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Evaluating Medium Term Forecasting Methods & their Implications for EU Output Gap Calculations

Kieran Mc Morrow, Werner Roeger and Valerie Vandermeulen

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Kieran Mc Morrow, Werner Roeger and Valerie Vandermeulen

Abstract

This paper sheds light on two specific, but interlinked, questions – firstly, how do the EU's, medium term actual GDP growth rate forecasts compare, in terms of accuracy and biasedness, with those of the EU's Member States, in their annual Stability and Convergence Programme (SCP) updates; and secondly, should medium term forecasts be allowed to influence the short run output gap and structural balance calculations used in the EU's fiscal surveillance procedures. Regarding the first question, the paper concludes that the EU's medium term forecasts are equally as good, and arguably better, than those of the SCP's both with respect to accuracy and biasedness. Regarding the second question, due to the relatively rapid loss in forecast accuracy as the time horizon lengthens; the paper suggests that using more forecast information should be avoided in the output gap and structural balance calculations. Extending the forecast horizon to be used in the output gap calculations could exacerbate an existing optimistic bias with respect to the supply side health of the EU's economy, thereby enlarging the risk of procyclicality problems, especially in the upswing phase of cycles, where most of the large fiscal policy errors tend to occur.

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Keywords: Production function methodology, output gaps.

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EXECUTIVE OVERVIEW

This paper assesses the implications of a proposal, made by several EU Member States, to change the way the EU's commonly agreed Production Function (PF) methodology currently estimates the output gaps used in the EU's fiscal surveillance procedures. The specific proposal analysed is whether the PF method's, model based, medium term actual GDP growth forecasts should be replaced with medium term judgemental forecasts from the EU Commission's (COM) experts. This would be a significant methodological change since currently only COM's short run judgemental forecasts are allowed to be taken into account in the output gap calculations. At the moment, the medium term actual GDP growth forecasts are fully non-judgemental, with the latter forecasts based on the PF method's medium term potential growth forecasts and an EPC endorsed output gap closure rule (which essentially ensures that the output gap is closed after five years). Consequently, the key question to be examined is whether the EU's current use of a model based, medium term, GDP forecasting methodology should be replaced by a judgemental approach[1].

The opinions amongst EU policy makers on the extent to which it is prudent to use judgemental medium term, actual GDP, forecasts, range across a wide spectrum. At one extreme are those who would be in favour of excluding even COM's short run judgemental forecasts from the output gap calculations due to their persistent optimistic bias. At the other extreme are those who argue for including medium term judgemental forecasts from COM to be taken into account in the calculations. The PF method is currently in the middle of this range of options, and therefore it is important to assess the theoretical and empirical evidence on this issue to see if the current status quo is supported or whether a change to a longer or shorter judgemental forecasting horizon should be considered.

In examining the case for allowing medium term actual GDP growth forecasts from COM to be used in the EU's output gap (and consequently the structural balance) calculations, the key questions to be addressed are:

- Firstly, how do the EU's medium term actual GDP growth rate forecasts (currently 100% model driven) compare, in terms of accuracy and biasedness, with those of the Member States, in their annual Stability and Convergence Programme (SCP) updates and would it be economically justified for the EU to replace its model based, medium term, methodology with a more judgement driven forecasting methodology?; and

- Secondly, and most importantly, what are the implications of allowing medium term forecasts to directly influence the short run output gap and structural balance estimates used in the EU's fiscal surveillance procedures?

In relation to the first question, this paper shows that the EU's, 100% model driven, medium term actual GDP growth forecasts compare favourably with those of the Member States' SCP updates, in terms of accuracy and biasedness, outperforming the SCP forecasts in 2 of the 3 forecast vintages which were analysed and having an average forecast bias over the 3 vintages which is significantly smaller than that of the SCP's. In addition, the EU's model based approach to medium term forecasting appears preferable to more judgement-driven approaches given the empirical evidence in the literature which shows that the value added of judgemental forecasts beyond a few quarters is highly questionable. Most economic commentators support the view that, for current year forecasts, there is a lot more information on economic developments (than a model can provide) which allows a superior judgemental forecast compared to a model based projection. However, this is a much more

[1] "Judgemental" forecasting methods rely heavily on the subjective expertise of experienced economists based on a wide set of information & incorporating intuitive judgement, opinions & subjective probability assessments. "Rules" / model based methods, on the other hand, keep the degree of expert judgement to an absolute minimum, relying instead on codified, model-based, calculations.

problematic proposition beyond the first year[2], and especially over a medium term time horizon, where the absence of high-frequency economic indicators, as well as the growing importance of structural growth determinants and dynamic interactions, necessitate the use of some sort of modelling approach[3].

In terms of trying to understand the possible sources of forecast biasedness, the paper suggests that judgemental forecasts are often plagued by the difficulties forecasters have in predicting crises and large recessions. For behavioural reasons, a short run optimistic bias is likely to increase with the forecast horizon since forecasters often find it "easier" (for expectational, confidence reasons) to project an acceleration in growth in the outer forecast year(s) rather than a deceleration. Although recessions are relatively common, COM, OECD and IMF forecasters have practically never forecast a negative growth rate in the second year of their short term forecasts, leading to a positive bias in the EU's output gap estimations (since they are based on COM's short term forecasts). Adding more forecast years, for example to cover the medium term, would increase the statistical likelihood of negative growth occurring over this longer forecast horizon, but not the likelihood of it being correctly projected. The current EU method is therefore not bias-free, as such a bias exists in the short term, but this behavioural rationale for the existence of a bias is at least excluded over the medium term, as the latter is strictly model-based.

In addition to the accuracy / bias criterion, the EU's medium term, model based, forecasting approach is also assessed using several other evaluation criteria. Firstly, we find that the EU's method can be considered as being consistent with "best practice", with a broad consensus in the literature supporting the EU's use of, model based, medium term forecasting methods which exploit both supply and demand side developments. Secondly, the EU's method is considered to be transparent and to guarantee equal treatment, which is a crucial criterion for the EU's fiscal surveillance framework since, unlike the situation with other international organisations, the EU's output gap estimates are used in legally binding fiscal policy decisions. This differentiation in the constraints facing the different international organisations is vital in understanding the specificities of their respective fiscal surveillance frameworks. Like the EU, the IMF and the OECD both use a model based, medium term, actual GDP growth, forecasting approach, where the actual GDP forecast is guided by the underlying supply side fundamentals (i.e. potential output) and the economy's cyclical position (i.e. the current level of the output gap – anchored on the expected potential output path). They consider this combined supply and demand side guided approach to be the most effective way of handling the additional uncertainty linked to the longer forecast horizon. Unlike the EU, however, ultimately it is the judgement of the IMF or OECD expert which determines the medium term forecast – they are only guided by, not controlled by, the model based approach. In the case of the EU, the Stability and Growth Pact (SGP) principles of transparency and equal treatment dictate that the EU's PF model based forecasts cannot be overruled by COM's experts.

One final point in relation to question one, whilst the EU's current, model based, medium term forecasting approach compares favourably with those of the Member States' SCP's, and is consistent with the forecasting methodology used by other international organisations, it is clear from the results of the present paper that further improvements are possible:

- Firstly, improvements are possible with respect to the EU's medium term potential output path (which economies tend to revert back towards) where work is still needed to produce an unbiased, no policy change, baseline; and

[2] Uncertainty levels naturally grow with respect to developments which are further away in time.

[3] Beyond the short run, structural, supply side factors become more important in driving economic developments and consequently, like the OECD and the IMF, the EU believes that having an unbiased estimate of the level of potential output is a crucial first step in the process of obtaining credible medium term projections. In this context, the EU's PF method uses an augmented Solow growth model, with macro variables, such as potential GDP (using information about trends for structural growth determinants, including labour, capital and total factor productivity) and the output gap (using information about capacity utilisation and the Phillips curve), all modelled using a parsimonious economic framework (annex 8.3).

- Secondly, by improving the current set of EPC approved output gap closure rules[4] (to avoid breaks in the forecasts between the short and medium term; to ensure symmetry; and to produce forecasts for most of the demand side variables which Member States are asked to submit in their annual SCP updates)[5].

Regarding the second question, the official methodology's filtering and smoothing procedures need to be kept in mind when assessing the impact on output gap and structural balance calculations from allowing medium term forecasts to directly influence the short run calculations[6]. If we were to change from only allowing COM's short run forecasts to be used in the potential growth rate calculations, to also include medium term forecasts, this change would result in non-negligible backward revisions to the short run output gap and structural balance estimates. This is due to the fact that the EU's PF method smoothes in any changes over both historical and future years to avoid an abrupt break in the potential output (and consequently in the output gap / structural balance) series. Consequently, if a country, in their SCP updates, uses a judgemental forecast with a time horizon beyond COM's short run forecasts, they will end up producing very different potential output and output gap paths to those produced by the official EU methodology. The evidence in this paper suggests that there is a significant risk of introducing an additional bias in the structural balance calculations from lengthening the forecast horizon permitted to be taken into account in the calculations. Currently, due to the optimistic bias in the second year of COM's short term forecasts, the EU's PF methodology is producing slightly optimistic structural balance estimates on a persistent basis. This bias would increase dramatically (it could potentially more than double) if the PF method also included medium term actual GDP growth forecasts.

[4] The 20 May 2011 EPC meeting endorsed the following operational rules for closing the output gap. Firstly, the default rule is that the output gap is closed at the end of the medium term. Secondly, in circumstances where the output gap is small at the end of the short term forecasts, the gap could be closed by 0.5 percentage points a year until the gap is closed. Finally, when an output gap is particularly large (i.e. more than double the EU average), a longer period of closure could be allowed, up to a maximum of two additional years.

[5] Improving the output gap closure rules would lead to a more sensible cyclical pattern of actual GDP growth rate forecasts over the medium term. Since we are in effect talking about a cyclical pattern around a potential output line, it is somewhat surprising that the current rules only allow the gap to be closed. It should be possible to forecast a positive or negative output gap depending on where a country is in the cycle. The data should be allowed to decide the path. In addition, no matter what output gap closure rule determined path for actual GDP is finally agreed upon, it would not have any knock-on effects on the short term potential output forecasts since it would be 100% driven by the cycle / by the demand side.

[6] As stated in the main text, the choice to use a longer judgemental forecast horizon for actual output as an input into the potential output and output gap calculations, not only affects the potential output results at the end of the sample, but also the estimates for T and T+1, due to the backward smoothing of the series.

1. INTRODUCTORY REMARKS

Whilst conscious of the specificities of the EU's, rules based, fiscal policy surveillance framework, this paper tries to examine two questions of a more general nature– firstly, how does the EU's model based, medium term, actual GDP growth forecasting methodology compare, in terms of accuracy and biasedness, with the medium term forecasting methodologies used by the EU's member states and secondly should medium term actual GDP growth forecasts be allowed to be included in the potential growth, output gap and structural balance calculations used in the EU's fiscal surveillance procedures. In answering these questions, the following two-pronged strategy was followed:

- Firstly, a survey was carried out of the medium term forecasting methods used by the 28 Member States in generating their annual Stability and Convergence Programme (SCP) T+4 projections (specifically the medium term actual GDP growth forecasts for T+3 and T+4) which are submitted to the Commission as part of their SCP updates[7]. Countries were asked to categorise the forecasting methods used in generating these medium term, actual GDP growth, forecasts as either being similar to the rules based PF method (i.e. where forecasts are 100% model generated, drawing on both supply side (potential growth) and demand side (output gap closure rules) developments in each EU economy)) or as being generated by "expert judgement" dominated forecasting methods.

- Secondly, assessing the theoretical and empirical evidence to see if the EU should consider replacing its model driven, medium term, forecasting methodology with a more judgement driven approach. In this context, the paper provides a short review of the literature and of the approach taken by other international institutions. This is followed by an empirical assessment of the accuracy and biasedness of the PF's, model based, medium term actual GDP growth forecasts compared with the SCP forecasts from the Member States, and the knock-on implications if these medium term forecasts were allowed to be used in calculating the output gap and structural balance estimates used in fiscal surveillance. In the final section, on the basis of an OGWG endorsed set of evaluation criteria, an attempt is made to reach an overall assessment as to whether it is preferable that the EU continues to calculate its output gap and structural balance estimates using only the Commission's short run, judgemental, forecasts or whether the fiscal surveillance process would be enhanced, or undermined, by allowing medium term judgemental forecasts to be taken into consideration in the calculations[8].

