = (1 + g_{2014})(1 + n_{2014}^U)$; n_{2014}^U is the GDP deflator value for 2014 given in the Update (the 2014 and 2015 values for the deflator are included in Table 3); c_{2014} is

calculated as $\propto \{(\frac{Y_{2014}^{U}*(1-0.00615)}{P_{2014}^{U}})\text{-}1\}$; R_{2014} equals $(1-0.00615)^{-1}$; and $\widetilde{b_{2013}^{U}}$ is, in this case, the original Update debt ratio for 2013, less the one percent fiscal consolidation in that year, rebased, i.e. $(b_{2013}^{U} - 0.01)R_{2013}$.

The growth rate, g_{2014}, is $\left\{\frac{(1+g_{2013}^{U})(1+g_{2014}^{U})(1-0.00615)}{1+g_{2013}}\right\} - 1$

The interest rate variable, i, has a value of 0.0582 in both 2014 and 2015, as per the previous exercise.

The debt ratio in 2014 is:

$$b_{2014} = \{((b_{2014}^{U} - 0.01) - (\frac{0.01}{x_{2014}^{U}}))R_{2014}\} + (c_{2014}^{U} - c_{2014})$$

$$+(1 + i_{2014})(\frac{b_{2013} - \widetilde{b_{2013}^{U}}}{x_{2014}})$$

where $x_{2014}^{U} = (1 + g_{2014}^{U})(1 + n_{2014}^{U})$. The entry $\frac{0.01}{x_{2014}^{U}}$ in this equation reflects the need to reduce the Update debt ratio value for 2014 by the one percent reduction in the debt ratio arising directly from consolidation already undertaken in 2013, prior to rebasing for the lower level of GDP in 2014 arising from the fiscal consolidation. Similar adjustments for the policy-induced change in the structural budget balance ratio in 2013 and 2014 have to be accounted for in adjusting the Update debt ratio in 2015 for the effects of consolidation in all three years.

2015

The deficit ratio and debt ratio in 2015 are, respectively,

$$d_{2015} = (s_{2015}^{U} + 0.01)R_{2015} + c_{2015}$$

$$- \{o_{2015}^{U}R_{2015} + i_{2015}\left(\frac{b_{2014} - \widetilde{b_{2014}^{U}}}{x_{2015}}\right)\}$$

$$b_{2015} = \{((b_{2015}^{U} - 0.01) - \left(\frac{0.01}{x_{2015}^{U}}\right) - \left(\frac{0.01}{x_{2014}^{U}x_{2015}^{U}}\right))R_{2015}\} + (c_{2015}^{U} - c_{2015})$$

$$+(1 + i_{2015})(\frac{b_{2014} - \widetilde{b_{2014}^U}}{x_{2015}})$$

where c_{2015} is calculated as $\propto \{(\frac{Y_{2015}^U * (1 - 0.00516)}{P_{2015}^U}) - 1\}$; $R_{2015} = (1 - 0.00516)^{-1}$; $g_{2015} = $

$\{\frac{(1 + g_{2013}^U)(1 + g_{2014}^U)(1 + g_{2015}^U)(1 - 0.00516)}{(1 + g_{2013})(1 + g_{2014})}\} - 1$; $x_{2015} = (1 + g_{2015})(1 + n_{2015}^U)$;

$x_{2015}^U = (1 + g_{2015}^U)(1 + n_{2015}^U)$; and $\widetilde{b_{2014}^U} = ((b_{2014}^U - 0.01) - (\frac{0.01}{x_{2014}^U}))R_{2014}$.

Table 1: Macroeconomic and Fiscal Outturns and Projections for Ireland from 2011 Update, 2010-2015.

		2010 $(t-1)$	2011 (t)	2012 $(t+1)$	2013 $(t+2)$	2014 $(t+3)$	2015 $(t+4)$
Macroeconomic variables							
Real growth rate (percent)	g^U	-1.0	0.8	2.5	3.0	3.0	3.0
Potential real growth rate (percent)	p^U	-1.4	-1.2	-0.6	0.5	1.1	1.7
Output gap (percent of potential output)	$\dfrac{Y^U - P^U}{P^U}$	-6.1	-4.2	-1.2	1.2	3.1	4.5
GDP deflator	n	-2.6	0.6	0.5	1.0	1.3	1.5
General government deficit ratio and its components (percent of nominal GDP)							
Overall budget balance: (a) + (b) − (c)	d^U	-12.4*	-10.0	-8.6	-7.2	-4.7	-2.8
(a) Structural primary budget balance	s^U	-6.7	-4.5	-3.4	-1.6	0.4	1.6
(b) Cyclical component of the primary budget balance	c^U	-2.4	-1.7	-0.5	0.5	1.2	1.8
(c) Interest payments on the government debt	o^U	3.3	3.8	4.7	6.1	6.3	6.2
General government debt (percent of nominal GDP)							
Debt ratio (at year end)	b^U	96	111	116	118	116	111

Source: Department of Finance, Dublin 2, Ireland, April 2011.
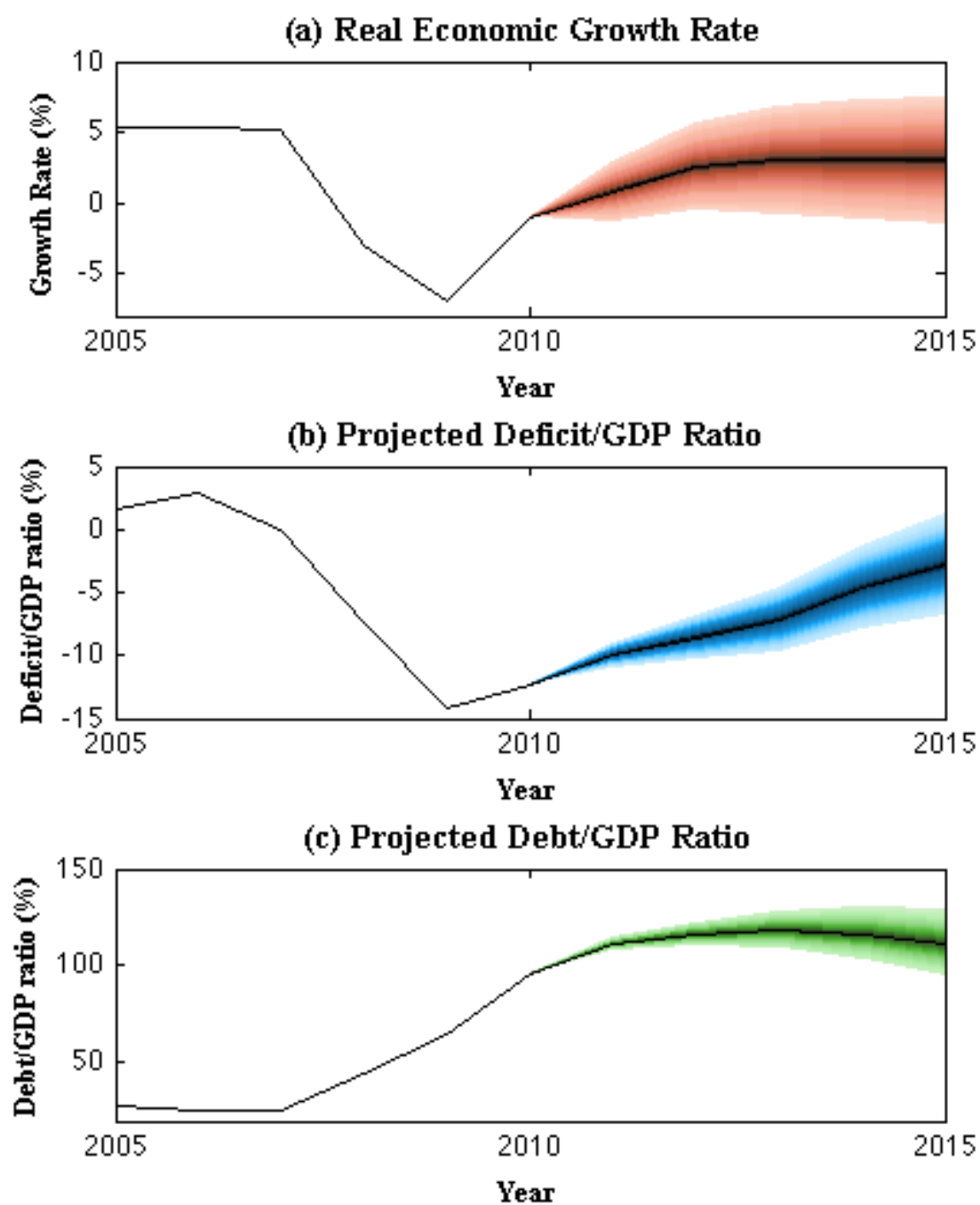
*This is the underlying deficit ratio value when State support to the banking system is excluded.

Table 2: Alternative Consolidation Scenario: Macroeconomic and Fiscal Outturns and Projections for Ireland, 2010-2015.