[7] The 2017 edition of the Vade Mecum on the Stability and Growth Pact explains that, in accordance with Regulation (EC) 1466/97, Member States are required to submit, annually, SCPs to the Council and the Commission in April of each year. The function of the SCPs is to allow the Commission and the Council to assess compliance with the MTO and the adjustment path towards it, including compliance with the expenditure benchmark. In order for such an assessment to be made, a range of economic and budgetary data must be included in the SCPs, as set out in the tables annexed to the Code of Conduct on the SGP, which have been jointly agreed by the Member States and the Commission in Council committees. The forecasts contained in the SCPs must be prepared in a sound and realistic manner, consistent with Directive 2011/85/EU on the requirements for budgetary frameworks of the Member States, and should therefore be based on the most likely macro-fiscal scenario or a more prudent one. As a result of the Two Pack, euro area Member States must base their Stability Programmes on macroeconomic forecasts produced or endorsed by an independent body. For all countries, as part of the SCPs, both the macroeconomic and budgetary forecasts must be compared with the most recently available Commission forecasts and, if appropriate, those of other independent bodies. In addition, the output gap and potential growth rate estimates are calculated according to the agreed methodologies. Following the ECOFIN Council meetings of July 2002 / May 2004, the production function (PF) approach for the estimation of output gaps constitutes the reference method.

[8] Essentially the question to be answered is whether there is support for such a change firstly from the literature and secondly from the empirical evidence, in terms of accuracy / biasedness, and from the additional information content, if any, of having an extended forecast horizon.

2. OVERVIEW OF THE MEDIUM TERM FORECASTING METHODS USED BY THE EU'S MEMBER STATES

A survey of the EU Member States[9] was initiated with the objective of obtaining a description of the forecasting methods which the 28 Member States use for the set of economic projections which they submit annually to the Commission as part of their SCP updates. The survey focussed in particular on understanding the differences between the common methodology's, model based, T+3 and T+4 actual GDP growth forecasts and the equivalent T+3 and T+4 forecasts in the SCP's. Member State representatives were asked to answer the following two questions regarding the specific methodologies they employed:

- Firstly, in overall terms, which of the following three broad categories would best describe the forecasting methodology used? :
    a) Similar to the approach in the Common methodology.
    b) Expert and judgemental forecasts for GDP growth and its components up to and including T+4.
    c) Other approach.

- Secondly, once the broad category choice of a), b) or c) was made, OGWG members were asked to provide a few lines of description of any specifically noteworthy features of the broad approach taken.

The Common Methodology is a hybrid procedure involving expert judgement and models (see Annex 8.3 and Havik et al., 2014 for details). For the short term forecast (two years), expert forecasts for GDP growth are allowed. After that the Production Function model calculates the medium term actual GDP growth forecasts in three steps. In the first step, historical data and the short term (t, t+1) judgemental GDP growth forecasts are used to calculate the potential growth and output gap estimates until the end of the second year using the commonly agreed PF methodology. In the second step, based on the estimated trends for the drivers of potential output, a projection for a, no-policy change, potential output baseline path up until year 5 is produced by the PF model. In the third and final step, the EU's method applies the Economic Policy Committee (EPC) approved rules for closing the output gap over the medium term, which when combined with the PF's potential growth projections produce the medium term projections for actual GDP growth.

The Commission's short and medium term output gap forecasts are 100% determined by the common PF methodology – in practice, this means that in order to ensure equal treatment and transparency, it is not possible for a Commission expert to overrule the output gap results produced by the agreed rules based framework.

Table 2.1 gives an overview of the responses which were received from all 28 of the EU's Member States and show that about 1/3 of countries were able to make a clear categorisation of their approach as being consistent with the EU's commonly agreed approach. The remaining 2/3 of countries had difficulty in deciding if their medium term forecasting methods should be categorised as either judgemental (option B) or model based but judgement dominated (option C). The key focus for the rest of this paper is to assess, both theoretically and empirically, the performance of the EU's rules based medium term forecasting methodology relative to the combined performance of the wide range of forecasting methodologies employed by the EU's Member States in their SCP updates.

[9] The survey of the forecasting methods used by the 28 EU Member States was carried out by the EPC's Output Gap Working Group (OGWG).

Table 2.1: **Overview of the Medium Term Forecasting Methods used by the Member States for the economic projections underlying their SCP Updates**

Which of the following three broad categories would best describe the forecasting methodology used to carry out your T+3 and T+4 actual GDP growth forecasts?	Number of Countries	% of all 28 Countries
Option A: Commonly Agreed Production Function Model : a non-judgemental approach in which actual GDP growth is 100% determined by the potential output path and EPC agreed output gap closure rules	10	36%
Option B : Judgemental : Expert and judgemental forecasts for GDP growth and its components up to and including T+4	6	21%
Option C : Hybrid Methods : a combination of model based forecasts (not based on the Commonly Agreed production function method) in combination with expert judgement (results are overruled on the basis of expert judgement)	12	43%

3. POSSIBLE FORECASTING APPROACHES AND HOW DO OTHER INTERNATIONAL INSTITUTIONS DEAL WITH THE ISSUE OF JUDGEMENTAL VERSUS NON-JUDGEMENTAL MEDIUM TERM FORECASTING METHODS

The objective of this section is to look at the possible forecasting approaches and how other international institutions deal with the issue of judgemental versus non-judgemental medium term forecasting methods and to draw a number of broad conclusions, based on a non-exhaustive review of the literature, on the various forecasting approaches:

- Firstly, several authors argue that *expert based judgemental forecasts*, which rely heavily on a large amount of survey information, are only really helpful for now-casting and for short term forecasting exercises (e.g. Gayer (2006), Chauvet and Potter (2013), Stark (2011)). They accept that the information provided by surveys does not improve forecasts beyond a horizon of 1 year (see, for example Gayer (2006)). This is also confirmed by forecast comparison exercises, which generally conclude that judgemental forecasts are outperformed by time series and model based approaches after a horizon of two to three quarters (see, for example Chauvet and Potter (2013)), although it must also be admitted that the improvement in forecasting performance is often marginal. Stark (2011), in an evaluation of the judgemental forecasts from the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters, using a sample stretching over 20 years (quarterly data between 1985 and 2007), concluded that the survey based forecasts did "quite well at short horizons, and often outperformed the forecasts of time series models…..However, forecast accuracy often deteriorates dramatically as the horizon lengthens… with a large degree of uncertainty surrounding forecasts at long horizons".

- Secondly, a *pure time series based analysis* of GDP growth also seems to be of limited value. For example, Galbraith (2003) finds that there is no valuable information in US GDP data

after 2 quarters. Even though Diebold et al (1997) claim that time series methods provide information for longer, several other studies have concluded that time series approaches and VAR models are not really suitable for the medium term. For example, Edge and Gürkaynak (2011) compared the forecasting performance of time series based methods (VAR) to model based methods (Smets Wouters DSGE model) without judgemental interventions, based on a horizon of up to 8 quarters using US GDP data. They found that the DSGE model performed slightly better[10] in the second year.

- Thirdly, most institutions which regularly carry out medium term projections concentrate on *model based approaches*. As documented by Hofer et al (2010), the models are 'usually based on a Keynesian neoclassical synthesis type with a strong emphasis on supply determinants for potential output'. Often a two-step procedure is applied. In the first step, the potential output path is determined using the supply side of the model (using a PF approach). In a second step, demand side developments are driven by an assumption regarding the speed of the closure of the output gap, with this output gap closure rule determined by either mechanical rules or models of the cycle. This two-step approach is currently pursued by the OECD (Turner 2016) and in the EU's commonly agreed production function methodology.

- Finally, one can find literature arguing for a more *mixed approach* in which several methods are combined. Some argue for judgemental adjustments of model based forecasts, in which the judgement is often less based on surveys but more on information known to governments, central banks or ministries, which might be hidden to the public. For instance Fildes and Steckler (2002) argue that models may have to be adjusted for a number of related reasons: structural breaks might cause changes to the sample data on which the model was based, changes in the institutional framework can affect the parameter estimates, revisions to data can lead to measurement errors… They argue that current information, outside the sources used by the model, can give insights into possible inadequacies in the model-based forecast, and should therefore be taken into account. More recently Jos Jansen et al. (2016) have written that "judgmental forecasts by professional analysts often embody valuable information that could be used to enhance the forecasts derived from purely mechanical procedures". Others argue for a combination of time series and structural models, believing that the combination can increase the accuracy of the forecast (e.g. Genre et al. (2013)). Elliot and Timmerman (2016) report in their review on forecasting in economics and finance that because each model or forecasting method is just an approximation of a complex and evolving reality, it is impossible for one method to dominate. According to Elliot and Timmerman this explains the success of what they call forecast combinations. This mixed approach is also used by the IMF (see below).

When it comes to other international institutions we can distinguish between the OECD and the IMF:

- A 2016 review of the OECD's forecasting track record (Turner 2016), explained that their short term forecasts "rely heavily on expert judgement which is informed by inputs from a range of different models, with forecasts subjected to repeated peer review". Whilst this approach ensures that the OECD's "current year GDP growth forecasts exhibit a number of desirable features including that they are unbiased, outperform naïve forecasts (such as sample means) and mostly identify turning points" (with the use of high frequency nowcasting indicator models helping to produce a trend improvement in the OECD's current-year forecasting performance), the opposite conclusion applied to the OECD's one-year-ahead forecasts - "such forecasts are biased, often little better than naïve forecasts and are poor at anticipating downturns". The OECD analysis concludes that "these weaknesses in

[10] They find that both approaches outperform judgemental forecasts (the so called Greenbook forecast of the FED staff after a forecasting horizon of two quarters).

forecasting performance beyond the current year underline the importance of increased efforts to use models to characterise the risk distribution around the baseline forecast".

- Whilst the IMF has in the past allowed its experts to use a mixture of model based and judgemental approaches for their medium term projections, more recently there have been attempts to impose a greater degree of cross country comparability by moving towards a more model based approach, using the OECD's PF method as a broad guide. This shift was initiated by two reports published by the IMF's Independent Evaluation Office (IEO, 2014). Regarding medium term GDP growth forecasts, the IEO states that "the tendency to overpredict GDP growth (i.e. an optimistic bias), previously found in other studies, exists for several countries in all IMF area departments and regardless of development stage and IMF program participation status". The paper argues that "more attention should be placed on constructing a unified view about medium-term growth potential in major regions and countries to guide desk economists in their forecasts". The main evaluation paper also stressed that the IMF's experts were strongly of the view that "having an estimate of potential output is a critical step in the process of obtaining medium-term forecasts of GDP growth and other variables". Following publication of these reports, the IMF started to move towards the approach used in other international organisations of having centralised processes in place for coordinating the medium-term forecasts of its experts in order to provide a model consistent view of potential output developments.

- The IMF's more coordinated approach was introduced for the first time in Spring 2015 when the results of a new model based approach (which is based on the OECD's Cobb-Douglas method) were published in the World Economic Outlook (IMF, 2015). This was a first attempt to establish a top-down potential output framework for the IMF's experts. It was not intended to be strictly imposed on experts since it is accepted that imposing one specific method (the approach followed by the OECD and the EU) is much more difficult for the IMF to do given its much larger, and more economically heterogeneous, country membership. The current situation is that the centralised method for calculating potential output is still only used as guidance for experts[11]. Since this common modelling approach is not imposed, currently IMF teams use a combination of filters and production function models to calculate potential growth rates up to T+5. The IMF experts are then expected to close the output gap over the course of the total forecast horizon (i.e. by T+5). Again, however, this output gap closure rule in T+5 is not applied strictly – the experts are allowed to use their judgement with respect to the closure path (teams can use discretion to assume a slower or faster closure) and an output gap close to zero in T+5 would be acceptable (i.e. within +/-0.5 percent of GDP growth). However, if the output gap is very different from zero, the expert would be expected to provide a justification.

[11] If a similar approach was adopted in the EU (i.e. the results of the PF method would no longer be imposed on ECFIN's experts but would simply be used as guidance for their judgemental projections), given the equal treatment principle underlying the EU's common methodology, would additional rules / principles have to be agreed to restrain the extent to which ECFIN's experts could deviate from the path implied by the PF's potential output path (i.e. when judging the impact of structural reforms) or from the commonly agreed output gap closure rules when assessing the likely demand side developments over the medium term ? In addition, would this degree of discretion be accorded to all EU countries or could it only be justified in exceptional circumstances?

4. COMPARISON OF THE RESULTS OF EU COMMISSION VERSUS MEMBER STATE (SCP) FORECASTING METHODOLOGIES, BASED ON THE AVAILABLE EMPIRICAL EVIDENCE

This section examines the empirical evidence with respect to the performance of different forecasting approaches. It does this on the basis of an analysis carried out to evaluate the properties (accuracy; biasedness; volatility) of the EU Commission's T to T+3 actual GDP growth forecasts (with the T+2 and T+3 Commission forecasts based on the EU's commonly agreed non-judgemental forecasting approach), compared with the equivalent T to T+3 forecasts from the Member States' SCP's. More specifically, this section tries to answer the following three questions:

- Firstly, what is the relative accuracy and degree of biasedness of the Commission's actual GDP growth forecasts compared with those in the SCP updates? (section 4.1);

- Secondly, since the ultimate objective of carrying out these Commission and SCP forecasts is to enhance the EU's fiscal surveillance process, sub-section 4.2 looks at the forecast bias issue and the knock-on effects of the bias on the output gap and structural balance forecasts used in the various fiscal surveillance exercises linked to the European Semester process;

- Finally, sub-section 4.3 examines the question as to whether there are any stability gains from extending judgemental forecasts beyond the short run to also cover the medium term.

4.1 ACCURACY OF THE MEDIUM TERM GROWTH FORECASTS

How does the accuracy of the Commission's medium term actual GDP growth forecasts (produced with the EU's non-judgemental common methodology) compare with those produced by the Member States in their SCP's? Using the Spring 2016 actual GDP growth outturns, for the years 2011-2016[12], as the reference, table 4.1 compares the actual GDP growth forecasts from three vintages of the Commission's Spring forecasts (Spring 2011, Spring 2012 and Spring 2013), with the broadly equivalent forecasts from the Member States submitted to the Commission as part of their SCP updates[13]. Using such a limited number of vintages is clearly an important caveat to bear in mind in interpreting the results. Since we base our comparison exercise on the Commission's (COM) Spring forecast, the following notation applies in Table 4.1: the current year (T) is the first year for the forecast; the (two-year) short term forecast covers the years T and T+1; and the four year forecast covers the years T to T+3. Remember that the short term forecast is expert based and created by the Commission's experts, whilst the medium term forecast (T+2 and T+3) is judgement-free model based.

12 Spring 2016 was available when the research for this note was first produced. Data on actual GDP up until 2015 come from Eurostat. For the Spring 2013 vintage, the Commission's Spring 2017 forecasts were used for the actual GDP outturn for 2016, which were added at a later stage.

13 Please note that there can be some differences between the timing of the Commission's Spring forecasts (with the 2011, 2012 and 2013 forecasts always published in the first two weeks of May) and the submission periods for the SCP's (the 2011 vintage of SCP's were submitted between March 2011 and July 2011; for the 2012 vintage, all the SCP's were submitted in April 2012; for the 2013 vintage, the SCP's were submitted over the period April to May 2013). Please also note that our analysis of the SCP forecasts could not go back before 2011 because firstly there are very large gaps in the SCP database (including the fact that due to a change to the procedure, no SCP's were submitted in the year 2010) and secondly the fact that the submission periods were focussed more on the end of the year, rather than the Spring period generally applied to the vintages from 2011 onwards.

Table 4.1: **Accuracy of Non-Judgemental vs Judgemental Medium Term (T+2 and T+3) Actual GDP growth Forecasts (2011, 2012 and 2013 Forecast Vintages vs Actual Outturns) (EU Weighted Average)**

Actual GDP Growth rates		Spring 2011 Vintage					Spring 2012 Vintage					Spring 2013 Vintage*				
		SCP's	COM	Actual Outturn (Spring 2016)	SCP's minus Outturn	COM minus Outturn	SCP's	COM	Actual Outturn (Spring 2016)	SCP's minus Outturn	COM minus Outturn	SCP's	COM	Actual Outturn (Spring 2016)	SCP's minus Outturn	COM minus Outturn
EU weighted Avg	t	2.0	1.9	2.0	0.0	0.0	0.3	0.1	-0.2	0.5	0.4	0.1	0.0	0.4	-0.3	-0.4
EU weighted Avg	t+1	2.3	2.0	-0.3	2.6	2.4	1.6	1.3	0.4	1.2	1.0	1.5	1.4	1.4	0.1	0.0
EU weighted Avg	t+2	2.6	2.2	0.3	2.3	1.8	2.0	1.8	1.4	0.6	0.4	1.9	1.8	2.0	-0.1	-0.2
EU weighted Avg	t+3	2.6	2.4	1.7	0.9	0.6	2.2	1.9	2.0	0.2	-0.1	2.0	1.8	1.9	0.1	-0.1
EU weighted Avg	Avg t t+1	2.1	2.0	0.8	1.3	1.2	0.9	0.7	0.1	0.8	0.7	0.8	0.7	0.9	-0.1	-0.2
EU weighted Avg	Avg t+2 t+3	2.6	2.3	1.0	1.6	1.2	2.1	1.9	1.7	0.4	0.1	2.0	1.8	2.0	0.0	-0.2
EU weighted Avg	Avg t t+3	2.4	2.1	0.9	1.5	1.2	1.5	1.3	0.9	0.6	0.4	1.4	1.3	1.4	0.0	-0.2
Option A: Commonly Agreed Production Function																
Option A Weighted Avg	t	2.4	2.4	2.9	-0.6	-0.6	0.5	0.4	0.1	0.4	0.3	0.3	0.2	0.4	-0.1	-0.2
Option A Weighted Avg	t+1	2.1	2.1	0.3	1.9	1.8	1.7	1.5	0.4	1.3	1.1	1.5	1.5	1.1	0.4	0.4
Option A Weighted Avg	t+2	2.9	1.7	0.6	2.2	1.1	1.9	1.7	1.1	0.8	0.6	1.8	1.9	1.8	0.0	0.0
Option A Weighted Avg	t+3	2.6	1.8	1.7	0.9	0.1	1.9	1.7	1.8	0.1	-0.2	1.8	1.7	1.9	0.0	-0.2
Option A Weighted Avg	Avg t t+1	2.2	2.2	1.6	0.6	0.6	1.1	1.0	0.3	0.9	0.7	0.9	0.9	0.8	0.2	0.1
Option A Weighted Avg	Avg t+2 t+3	2.7	1.8	1.2	1.6	0.6	1.9	1.7	1.5	0.5	0.2	1.8	1.8	1.8	0.0	-0.1
Option A Weighted Avg	Avg t t+3	2.5	2.0	1.4	1.1	0.6	1.5	1.3	0.9	0.7	0.5	1.4	1.3	1.3	0.1	0.0
Option B: Mainly Judgemental																
Option B Weighted Avg	t	1.5	1.0	-0.4	1.9	1.5	-1.3	-1.4	-2.2	0.9	0.8	-1.0	-1.1	-1.3	0.3	0.1
Option B Weighted Avg	t+1	2.2	1.6	-2.0	4.2	3.6	0.5	0.1	-1.3	1.8	1.4	0.7	1.0	1.4	-0.7	-0.3
Option B Weighted Avg	t+2	2.4	1.9	-1.3	3.7	3.2	1.6	1.5	1.4	0.2	0.1	1.1	0.9	2.7	-1.5	-1.7
Option B Weighted Avg	t+3	2.5	2.3	1.4	1.0	0.8	2.0	1.9	2.7	-0.7	-0.7	1.6	1.5	2.7	-1.1	-1.2
Option B Weighted Avg	Avg t t+1	1.8	1.3	-1.2	3.0	2.5	-0.4	-0.6	-1.8	1.4	1.1	-0.1	0.0	0.0	-0.2	-0.1
Option B Weighted Avg	Avg t+2 t+3	2.4	2.1	0.1	2.4	2.0	1.8	1.7	2.0	-0.2	-0.3	1.4	1.2	2.7	-1.3	-1.4
Option B Weighted Avg	Avg t t+3	2.1	1.7	-0.6	2.7	2.3	0.7	0.5	0.1	0.6	0.4	0.6	0.6	1.4	-0.7	-0.8
Option C: Hybrid Methods																
Option C Weighted Avg	t	1.7	1.6	1.5	0.2	0.2	0.3	0.1	-0.2	0.5	0.3	0.1	0.0	0.8	-0.6	-0.7
Option C Weighted Avg	t+1	2.4	2.1	-0.4	2.8	2.5	1.6	1.4	0.8	0.8	0.7	1.7	1.5	1.8	-0.1	-0.4
Option C Weighted Avg	t+2	2.6	2.3	0.7	1.9	1.7	2.2	2.0	1.8	0.4	0.2	2.2	1.9	2.1	0.1	-0.2
Option C Weighted Avg	t+3	2.7	2.5	1.8	0.9	0.7	2.5	2.2	2.1	0.4	0.2	2.4	2.1	1.7	0.7	0.3
Option C Weighted Avg	Avg t t+1	2.1	1.9	0.6	1.5	1.3	1.0	0.8	0.3	0.7	0.5	0.9	0.7	1.3	-0.4	-0.6
Option C Weighted Avg	Avg t+2 t+3	2.6	2.4	1.2	1.4	1.2	2.4	2.1	2.0	0.4	0.2	2.3	2.0	1.9	0.4	0.1
Option C Weighted Avg	Avg t t+3	2.4	2.2	0.9	1.5	1.3	1.7	1.4	1.1	0.5	0.3	1.6	1.4	1.6	0.0	-0.2

Note: All Short Term forecasts (T and T+1) in table are based on judgemental forecasting methods. Descriptions of options A, B & C are provided in the earlier Table 2.1. The "vintages" referred to in the Table refer to the Commission's Spring forecasts from the years 2011, 2012 & 2013 respectively.

Note: Data is collected on actual GDP growth rates for individual countries. Using nominal GDP levels, the growth rates can be weighted and an average can be calculated. The averages are done on a "like for like" basis –i.e. if a country is not available for a specific year in a vintage, it is not included in the weighted average for that specific year; if it is available for other years, it is included in the weighted average calculation. This "like for like" rule means that particular caution is needed in interpreting the weighted averages for Vintage 2011, since SCP data for some years for Germany, France, the Netherlands and Portugal are missing due to gaps in the SCP database. This is less of a problem for the other two vintages where only Greece is missing from the SCP database. Croatia only joined the EU on 1 July 2013 and consequently is excluded from the analysis. Similarly, the weighted average for each option is based on the individual member state data of those member states having stated that they follow option A, B or C (see table 2.1 for explanation of the options).

* For vintage 2013, the outturn for 2016 (i.e. t+3) is taken from the Commission's final Spring 2017 forecasts. This part of the table had been left blank for the June 2016 note to the OGWG since the outturn for 2016 wasn't available at that time. Note also that t = 2013; t+1=2014; t+2=2015; and t+3=2016.

In terms of forecasting methods, both the Commission and the Member States unanimously agree that the best approach over the short term (t, t+1) is to use an essentially judgement driven forecasting approach. This degree of unanimity is however absent over the medium term (t+2, t+3) where the Commission and 1/3 of the Member States use the non-judgemental, commonly agreed, PF methodology to produce a medium term actual GDP growth projection, with the remaining 2/3 of the Member States using a wide variety of judgement dominated forecasting methods.

Table 4.1 provides an overview of the accuracy of the Commission and SCP short and medium term forecasts by focusing only on the weighted average for the EU as a whole (the detailed country-by-country results are given in Annex 8.1). The main conclusions to be drawn from Table 4.1 are as follows:

- Firstly, regarding the accuracy of judgemental forecasts over the short run (i.e. t and t+1), the accuracy level of the Commission's short run judgemental forecasts for the EU as a whole for actual GDP growth is broadly equal to that of the Member States, with in fact the Commission having slightly more accurate results over the three vintages analysed. This overall conclusion also applies to the three country groupings shown in the table (these groupings are taken from the earlier table, with the breakdown of the 28 countries based on the responses received from the Member States to the Survey launched by the EPC secretariat). As noted earlier, for the years t and t+1, there are no differences in the forecasting methodologies used by the 28 countries and the Commission - all use expert driven judgemental approaches.

- Secondly, regarding the medium term forecasts, here there are significant differences in the forecasting methodologies used by the three country groupings. The option A countries use a non-judgemental approach (similar to the 100% rules based EU approach); option B countries would describe their forecasting methods as mainly judgemental; whilst option C countries use medium term forecasting methods which are "model-assisted but judgement dominated". The key results are as follows:

    1. The Commission's medium term forecasts (based on the EU's commonly agreed methodology) outperform those of all of the EU's Member States combined in both the 2011 and 2012 vintages, whilst the Member States do slightly better for the 2013 vintage.