		2010	2011	2012	2013	2014	2015
Macroeconomic variables							
Real growth rate (percent)	g	-1.0	0.8	2.5	2.673	2.692	3.103
Potential real growth rate (percent)	p	-1.4	-1.2	-0.6	0.5	1.1	1.7
Output gap (percent of potential output)	$\dfrac{Y-P}{P}$	-6.1	-4.2	-1.2	0.879	2.466	3.961
GDP deflator	n	-2.6	0.6	0.5	1.0	1.3	1.5
General government deficit ratio and its components ***(percent of nominal GDP)***							
Overall budget balance: (a) + (b) − (c)	d	-12.4*	-10.0	-8.6	-6.370	-3.952	-2.055
(a) Structural primary budget balance	s	-6.7	-4.5	-3.4	-0.602	1.409	2.613
(b) Cyclical component of the primary budget balance	c	-2.4	-1.7	-0.5	0.352	0.986	1.584
(c) Interest payments on the government debt	o	3.3	3.8	4.7	6.119	6.347	6.252
General government debt ***(percent of nominal GDP)***							
Debt ratio (at year end)	b	96	111	116	117.520	115.111	109.272

*This is the underlying deficit ratio value when State support to the banking system is excluded.

Figure 1: GDP and Fiscal Fan Charts: No Policy Change

(a) Real Economic Growth Rate

(b) Projected Deficit/GDP Ratio

(c) Projected Debt/GDP Ratio

Figure 2: Projected GDP and Fiscal Densities for 2015: No Policy Change

(a) Density of Real Economic Growth Rate, 2015

Risk bounds = [-1.57, 3, 7.48]

(b) Density of Deficit/GDP Ratio, 2015

90% prediction interval = [-6.76, -2.82, 1.2]

(c) Density of Debt/GDP Ratio, 2015

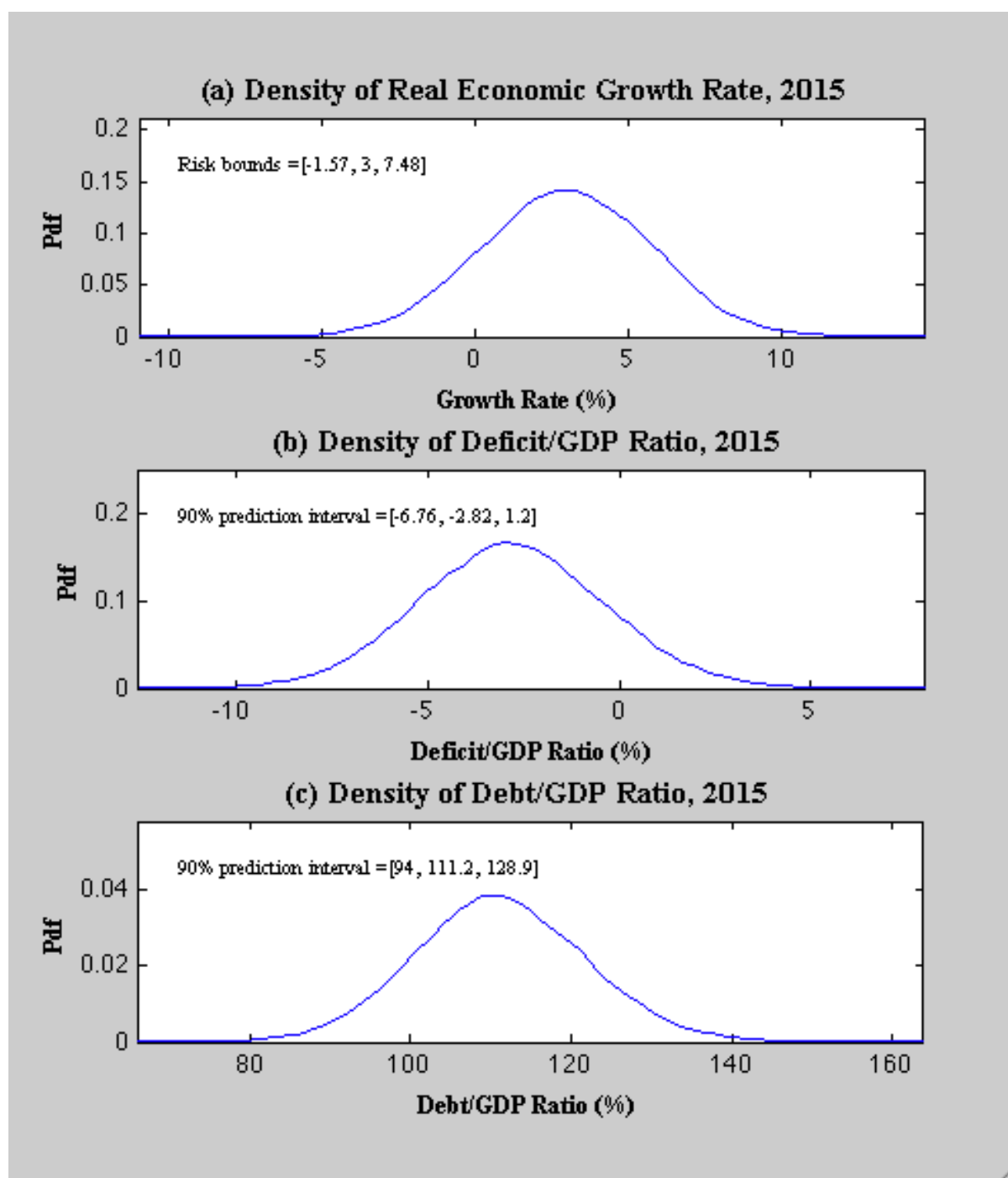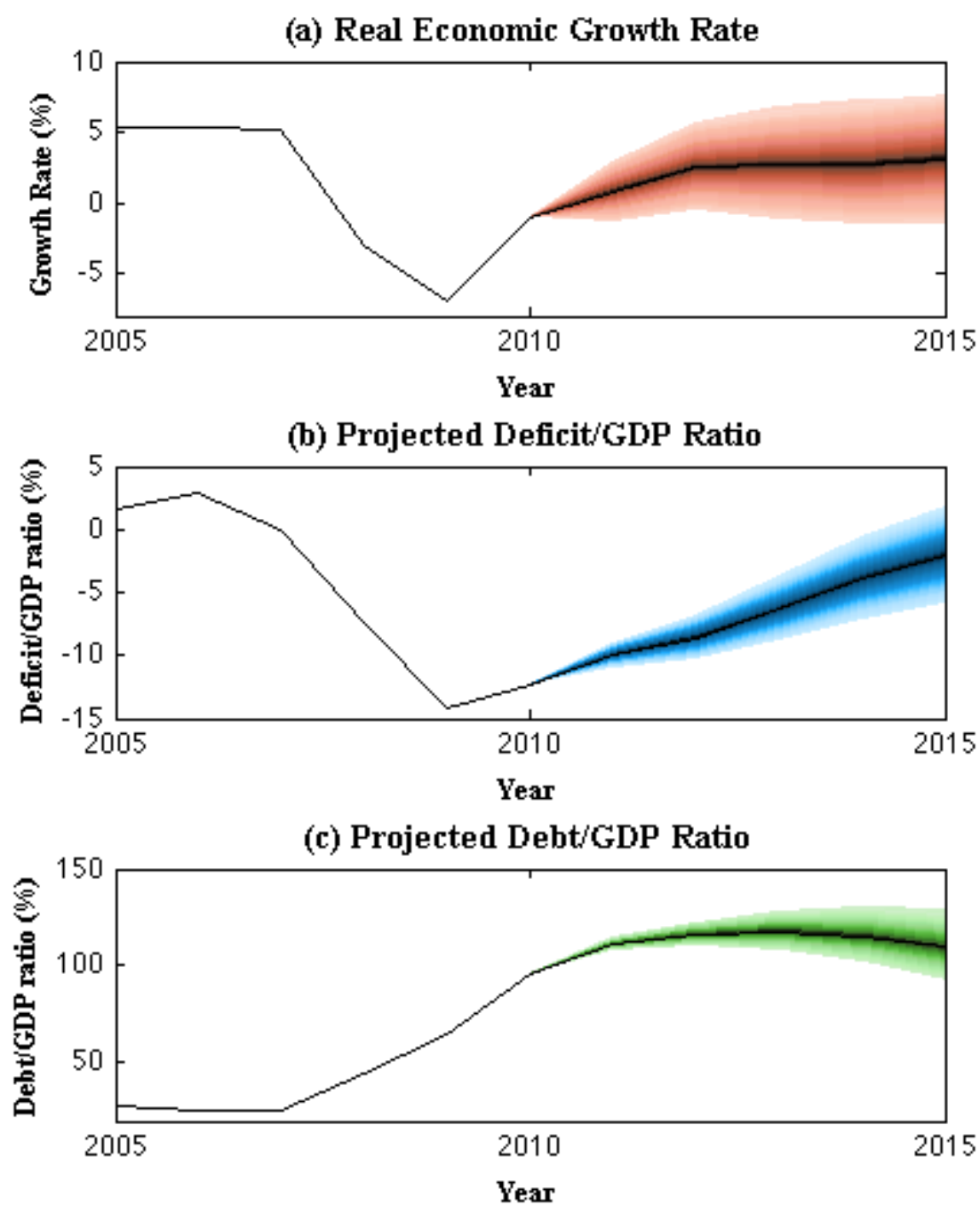90% prediction interval = [94, 111.2, 128.9]