    2. Relative to all three of the individual groupings of Member States (i.e. options A, B and C), again the Commission did better for the 2011 and 2012 vintages, and slightly worse for the 2013 vintage.

    3. The breakdown of the Member States's results into options A, B and C unfortunately does not yield very much in terms of analytical insights. Firstly, it is difficult to explain the relatively large degree of differences between the results for the 3 options. Secondly, it is surprising to see the extent of the differences between the Commission results and those for option A countries (which also apply the EU's agreed model based approach) - one would have expected to witness a greater degree of convergence in terms of forecast accuracy but this is not the case. Given the difficulties in trying to explain these differences across the A, B and C country categories, the rest of the paper will confine itself to comparing the Commission forecasts with the SCP forecasts for all of the Member States combined. This latter approach is also justified given that the Commission and SCP forecasts are not completely independent exercises since the Member States SCP forecasts are expected to be compared with the most recently available Commission forecasts.

4. Finally, concerning the issue of biasedness, table 4.2 shows that the bias introduced from the year t forecasts, both for the Commission and for all of the SCP's combined, is relatively small and consequently there is no real debate for most countries as to whether to include year t actual GDP growth forecasts in the potential growth calculations (this conclusion applies also to the derived output gap and structural balance calculations). Current year forecasts appear to contain some useful information for the calculation of output gaps and since those forecasts are close to being unbiased, they are generally not problematic to use in the PF method. However, this is clearly not the case with t+1 forecasts which introduce a significant and systematic optimistic bias[14] in the case of both the Commission and SCP forecasts. As will be discussed later in section 4.2, this short run forecast bias issue not only has implications for medium term actual GDP growth forecasts but also, more importantly, it already introduces a significant bias into the short run output gap and structural balance calculations.

In the literature on evaluating the performance of different expert driven judgemental forecasting methods, a well-established result is the loss of accuracy in the forecast beyond the first few quarters. Consequently, in addition to evaluating the bias in the forecast over a medium term horizon, it is important to first look at differences in the forecast accuracy between the first and second year of the forecasts (i.e. t and t+1). For these *short run forecast periods*, it should be stressed again that there are no differences in the forecasting methodologies used by the 28 Member States and the Commission – all the forecasts can be characterised as expert driven judgemental approaches which are strongly based on using large information sets, including also survey indicators.

The results shown in table 4.2 / graph 4.1 confirm the general conclusion from the literature on forecast comparison exercises that the accuracy of judgmental forecasts deteriorates rapidly beyond the first year. For year T, one can see that the Commission and Member State forecasts for the current year are generally very accurate and very importantly do not show any bias across vintages - averaged across the three vintages, the forecast bias is essentially zero for both the Commission and the Member States. However, the picture for T+1 is very different with significant, persistent, forecast errors. Averaged across the three vintages, there is a large optimistic growth rate bias of over 1% point for the Commission's forecasts (+1.1% points) and of about 1 ¼% points for the Member States SCP forecasts (+1.3% points)[15].

[14] Please note that this optimistic bias in the forecasts (which is essentially due to the fact that expert judgement driven forecasts invariably never forecast downturns / recessions – this tendency applies not only to short term forecasts but also over medium term time horizons) is different from the end point bias issue attached to the use of statistical filtering techniques, especially the end point bias problem with the HP filter. There are very little end point bias issues with the KF method. Consequently, with the method's smoothing properties, the optimistic bias in the t+1 forecasts ends up as an optimistic bias in the potential growth calculations.

[15] This is similar to the results from a paper by Pain et al. (2014) which analysed OECD forecasts for GDP growth rates over the period 2007-2012 and found that the "average over prediction for OECD countries for the current year was only 0,15 percentage points, whereas for the one-year-ahead forecast it was 1,5 percentage points, i.e. ten times greater".

Table 4.2: **Accuracy of Commission's and SCP's Judgemental Short Term Forecasts (2011, 2012 and 2013 Actual Growth Rate Forecast Vintages vs Actual Spring 2016 Outturns) and Average Forecast Bias in T and T+1 (EU, Weighted Average)**

Real GDP Growth Forecast Errors (Actual minus Vintage)		Vintage Spring 2011	Vintage Spring 2012	Vintage Spring 2013	Average Bias for 3 Vintages
EU Commission	Year T Forecasts	0.0	0.4	-0.4	0.0
	Year T+1 Forecasts	2.4	1.0	0.0	1.1
Stability and Convergence Programme	Year T Forecasts	0.0	0.5	-0.3	0.1
	Year T+1 Forecasts	2.6	1.2	0.1	1.3

Note: Individual countries GDP growth rates are weighted using nominal GDP levels for the vintages and for the outturn and the forecast error is calculated as the difference between these EU growth rates.

Graph 4.1: **Average Forecast Bias for Year T and T+1, Actual GDP growth, Forecasts (Commission vs SCP's) (2011, 2012, and 2013 Spring Forecast Vintages)**

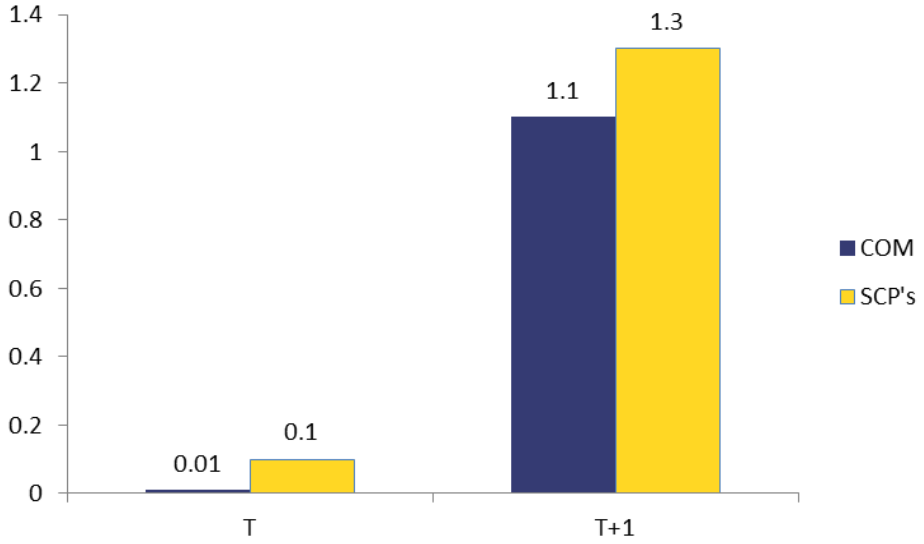


Table 4.3 / graph 4.2 then go on to show the forecast accuracy and biasedness of the Commission's and the Member State SCP forecasts over the short term as a whole (i.e. T plus T+1) and the *medium term* (i.e. T+2 and T+3) *forecasting horizon*. These combined short and medium term results confirm that the significant positive growth rate bias shown earlier in the 2nd year of the short run forecasts persists beyond the short run. On average across all 3 vintages there remains an optimistic bias over the medium term for both the Commission's forecasts (+0.4) and the Member State forecasts (+0.7). The bias persists either as an upward bias in the growth rate, or as an upward bias in the level of GDP[16]. These results suggest that the Commission's strictly model based (non-judgemental) medium term projections do significantly better compared with the combined performance of the SCP projections (which includes both judgemental and non-judgemental methods), with the Commission's average forecast bias being only about half that of the SCP's.

In addition, it should be stressed that the relative performance of the EU's, model based, medium term projections could possibly be further improved by the EU's member states agreeing to replace the current, purely mechanical, medium term output gap closure rule with a more symmetric time series

[16] The large optimistic bias in the 2011 vintage reflects the very delayed recovery in the EU relative to previous recoveries whilst the opposite situation emerged in the 2013 vintage. Regarding the latter vintage, positive headwinds (oil price drop; Euro devaluation; and the start of quantitative easing) led to net positive GDP growth surprises of about 1 ppt. Since these positive headwinds could not have been foreseen at the time of the Spring 2013 forecasts and since it is not the intention of a no policy change forecast to predict policy changes (QE) or changes in exogenous variables (oil prices; exchange rates), the small forecasting errors for the 2013 vintage should not be interpreted as an absence of a positive bias.

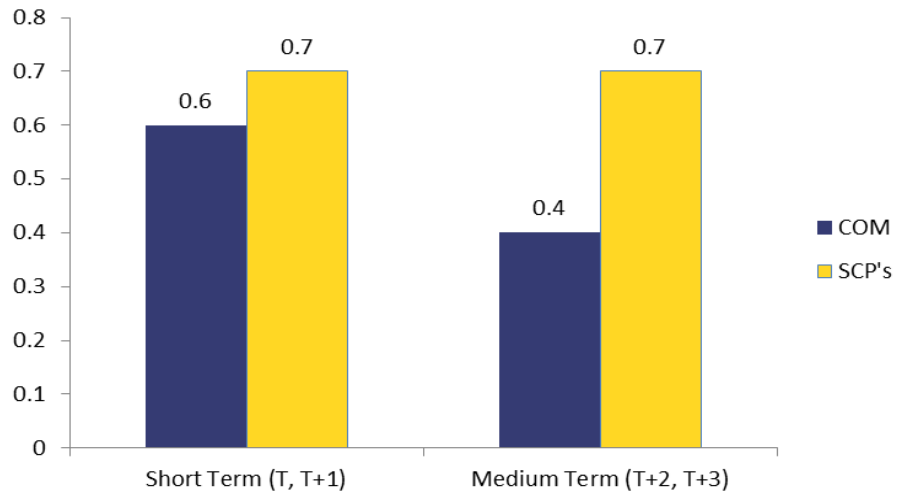
driven output gap projection. This suggested change is currently being examined in the EPC's OGWG.

Table 4.3: **Accuracy of Commission's and SCP's Short and Medium Term, Actual GDP growth, Forecasts (2011, 2012 and 2013 Forecast Vintages vs Actual Spring 2016 Outturns) and Average Forecast Bias (EU, Weighted Average)**

Real GDP Growth Forecast Errors (Actual minus Vintage)		Vintage Spring 2011	Vintage Spring 2012	Vintage Spring 2013	Average Bias for 3 Vintages
EU Commission	Judgemental Short Term Forecasts : Average T, T+1	1.2	0.7	-0.2	0.6
	Non-Judgemental Medium Term Forecasts : Average T+2, T+3	1.2	0.1	-0.2	0.4
Stability and Convergence Programme	Judgemental Short Term Forecasts : Average T, T+1	1.3	0.8	-0.1	0.7
	Judgmental and Non-Judgemental Medium Term Forecasts : Average T+2, T+3	1.6	0.4	0.0	0.7

Note: Individual countries GDP growth rates are weighted using nominal GDP levels for the vintages and for the outturn and the forecast error is calculated as the difference between these EU growth rates.

Graph 4.2: **Average, Actual GDP growth, Forecast Bias for Short (T, T+1) and Medium Term (T+2, T+3) Forecasts (Commission vs SCP's) (2011, 2012, and 2013 Spring Forecast Vintages)**



4.2. FISCAL SURVEILLANCE IMPLICATIONS

In this section we try to estimate the impact of a forecast bias in T+1, T+2 and T+3 on the potential output and output gap estimates in period T. Because of the smoothing properties of standard trend extraction methods, including the EU's production function approach, a bias in the forecast for T+j has consequences for potential growth estimates in period T (and earlier) and this therefore affects the output gap and structural balance estimates in period T.

Planas and Rossi (2016) have theoretically deducted the impact of adding (judgemental) forecasts at the end of the data sample on the estimate of potential growth. They find that the impact depends on

the bias in the forecasts that are added. As described in section 4.1, the forecasts often have a considerable bias, and we can differentiate between four cases (see Graph 4.3):

- Case 1: The growth forecast bias persists beyond T+1 until T+3 :
  - This was the case in the Spring 2011 vintage on SCPs, in which the EU weighted average bias was 2.6% of growth in GDP in T+1, 2.4% in T+2 and 1.3% in T+3[17].

- Case 2: The growth forecast bias gets smaller after T+1 :
  - This was the case in the Spring 2012 vintage on SCPs, in which the EU weighted average bias was 1.2% of growth in GDP in T+1, 0.6% in T+2 and 0.2% in T+3[18].

- Case 3: There is only a forecast bias in T+1 :
  - This is the case in all Commission Forecasts, using the current PF methodology, where only information up to T+1 is used in the potential output calculations. This was for example visible in the Spring 2011 exercise in which the EU weighted forecast bias was 2.4% in T+1[19].

- Case 4: The forecast bias in T+1 will be completely eliminated by T+3 :
  - This bias is purely hypothetical based on the assumption that the T+3 projection would completely offset the T+1 bias in the following two years[20].

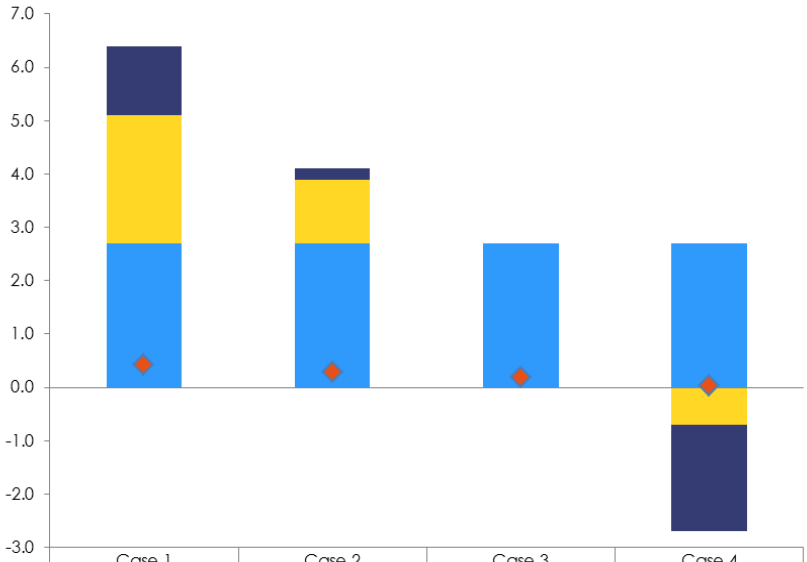
[17] Notice that in the work of Planas and Rossi (2016) the numbers were slightly different since their analysis was based on a preliminary study of the biases. The actual GDP growth rate biases used were 2.7% in T+1, 2.4% in T+2 and 1.3% in T+3.

[18] In order to make the results of Case 2 comparable to Case 1 and to isolate the impact of the profile of the bias over time, the forecasting errors were scaled up in order to have the same forecasting error in T+1 as in Case 1. The actual GDP growth rate biases used were 2.7% in T+1, 1.2% in T+2 and 0.2% in T+3.

[19] In order to make the results of Case 3 comparable to Case 1 and to isolate the impact of the profile of the bias over time, the forecasting errors were scaled up in order to have the same forecasting error in T+1 as in Case 1. The actual GDP growth rate biases used were 2.7% in T+1, 0% in T+2 and 0% in T+3.

[20] In order to make the results of Case 4 comparable to Case 1 and to isolate the impact of the profile of the bias over time, the actual GDP growth rate biases used were 2.7% in T+1, -0.7% in T+2 and -2.0% in T+3.

Graph 4.3: **Bias in actual GDP growth rates and the impact on potential GDP growth rates (4 cases)**



	Case 1	Case 2	Case 3	Case 4
gGDP bias T+3	1.3	0.2	0.0	-2.0
gGDP bias T+2	2.4	1.2	0.0	-0.7
gGDP bias T+1	2.7	2.7	2.7	2.7
gGDP bias T	0.0	0.0	0.0	0.0
gYPOT bias T	0.4	0.3	0.2	0.0

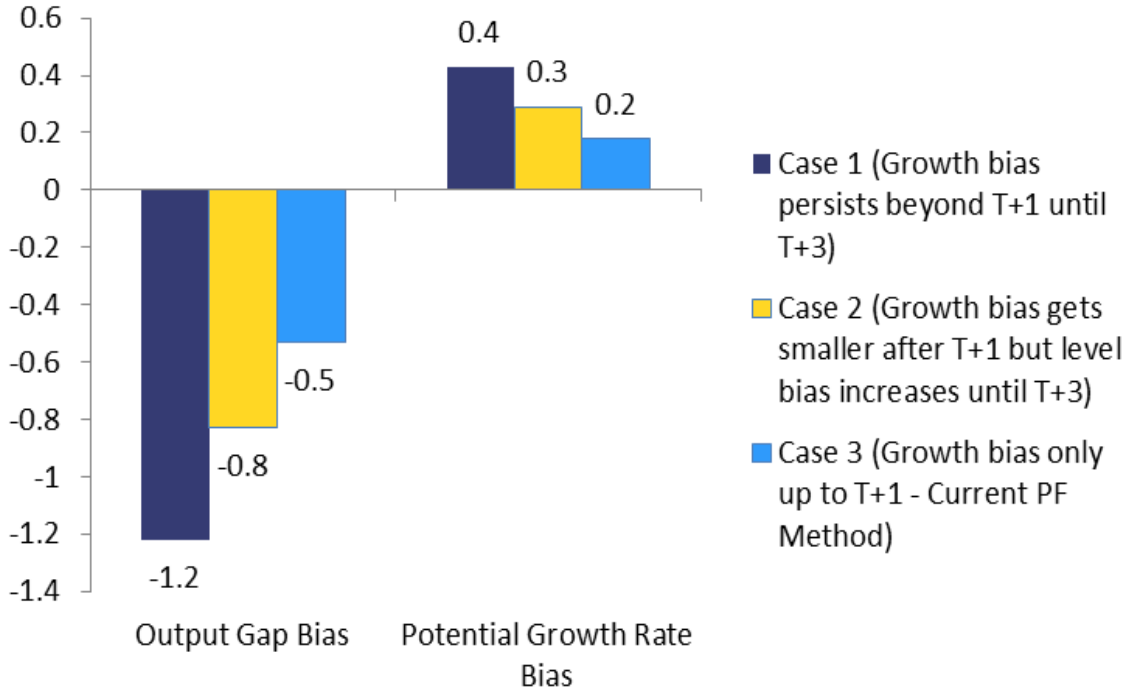
The model used by Planas and Rossi (2016) is realistic in terms of the general time series properties we encounter in trend estimation. Nevertheless the results reported in Table 4.4 / Graph 4.4, which were produced using the example of Italy, are only indicative and may change slightly if this experiment is conducted for country datasets other than Italy. The results are not however too surprising since, for example, they show that the period T potential growth rate bias is largest if the actual growth rate bias in the forecast persists beyond T+1 (i.e. case 1). A persistent actual growth rate bias of the order of magnitude of case 1 (total bias over the three years of 6.4 ppt) biases the potential growth estimate in period T by around 0.4 ppts. The effects of the bias for the output gap / structural balance are even more severe since potential growth is also biased upwards in periods T-j, with the result that the plausibility of the whole exercise would be severely undermined since the output gap bias would be more than twice as high (i.e. 1.2 ppts) compared with the potential growth bias (i.e. 0.4 ppts). The bias for potential growth and the output gap is somewhat smaller if the actual growth rate bias gets significantly smaller (i.e. case 2, total bias of 4.1 ppt). The bias declines further, but is still considerable, in the T+1 case (i.e. case 3, total bias of 2.7 ppt) and it is smallest (but remains positive) if the T+4 projections correct the T+1 bias (i.e. case 4, total bias of 0 ppt).

Table 4.4: **Knock-On effect of actual GDP growth forecast Bias on period T output gap and potential growth estimates**

	Case 1	Case 2	Case 3 (Current PF Method)	Case 4
Output Gap Bias	-1.22	-0.83	-0.53[21]	-0.14
Potential Growth Rate Bias	0.43	0.29	0.18	0.03

[21] This estimate of the output gap bias is similar to that of an analysis from the Bundesbank in 2012 (Kempkes 2012) which looked at real-time output gaps for EU-15 countries over the period 1996-2011 and found an average downward bias of about 0,5 percentage points per year.

Graph 4.4: **Knock-On effect of actual GDP growth forecast Bias on period T Output gap and Potential growth rate estimates**



This analysis shows that a continued forecast bias beyond T+1 has non-negligible consequences for potential growth, output gap and structural balance calculations in period T and increases the bias even in situations where the forecast bias is not increasing after t+1. How representative the bias profile identified from the 2011 and 2012 vintages is, is obviously unclear. However, it may not be unrealistic to assume that because of some mean reversion imposed on medium term GDP growth projections, the growth rate bias in medium term GDP growth projections may not increase over time. Since we allow the bias to be largest in T+1, we are confident that we are not biasing the experiment in favour of the official T+1 methodology. In this regard, table 4.4 / graph 4.4 makes it clear that whilst policy makers would be right to reject changing the PF methodology to include judgemental T+2 and T+3 forecasts (since such a change could result in systematic structural balance errors of the order of 0.6% points – i.e. roughly 50% of the 1.2% output gap bias), nevertheless they should not be complacent about the official T+1 methodology. Whilst only information up to T+1 is currently used in the potential output calculations, the optimistic growth rate bias in T+1 could still be resulting in a structural balance bias of roughly 0.25 percentage points.

4.3. IMPACT OF A LONGER FORECAST HORIZON

This section looks at the impact of a longer forecast horizon on Potential Growth and Output Gap revisions. We investigate whether there are any stability gains from moving to medium term judgemental forecasts, e.g. can they reduce procyclicality and the forecast bias. Several EU member states are concerned that since potential growth tends to be a bit procyclical, it would be important to assess whether a longer judgemental forecast horizon could help in stabilising potential output and therefore also the output gap and structural balance estimates[22]. Various alternative views exist on the

[22] Could longer judgemental forecasts stabilise or reverse an optimistic or pessimistic bias? Alternatively, given that the evidence for mean reversion is weak for most EU countries (unlike the US with its deterministic trend), would longer judgemental forecasts just result in a more persistent bias (i.e. waves of optimism or pessimism), such as for example the persistent positive bias in the run up to the 2008 crisis? In addition, if a forecaster keeps his actual GDP growth rates at a steady rate of 2% for the medium term years, whilst this might arithmetically lead to more stable potential growth rates, it

advantages and disadvantages of a longer forecast horizon on revisions. Regarding the advantages, it can possibly be argued that longer term projections may provide more stability, with beneficial impacts on revisions (this could especially be true in the case of potential output estimates). However, one can also argue that waves of optimism and pessimism may be more pronounced in the case of T+4 projections. A typical example for this latter view would be a comparison of medium term projections made before the 2009 recession and right after 2009. Whilst before the 2009 recession, the medium term projection was likely to be over-optimistic for 4 years instead of 2 years, whilst – in light of the big recession in 2009, the outlook for the following years could have been overly pessimistic. Since it is impossible to come up with clear a priori reasons for differentiating the revision properties of the T+2 vs T+4 approach, an empirical evaluation based on available data vintages seems warranted.

This section looks at this question by comparing the revision properties of output gaps and potential growth rates between the T+2 (non-judgemental) and the T+4 (judgemental) methodologies. In particular, we compare projections made for output gaps in period T for period T, T+1, T+2 and T+3, with output gap estimates made in later periods. In this regard, the rows V, V+1, V+2 and V+3 in tables 4.5 and 4.6 must be read as follows:

- Line V compares the projection made in year T (Vintage T) for year T with the output gap / potential growth estimate made for period T in T+1 (Vintage T+1).

- Line V+1 compares the projection made in T (Vintage T) for T+1 with the output gap / potential growth estimate made for period T+1 in T+1 (Vintage T+1).
- Line V+2 compares the projection made in T (Vintage T) for T+2 with the output gap / potential growth estimate made for period T+2 in T+2 (Vintage T+2).

- Line V+3 compares the projection made in T (Vintage T) for T+3 with the output gap / potential growth estimate made for period T+3 in T+3 (Vintage T+3).

Note in particular, for Vintage T and Vintage T+1, we compare not only the forecast made in period T for T+1 with the nowcast made in T+1 for T+1 but we also compare the estimate for T, made in T+1 with the nowcast made in T for T.

Due to limited data availability, this comparison is only done for the vintages 2011, 2012, 2013, 2014 and 2015. A comparison for three forecasting years can only be made for the first two vintages. For the following years we have to progressively shorten the forecasting horizon such that for vintage 2015 we compare the forecast made for the output gap / potential growth in 2015 for 2015 with the projection made in Spring 2016 for the year 2015.

The following tables show revisions of forecasts for output gaps and potential growth rates for a weighted average of all the EU countries (see Annex 8.2 for the country specific results).

may not necessarily lead to lower output gap revisions. The key question therefore is whether longer judgemental forecasts can add any new information?