Figure 3: GDP and Fiscal Fan Charts: Alternative Policy Scenario

Figure 4: Projected GDP and Fiscal Densities for 2015: Alternative Policy Scenario
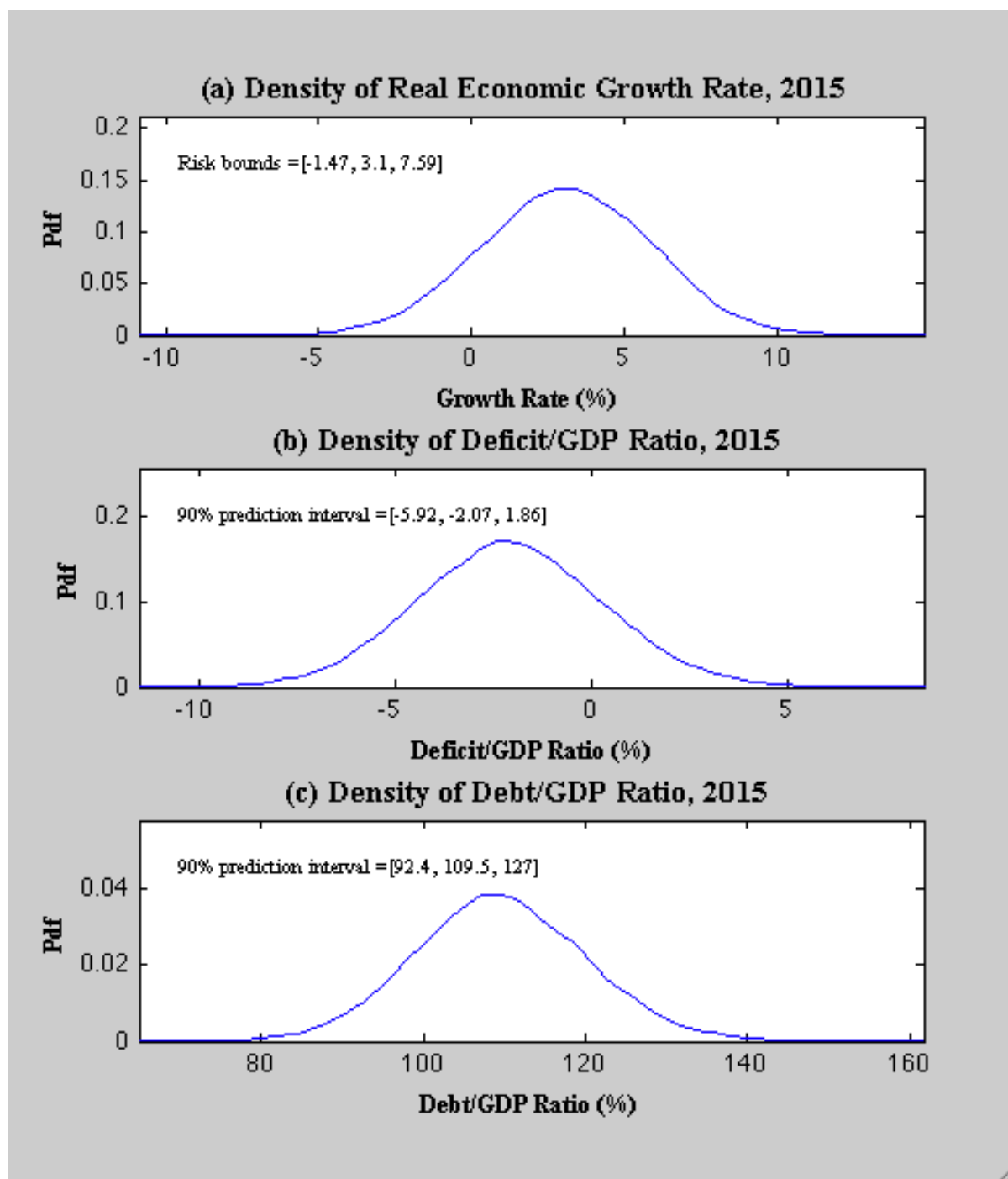
Figure 5: Fiscal Fan Charts: Official/No Policy Change and Alternative Policy Scenarios

(a) Projected Deficit/GDP Ratio

White line: official central projection for 2014-2015

Official: green

Alternative: blue

(b) Projected Debt/GDP Ratio

White line: official central projection for 2014-2015

Official: green

Alternative: blue