Table 4.5: **Output Gap Revisions - EU (weighted Average) T+4 (SCP) vs. T+2 (COM)**

	Vintage 2011		Vintage 2012		Vintage 2013		Vintage 2014		Vintage 2015	
	SCP	COM	SCP	COM	SCP	COM*	SCP	COM	SCP	COM
V	-0.6	-1.1	-0.3	-0.5	-1.3	-0.8	0.0	0.0	-0.3	-0.4
V+1	1.1	0.2	0.9	0.5	-0.2	0.5	0.1	0.1		
V+2	1.6	0.5	1.2	0.6	-0.2	1.1				
V+3	1.8	0.5	1.2	0.6						

* Note: In March 2014 the EPC approved a significant change to the common methodology used for calculating non-cyclical unemployment (i.e. the so-called NAWRU). This change explains the apparent discrepancy between the small change shown for potential growth in Table 4.6, with the large change to the output gap shown in this table. Whilst the potential growth rate effects of this NAWRU change were quite small in the year 2013, the fact that the change led to significant backward revisions to the NAWRU, this resulted in much greater output gap shifts. As an example, the change to the Spanish NAWRU led to a change in Spain's 2013 output gap of over 4 percentage points between the Spring 2013 real time estimate (-4.6%) and the latest Spring 2017 estimate for 2013 (-8.7%).

Table 4.6: **Potential Growth Revisions - EU (weighted Average) T+4 (SCP) vs. T+2 (COM)**

	Vintage 2011		Vintage 2012		Vintage 2013		Vintage 2014		Vintage 2015	
	SCP	COM	SCP	COM	SCP	COM	SCP	COM	SCP	COM
V	0.1	0.0	0.2	0.2	0.3	0.1	0.3	0.0	0.0	0.0
V+1	0.1	-0.1	0.3	0.3	0.4	0.1	0.1	0.0		
V+2	0.2	0.1	0.2	0.2	0.3	0.1				
V+3	0.3	0.3	0.2	0.1						
Absolute average	0.2	0.1	0.2	0.2	0.4	0.1	0.2	0.0	0.0	0.0

As can be seen from Tables 4.5 and 4.6, extending the judgemental forecasting horizon does not improve the revision properties of the output gap or the potential growth rate calculations :

- Concerning output gaps, it appears that for the medium term (V+2 and V+3) the revisions are larger when using the SCP than the Commission. The closing of the output gap was too optimistic in both methods, but still more optimistic in the SCP. Looking at the shorter term forecast, both methods perform equally well (V).

- Concerning potential output projections, the results show that, on average, potential growth forecasts based on both methods have been biased upwards in general, but this is more pronounced for the SCP approach for all vintages, except for 2015, where in both approaches potential growth for 2015 has not been revised based on data available in Spring 2016.

In overall terms, given the limited number of vintages used in this analysis, we have to be careful in drawing definitive conclusions regarding the effects of a longer judgemental forecasting horizon on stabilising the potential growth, output gap and structural balance estimates. Whilst one cannot clearly state that a shorter T+2 time horizon is better than a longer T+4 time horizon, one can be comfortable with the view that there are no stability advantages from moving to T+4, and that such a move could result in even slight disadvantages. If one just focuses on revisions to the output gap and potential growth estimates, on the basis of the evidence presented, a move to T+4 would not lead to an improvement in the stability of either indicator.

5. OVERALL EVALUATION OF THE EU'S, NON-JUDGEMENTAL, MEDIUM TERM FORECASTING METHODOLOGY

Drawing on the earlier insights from the literature survey and the empirical evidence presented, this final section tries to evaluate all of the evidence in order to draw some tentative conclusions regarding the EU's commonly agreed, model based, medium term forecasting approach. From a methodological perspective, the fundamental question to be answered in this section is the following, is it economically prudent for the common PF methodology to include 4 years of judgemental forecasts in calculating a, no policy change, potential output baseline scenario, or is it more sensible to stick with the current approach of only allowing 2 years of judgemental forecasts? In answering this question and, in particular, in evaluating the merits of the EU's non-judgemental medium term forecasting methods, it is important at the outset to stress the specificities of the EU's surveillance framework. As highlighted in the IMF's IEO report in 2014, these "specificities" need to be clearly understood if a balanced evaluation is to take place. In commenting on the EU's approach, the IEO report was very conscious of the necessity of the EU having much more centralised procedures, compared with the level of discretion currently accorded to the IMF's experts. The report in fact offers a convincing justification for the current, rules based, EU surveillance framework : *'In the case of the EC, member countries indeed require homogeneity of forecasting methods because of the preeminent role of cyclically adjusted fiscal balances in the institutional quantitative assessments for these countries. A central unit within the EC coordinates the efforts of the teams producing medium-term forecasts for individual economies, with a view to assuring not only accounting, technical, and statistical consistency, but also analytical and economic consistency*.'

As well as being aware of the above IMF comments, it is clear that there are a number of other important considerations which need to be examined closely in order to reach a balanced judgement with respect to the overall performance of the EU's rules-based forecasting methodology. In the OGWG discussions on the respective merits of medium term judgemental versus non-judgemental forecasting methods, there was a consensus in the working group around four standard criteria for evaluating the EU's rules based medium term forecasting methodology: firstly, consistency with established "best practice" in the economic literature; secondly, an empirical assessment of the degree of bias, if any, in the forecasting approach; thirdly, given the legally binding nature of the EU's fiscal decisions, the importance of any forecasting methodology ensuring transparency and equal treatment for all EU countries; and finally the need to avoid excessive complexity.

Criterion 1: Is the EU's medium term forecasting method consistent with "Best Practice" in the literature and in other international institutions? : A prerequisite for acceptance of a surveillance procedure is consistency with common practice, which is usually based on a broad consensus in the economic literature. As discussed earlier, the current EU approach to medium term forecasts is fully in line with the literature consensus. In addition, all of the international institutions which do medium term projections use a similar model based approach to that of the EU for their medium term forecasting exercises. The only differences between the IMF, OECD and EU approaches are firstly the extent to which a single modelling approach is imposed (where the IMF is finding it difficult to impose one common approach due to much higher levels of country heterogeneity and data issues for developing countries); and secondly, the degree to which they impose a single set of output gap closure rules (where both the OECD and the IMF do give a degree of discretion to their experts with respect to the closure path, whereas the EU's method strictly follows the EPC approved output gap closure rules).

Criterion 2: Does the EU's model based methodology have a general tendency to produce biased (too optimistic or too pessimistic) or unbiased medium term forecasts and would medium term judgemental forecasts lead to an improvement or a deterioration with respect to biasedness ?: An important criterion in evaluating forecasting methods is the degree of bias and persistent errors inflicted by the different methodological approaches. Judgement based methods are subject to a possible (positive) bias. There is evidence for this from the IMF's 2014 evaluation process ("*WEO medium-term forecasts have a tendency to overpredict GDP growth….As in short-term forecasts, the existence of bias in medium-term forecasts of GDP growth seems to be largely a reflection of the inability to predict crises and large recessions*"). This IMF viewpoint is also supported by the empirical research summarised in this paper, which especially finds evidence of a significant upward bias in the second year of the short term forecasts, which persists over the medium term, for both the Commission's own forecasts and from those of the Member States in their annual SCP forecasts. Strictly model based forecasts are also subject to a bias under specific circumstances. For example, if GDP growth and its determinants show a downward trend historically, mean reversion usually implies some upward bias. If the medium term projection is based on a biased short term forecast, then this bias will persist over time.

The extent to which both approaches inflict a bias is an empirical matter, with the current paper showing that the EU's methodology has an optimistic actual GDP growth forecast bias of roughly ½ a % over both the short run and medium term time horizons, compared with an equivalent short and medium term bias of around ¾ of a % point for the SCP forecasts. The implications of these significant actual GDP growth forecast biases on the potential growth and output gap / structural balance calculations depend crucially on understanding that the backward smoothing mechanism in the EU's trend extraction methodology ensures that a bias in the forecast for T+j has consequences for potential growth estimates in period T (and earlier) and this therefore affects the output gap and structural balance estimates in period T. As a result, the longer the period of the forecasts which are permitted to be used in the official PF method, the greater the risk of exacerbating the optimistic bias which currently exists in the PF method. As stressed earlier, since currently the EU's method only allows the Commission's short run forecasts to be taken into account in the potential growth and output gap / structural balance calculations, the final optimistic structural balance bias is of the order of a ¼ of a % point, whereas changing the method to allow medium term forecasts to also to be taken into account in the calculations could result in an optimistic structural balance bias of around 0.6% points. Clearly therefore on the basis of forecast bias considerations, the evidence suggests that the EU should not consider lengthening the time horizon of the Commission forecasts used in the output gap / structural balance calculations.

Criterion 3: How does the EU's medium term approach compare in terms of transparency and equal treatment? : In the context of the EU's fiscal surveillance framework where, unlike the OECD and IMF forecasts, there are crucial, legally binding, decisions taken on the basis of the ECFIN expert forecasts, transparency and equal treatment are an especially important set of evaluation criteria. Purely judgemental methods have a hard time in meeting these two, mutually supportive, criteria, since the criteria / intuition underlying expert judgement cannot be completely revealed by the expert[23]. A purely model based approach comes close to fulfilling the requirements for equal

[23] In the context of medium term projections, there is also the risk that experts would either assume that the economy reverts back to the historic trend (mean reversion) or to a trend estimate based on another source. Pritchett and Summers (2014) stress that "abnormally rapid growth is rarely persistent" since "regression to the mean is the empirically most salient feature of economic growth" and consequently an assumption of reversion to historical growth trends following a period of under- or over-performance appears reasonable (although it should be stressed that unlike the US, the evidence for mean reversion is much less clearcut for many EU countries). Given the empirical evidence, it is not surprising to find that mean reversion is a feature not only of macro models but is also employed by judgement-based forecasters, since there is practically no information about the cyclical development of economies beyond a few quarters. Whilst forecasters need to consider some form of mean reversion or an output gap closure rule to produce their forecasts, the key consideration is whether these choices should be decided by the expert or by a rules based framework ? Experts must assume a gradual return of the economy towards equilibrium which inevitably means having to consider either some form of mean reversion towards the economy's long term potential growth rate (this is a difficult judgement call for experts since projecting either an excessively

treatment and transparency. Although, to some extent, even these methods rely on residual judgement: for example, when it comes to setting variance bounds for the cycle and trend shocks in the context of statistical filters. Nevertheless the criteria for setting priors can be revealed and justified in principle. Also efforts have been made in recent years to increase the level of transparency within the current EU methodology by publishing (on the CIRCABC website) the variance bounds and priors used after each of the Commission's Winter, Spring and Autumn forecasting exercises. The HP filter constitutes the limit case of a methodology which treats each country equally on methodological grounds. However, here the question arises as to whether the underlying assumptions concerning time series properties may not apply to the same extent across countries.

Criterion 4: How does the EU's approach compare in terms of complexity?: Whilst the PF approach seems to do relatively well (compared with judgemental approaches) if assessed on the basis of the three criteria postulated above, it is sometimes argued that the approach has become too complex. This complexity, however, is a reflection of the fact that since the Commission's experts are not allowed to use their judgement to overrule the model projections, a degree of complexity is unavoidable in order to produce credible forecasts. This complexity is also justified given the empirical results presented in the last section which showed that the forecasting performance of the EU's, purely model-based, approach compares reasonably well with the more judgemental approaches used by the Member States in their SCP forecasts. The current degree of complexity is also vindicated by a 2015 analysis of the EU's method, which concluded that, in relative terms, the stability, real-time reliability and financial crisis performance of the EU's PF method was superior to those of the previously used HP filter method, as well as the equivalent OECD and IMF approaches[24]. Finally, in evaluating methods relative to the complexity criterion, one needs to be aware of a trade-off between non- model based judgemental approaches, which score badly in terms of transparency, and model based approaches which can be more transparent but will be much more complex if they require "fully-fledged macroeconomic and fiscal projections". The latter variant would add substantially to the current level of complexity in the estimation process (e.g. in terms of the number of variables to be considered, compared with the current relatively parsimonious specification of the medium term model underpinning the common method). In this context, it is also very important to stress that the EU's common methodology is very different from using a judgement dominated approach based on a fully fledged macreconomic model since although the final forecast from a fully-fledged model may be model consistent, the forecast path is determined by the judgement of the forecaster, not by the model (i.e. the residuals of the model are simply adjusted by the forecaster to produce the path which has already been established in the forecaster's own mind).

rapid or excessively slow return towards trend growth in the last year of the forecast inevitably creates problems in terms of revisions for the outer year in subsequent forecasts) or be guided by an output gap closure rule.

[24] Quarterly Report on the Euro Area (QREA), December 2015.

6. CONCLUDING REMARKS

On the basis of four, OGWG endorsed, evaluation criteria, and bearing in mind the specificities of the EU's policy surveillance procedures, this paper has tried to answer two different, but interlinked, questions – firstly, how do the EU's, medium term, actual GDP growth rate forecasts compare, in terms of accuracy and biasedness, with those of the EU's member states in their equivalent SCP forecasts and secondly should medium term actual GDP growth forecasts be allowed to be included in the potential growth, output gap and structural balance calculations for period T and T+1.

- Regarding the first question, the evidence presented in this paper shows that the EU's forecasts are equally as good, and arguably better, than the results from the SCP forecasts combined. Whilst the Commission's and the SCP forecasts both clearly suffer from a very significant optimistic bias in period T+1 which persists over the medium term, the Commission bias is smaller compared with that of the SCP's over both the short and medium term.

- Regarding the second question, due to the backward smoothing properties of the EU's PF methodology for calculating potential growth rates, and given the persistence of the actual GDP growth forecast bias over the short and medium term, the clear conclusion of this paper is that the EU's methodology should not be changed to include more forecast information in the output gap / structural balance calculations. Since the effectiveness of the EU's fiscal surveillance processes depend strongly on having an unbiased, no policy change, short and medium term potential output baseline upon which prudent fiscal policy decisions can be taken, including information in the PF method which leads to unjustified optimism regarding the current or future supply side health of the EU's economy must be avoided at all costs. Since the first year of the Commission's short run forecasts already suffers from an optimistic bias, one should avoid potentially exacerbating the bias by adding additional forecast years. A prudent approach is warranted in order to limit the risk of procyclicality problems with the output gap / structural balance calculations, especially in the upswing phase of cycles where most of the large fiscal policy errors tend to occur.

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8. ANNEXES

8.1. ACTUAL GROWTH RATE REVISIONS: COMMISSION VERSUS MEMBER STATES (SCP UPDATES)

The tables in this annex show the growth in output (Yg) forecast by the Member States in the framework of the SCP and by ECFIN in their Spring forecast round. This output growth is for each vintage compared to the Spring 2016 forecast which contains the realised output growth[25]. For each vintage the last two columns report the difference between the forecast and the realised value, and thus a smaller (absolute) value shows smaller revisions over time and thus a more correct estimate of the output growth. We look at vintage Spring 2011, for the years t:2011 until t+3:2014, vintage Spring 2012 for the years t:2012 until t+3:2015, and vintage Spring 2013, for the years t:2013 until t+3:2016. Since we are using the Spring forecasts, the t value is also a forecast, and can be considered as the first year forecast. Therefore t+3 is in fact the fourth year forecast (t+4). The next lines give an average for t and t+1, for t+2 and t+3 and then for the whole four year forecast period (t-t+3). This is repeated for all countries.

Although countries show different results some conclusions can be drawn:

- The differences (errors) in actual output growth are much larger as of t+1. For t they are, for most countries and most vintages, relatively small.

- The differences seem to be smaller for most countries for the 2013 vintage than for the two previous vintages. This might be related to the fact that the first year of the oldest vintage is longer ago than that of the last vintage, and as time passes by there is a larger chance for revisions (e.g. because of data revisions and added data points at the end of the sample). In addition, as discussed in footnote 16, the small forecasting errors for the 2013 vintage should not be interpreted as an absence of a positive bias.

- Comparing the Member State and ECFIN forecasts, we can see that the differences are often in the same direction and of the same size. It seems that both the Member States and ECFIN often make the same mistake, although the errors made by ECFIN are often slightly smaller.

[25] Note : For the Spring 2013 vintage, the Commission's Spring 2017 forecasts were used for the actual GDP outturn for 2016.

Yg, like with like		Vintage 2011					Vintage 2012					Vintage 2013				
		MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I	MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I	MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I
AT	t	2.5	2.4	2.8	-0.3	-0.4	0.4	0.8	0.8	-0.4	0.0	1.0	0.6	0.3	0.7	0.3
AT	t+1	2.0	2.0	0.8	1.3	1.2	1.4	1.7	0.3	1.1	1.3	1.8	1.8	0.4	1.4	1.4
AT	t+2	2.1	1.7	0.3	1.7	1.4	2.0	1.6	0.4	1.6	1.3	2.0	1.8	0.9	1.1	1.0
AT	t+3	2.2	1.8	0.4	1.8	1.5	2.2	1.4	0.9	1.3	0.5	1.8	1.4	1.5	0.3	-0.1
AT	Avg t t+1	2.3	2.2	1.8	0.5	0.4	0.9	1.2	0.5	0.4	0.7	1.4	1.2	0.3	1.0	0.8
AT	Avg t+2 t+3	2.1	1.8	0.3	1.8	1.4	2.1	1.5	0.6	1.5	0.9	1.9	1.6	1.2	0.7	0.4
AT	Avg t t+3	2.2	2.0	1.1	1.1	0.9	1.5	1.4	0.6	0.9	0.8	1.6	1.4	0.8	0.9	0.6
BE	t	2.0	2.4	1.8	0.2	0.6	0.1	0.0	0.2	-0.1	-0.2	0.2	0.0	0.0	0.2	0.0
BE	t+1	2.3	2.2	0.2	2.1	2.1	1.3	1.2	0.0	1.3	1.2	1.5	1.2	1.3	0.2	-0.2
BE	t+2	2.1	1.8	0.0	2.1	1.8	1.7	1.5	1.3	0.4	0.1	1.6	1.5	1.4	0.2	0.1
BE	t+3	2.3	1.9	1.3	1.0	0.5	1.8	1.5	1.4	0.4	0.2	1.7	1.6	1.2	0.5	0.3
BE	Avg t t+1	2.2	2.3	1.0	1.2	1.3	0.7	0.6	0.1	0.6	0.5	0.9	0.6	0.7	0.2	-0.1
BE	Avg t+2 t+3	2.2	1.9	0.7	1.5	1.2	1.8	1.5	1.4	0.4	0.1	1.7	1.5	1.3	0.3	0.2
BE	Avg t t+3	2.2	2.1	0.8	1.3	1.2	1.2	1.1	0.7	0.5	0.3	1.3	1.1	1.0	0.3	0.1
BG	t	3.6	2.8	1.6	2.0	1.2	1.4	0.5	0.2	1.2	0.3	1.0	0.9	1.3	-0.3	-0.4
BG	t+1	4.1	3.7	0.2	3.9	3.4	2.5	1.9	1.3	1.2	0.7	1.8	1.7	1.5	0.3	0.1
BG	t+2	4.4	3.1	1.3	3.1	1.8	3.5	2.6	1.5	2.0	1.0	2.9	2.3	3.0	-0.1	-0.6
BG	t+3	4.2	3.3	1.5	2.7	1.7	4.0	2.9	3.0	1.0	-0.1	3.4	2.5	3.4	0.0	-0.9
BG	Avg t t+1	3.9	3.2	0.9	2.9	2.3	2.0	1.2	0.8	1.2	0.5	1.4	1.3	1.4	0.0	-0.1
BG	Avg t+2 t+3	4.3	3.2	1.4	2.9	1.8	3.8	2.7	2.3	1.5	0.5	3.2	2.4	3.2	-0.1	-0.8
BG	Avg t t+3	4.1	3.2	1.2	2.9	2.0	2.9	2.0	1.5	1.3	0.5	2.3	1.8	2.3	0.0	-0.5
CY	t	1.5	1.5	0.4	1.1	1.1	-0.5	-0.8	-2.4	1.9	1.6	-8.7	-8.7	-5.9	-2.8	-2.7
CY	t+1	2.5	2.4	-2.4	4.9	4.8	0.5	0.3	-5.9	6.4	6.3	-3.9	-3.9	-2.5	-1.4	-1.4
CY	t+2	2.7	1.6	-5.9	8.7	7.5	1.0	1.7	-2.5	3.5	4.2	1.2	-0.5	1.6	-0.4	-2.1
CY	t+3	3.0	1.5	-2.5	5.5	4.0	1.5	1.8	1.6	-0.1	0.3	1.9	-0.2	2.8	-0.9	-3.0
CY	Avg t t+1	2.0	1.9	-1.0	3.0	3.0	0.0	-0.2	-4.2	4.2	4.0	-6.3	-6.3	-4.2	-2.1	-2.1
CY	Avg t+2 t+3	2.9	1.5	-4.2	7.1	5.8	1.3	1.7	-0.5	1.7	2.2	1.6	-0.3	2.2	-0.7	-2.5
CY	Avg t t+3	2.4	1.7	-2.6	5.0	4.4	0.6	0.8	-2.3	2.9	3.1	-2.4	-3.3	-1.0	-1.4	-2.3
CZ	t	1.9	2.0	2.0	-0.1	0.0	0.2	0.0	-0.9	1.1	0.9	0.0	-0.4	-0.5	0.5	0.1
CZ	t+1	2.3	2.9	-0.9	3.2	3.8	1.3	1.5	-0.5	1.8	2.1	1.2	1.6	2.0	-0.8	-0.3
CZ	t+2	3.3	2.3	-0.5	3.8	2.8	2.2	2.8	2.0	0.2	0.8	2.1	2.1	4.2	-2.1	-2.1
CZ	t+3	4.0	2.4	2.0	2.0	0.4	2.8	3.0	4.2	-1.4	-1.2	2.6	2.1	2.4	0.2	-0.3
CZ	Avg t t+1	2.1	2.4	0.5	1.6	1.9	0.8	0.8	-0.7	1.5	1.5	0.6	0.6	0.7	-0.1	-0.1
CZ	Avg t+2 t+3	3.7	2.3	0.7	2.9	1.6	2.5	2.9	3.1	-0.6	-0.2	2.4	2.1	3.3	-1.0	-1.2
CZ	Avg t t+3	2.9	2.4	0.6	2.2	1.7	1.6	1.8	1.2	0.4	0.6	1.5	1.4	2.0	-0.5	-0.7
DE	t	2.3	2.6	3.7	-1.4	-1.1	0.7	0.7	0.4	0.3	0.3	0.4	0.4	0.3	0.1	0.1
DE	t+1	1.8	1.9	0.4	1.4	1.5	1.6	1.7	0.3	1.3	1.4	1.6	1.8	1.6	0.0	0.2
DE	t+2						1.6	1.5	1.6	0.0	-0.1	1.4	1.6	1.7	-0.3	-0.1
DE	t+3						1.6	1.3	1.7	-0.1	-0.4	1.4	1.0	1.9	-0.5	-0.9
DE	Avg t t+1	2.1	2.3	2.0	0.0	0.2	1.2	1.2	0.4	0.8	0.8	1.0	1.1	0.9	0.1	0.2
DE	Avg t+2 t+3						1.6	1.4	1.6	0.0	-0.3	1.4	1.3	1.8	-0.4	-0.5
DE	Avg t t+3	2.1	2.3	2.0	0.0	0.2	1.4	1.3	1.0	0.4	0.3	1.2	1.2	1.4	-0.2	-0.2
DK	t	1.8	1.7	1.2	0.6	0.6	1.2	1.1	-0.1	1.3	1.2	0.7	0.7	-0.2	0.9	1.0
DK	t+1	1.8	1.5	-0.1	1.9	1.6	1.5	1.4	-0.2	1.7	1.6	1.6	1.7	1.3	0.3	0.4
DK	t+2	2.1	1.6	-0.2	2.3	1.8	1.8	1.2	1.3	0.5	0.0	1.7	2.8	1.2	0.5	1.6
DK	t+3	1.8	1.7	1.3	0.5	0.5	2.2	1.4	1.2	1.1	0.2	2.4	3.1	1.3	1.1	1.8
DK	Avg t t+1	1.8	1.6	0.5	1.3	1.1	1.4	1.3	-0.2	1.5	1.4	1.2	1.2	0.5	0.6	0.7
DK	Avg t+2 t+3	2.0	1.7	0.5	1.4	1.1	2.0	1.3	1.2	0.8	0.1	2.1	2.9	1.2	0.8	1.7
DK	Avg t t+3	1.9	1.6	0.5	1.4	1.1	1.7	1.3	0.5	1.1	0.8	1.6	2.1	0.9	0.7	1.2
EE	t	4.0	4.9	7.6	-3.6	-2.7	1.7	1.6	5.2	-3.5	-3.6	3.0	3.0	1.6	1.4	1.5
EE	t+1	4.0	4.0	5.2	-1.2	-1.2	3.0	3.8	1.6	1.4	2.2	3.6	4.0	2.9	0.7	1.1
EE	t+2	3.6	2.0	1.6	2.0	0.4	3.4	2.8	2.9	0.5	-0.1	3.5	3.0	1.1	2.4	1.9
EE	t+3	3.6	2.2	2.9	0.7	-0.8	3.5	2.8	1.1	2.4	1.7	3.5	2.6	1.6	1.9	1.0
EE	Avg t t+1	4.0	4.4	6.4	-2.4	-2.0	2.4	2.7	3.4	-1.0	-0.7	3.3	3.5	2.2	1.1	1.3
EE	Avg t+2 t+3	3.6	2.1	2.2	1.4	-0.2	3.5	2.8	2.0	1.5	0.8	3.5	2.8	1.3	2.2	1.5
EE	Avg t t+3	3.8	3.2	4.3	-0.5	-1.1	2.9	2.7	2.7	0.2	0.1	3.4	3.2	1.8	1.6	1.4

Yg, like with like		Vintage 2011					Vintage 2012					Vintage 2013				
		MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I	MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I	MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I
EL	t	-3.0	-3.5	-9.1	6.1	5.6										
EL	t+1	1.1	1.1	-7.3	8.4	8.4										
EL	t+2	2.1	1.6	-3.2	5.3	4.8										
EL	t+3	2.1	1.9	0.7	1.4	1.3										
EL	Avg t t+1	-1.0	-1.2	-8.2	7.3	7.0										
EL	Avg t+2 t+3	2.1	1.8	-1.3	3.4	3.0										
EL	Avg t t+3	0.6	0.3	-4.7	5.3	5.0										
ES	t	1.3	0.8	-1.0	2.3	1.8	-1.7	-1.8	-2.6	0.9	0.9	-1.3	-1.5	-1.7	0.4	0.2
ES	t+1	2.3	1.5	-2.6	4.9	4.1	0.2	-0.3	-1.7	1.9	1.3	0.5	0.9	1.4	-0.9	-0.4
ES	t+2	2.4	2.0	-1.7	4.1	3.6	1.4	1.5	1.4	0.0	0.1	0.9	0.3	3.2	-2.3	-2.9
ES	t+3	2.6	2.4	1.4	1.2	1.0	1.8	2.0	3.2	-1.4	-1.2	1.3	0.9	3.2	-1.9	-2.3
ES	Avg t t+1	1.8	1.1	-1.8	3.6	2.9	-0.8	-1.0	-2.1	1.4	1.1	-0.4	-0.3	-0.2	-0.2	-0.1
ES	Avg t+2 t+3	2.5	2.2	-0.2	2.7	2.3	1.6	1.7	2.3	-0.7	-0.6	1.1	0.6	3.2	-2.1	-2.6
ES	Avg t t+3	2.2	1.7	-1.0	3.1	2.6	0.4	0.3	0.1	0.4	0.3	0.4	0.2	1.5	-1.2	-1.4
FI	t	3.6	3.7	2.6	1.0	1.1	0.8	0.8	-1.4	2.2	2.2	0.4	0.3	-0.8	1.2	1.0
FI	t+1	2.7	2.6	-1.4	4.1	4.0	1.5	1.6	-0.8	2.3	2.4	1.6	1.0	-0.7	2.3	1.7
FI	t+2	2.4	2.6	-0.8	3.2	3.3	2.1	1.4	-0.7	2.8	2.1	2.1	1.4	0.5	1.6	0.9
FI	t+3	2.1	2.4	-0.7	2.8	3.1	1.9	1.4	0.5	1.4	0.9	1.7	1.5	1.4	0.3	0.1
FI	Avg t t+1	3.2	3.1	0.6	2.6	2.6	1.2	1.2	-1.1	2.2	2.3	1.0	0.6	-0.7	1.7	1.4
FI	Avg t+2 t+3	2.3	2.5	-0.7	3.0	3.2	2.0	1.4	-0.1	2.1	1.5	1.9	1.4	1.0	0.9	0.5
FI	Avg t t+3	2.7	2.8	-0.1	2.8	2.9	1.6	1.3	-0.6	2.2	1.9	1.5	1.0	0.1	1.3	0.9
FR	t	2.0	1.8	2.1	-0.1	-0.3	0.7	0.5	0.2	0.5	0.3	0.1	-0.1	0.7	-0.6	-0.8
FR	t+1						1.8	1.3	0.7	1.1	0.7	1.2	1.1	0.2	1.0	0.9
FR	t+2						2.0	2.0	0.2	1.8	1.8	2.0	2.3	1.2	0.8	1.1
FR	t+3						2.0	2.0	1.2	0.8	0.8	2.0	2.4	1.2	0.8	1.2
FR	Avg t t+1	2.0	1.8	2.1	-0.1	-0.3	1.2	0.9	0.4	0.8	0.5	0.7	0.5	0.4	0.2	0.1
FR	Avg t+2 t+3						2.0	2.0	0.7	1.3	1.3	2.0	2.3	1.2	0.8	1.2
FR	Avg t t+3	2.0	1.8	2.1	-0.1	-0.3	1.6	1.4	0.5	1.1	0.9	1.3	1.4	0.8	0.5	0.6
HR	t															
HR	t+1															
HR	t+2															
HR	t+3															
HR	Avg t t+1															
HR	Avg t+2 t+3															
HR	Avg t t+3															
HU	t	3.1	2.7	1.8	1.3	1.0	0.1	-0.3	-1.7	1.8	1.4	0.7	0.2	1.9	-1.2	-1.7
HU	t+1	3.0	2.6	-1.7	4.7	4.3	1.6	1.0	1.9	-0.3	-0.9	1.9	1.4	3.7	-1.8	-2.3
HU	t+2	3.2	0.4	1.9	1.3	-1.5	2.5	0.7	3.7	-1.2	-3.0	2.3	1.8	2.9	-0.6	-1.2
HU	t+3	3.3	0.5	3.7	-0.4	-3.1	2.5	0.7	2.9	-0.4	-2.2	2.5	2.0	2.0	0.5	0.0
HU	Avg t t+1	3.1	2.7	0.0	3.0	2.7	0.9	0.4	0.1	0.7	0.3	1.3	0.8	2.8	-1.5	-2.0
HU	Avg t+2 t+3	3.3	0.5	2.8	0.5	-2.3	2.5	0.7	3.3	-0.8	-2.6	2.4	1.9	2.4	0.0	-0.6
HU	Avg t t+3	3.2	1.6	1.4	1.7	0.2	1.7	0.5	1.7	0.0	-1.2	1.9	1.3	2.6	-0.8	-1.3
IE	t	0.8	0.6	2.6	-1.8	-1.9	0.7	0.5	0.2	0.5	0.4	1.3	1.1	1.4	-0.1	-0.4
IE	t+1	2.5	1.9	0.2	2.3	1.8	2.2	1.9	1.4	0.8	0.5	2.4	2.2	5.2	-2.8	-3.0
IE	t+2	3.0	0.7	1.4	1.6	-0.7	3.0	0.4	5.2	-2.2	-4.8	2.8	1.5	7.8	-5.0	-6.3
IE	t+3	3.0	1.6	5.2	-2.2	-3.6	3.0	1.0	7.8	-4.8	-6.8	2.7	2.0	5.2	-2.5	-3.2
IE	Avg t t+1	1.7	1.3	1.4	0.3	-0.1	1.5	1.2	0.8	0.7	0.4	1.9	1.6	3.3	-1.5	-1.7
IE	Avg t+2 t+3	3.0	1.2	3.3	-0.3	-2.2	3.0	0.7	6.5	-3.5	-5.8	2.8	1.8	6.5	-3.8	-4.7
IE	Avg t t+3	2.3	1.2	2.3	0.0	-1.1	2.2	1.0	3.6	-1.4	-2.7	2.3	1.7	4.9	-2.6	-3.2
IT	t	1.1	1.0	0.6	0.5	0.4	-1.2	-1.4	-2.8	1.6	1.4	-1.3	-1.3	-1.7	0.4	0.4
IT	t+1	1.3	1.3	-2.8	4.1	4.1	0.5	0.4	-1.7	2.2	2.2	1.3	0.7	-0.3	1.6	1.1
IT	t+2	1.5	1.3	-1.7	3.3	3.0	1.0	1.0	-0.3	1.3	1.4	1.5	1.3	0.8	0.7	0.5
IT	t+3	1.6	1.3	-0.3	2.0	1.7	1.2	1.2	0.8	0.4	0.5	1.3	1.4	0.9	0.4	0.6
IT	Avg t t+1	1.2	1.1	-1.1	2.3	2.3	-0.4	-0.5	-2.3	1.9	1.8	0.0	-0.3	-1.0	1.0	0.7
IT	Avg t+2 t+3	1.6	1.3	-1.0	2.6	2.4	1.1	1.1	0.2	0.9	0.9	1.4	1.3	0.8	0.6	0.5
IT	Avg t t+3	1.4	1.2	-1.1	2.5	2.3	0.4	0.3	-1.0	1.4	1.4	0.7	0.5	-0.1	0.8	0.6

Yg, like with like		Vintage 2011					Vintage 2012					Vintage 2013				
		MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I	MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I	MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I
LT	t	5.8	5.0	6.0	-0.2	-1.1	2.5	2.4	3.8	-1.3	-1.4	3.0	3.1	3.5	-0.6	-0.4
LT	t+1	4.7	4.7	3.8	0.9	0.9	3.7	3.5	3.5	0.2	0.0	3.4	3.6	3.0	0.4	0.5
LT	t+2	3.7	1.0	3.5	0.2	-2.5	3.7	2.5	3.0	0.7	-0.6	4.3	1.9	1.6	2.7	0.3
LT	t+3	3.4	1.9	3.0	0.4	-1.1	3.4	2.4	1.6	1.8	0.8	4.0	1.9	2.3	1.7	-0.3
LT	Avg t t+1	5.3	4.8	4.9	0.3	-0.1	3.1	3.0	3.7	-0.6	-0.7	3.2	3.3	3.3	-0.1	0.0
LT	Avg t+2 t+3	3.6	1.5	3.3	0.3	-1.8	3.6	2.4	2.3	1.2	0.1	4.1	1.9	1.9	2.2	0.0
LT	Avg t t+3	4.4	3.1	4.1	0.3	-1.0	3.3	2.7	3.0	0.3	-0.3	3.7	2.6	2.6	1.0	0.0
LU	t	3.2	3.4	2.6	0.6	0.9	1.0	1.1	-0.8	1.8	1.9	1.0	0.8	4.3	-3.3	-3.5
LU	t+1	3.5	3.8	-0.8	4.3	4.7	2.1	2.1	4.3	-2.2	-2.2	2.2	1.6	4.1	-1.9	-2.5
LU	t+2	3.7	3.5	4.3	-0.6	-0.8	3.3	1.8	4.1	-0.8	-2.3	1.7	1.5	4.8	-3.1	-3.4
LU	t+3	4.0	3.6	4.1	-0.1	-0.4	4.1	2.0	4.8	-0.7	-2.9	3.4	1.7	4.2	-0.8	-2.5
LU	Avg t t+1	3.4	3.6	0.9	2.5	2.8	1.6	1.6	1.7	-0.2	-0.2	1.6	1.2	4.2	-2.6	-3.0
LU	Avg t+2 t+3	3.9	3.6	4.2	-0.4	-0.6	3.7	1.9	4.5	-0.8	-2.6	2.6	1.6	4.5	-2.0	-2.9
LU	Avg t t+3	3.6	3.6	2.5	1.1	1.1	2.6	1.7	3.1	-0.5	-1.4	2.1	1.4	4.4	-2.3	-3.0
LV	t	3.3	3.3	6.2	-2.9	-2.9	2.0	2.2	4.0	-2.0	-1.8	4.0	3.8	3.0	1.0	0.8
LV	t+1	4.0	4.0	4.0	0.0	0.0	3.7	3.6	3.0	0.7	0.6	4.0	4.1	2.4	1.6	1.8
LV	t+2	4.0	0.9	3.0	1.0	-2.1	4.0	2.4	2.4	1.6	0.0	4.0	2.4	2.7	1.3	-0.3
LV	t+3	4.0	1.7	2.4	1.6	-0.6	4.0	2.6	2.7	1.3	-0.1	4.0	2.6	2.0	2.0	0.6
LV	Avg t t+1	3.7	3.7	5.1	-1.5	-1.4	2.9	2.9	3.5	-0.7	-0.6	4.0	4.0	2.7	1.3	1.3
LV	Avg t+2 t+3	4.0	1.3	2.7	1.3	-1.4	4.0	2.5	2.6	1.4	0.0	4.0	2.5	2.3	1.7	0.1
LV	Avg t t+3	3.8	2.5	3.9	-0.1	-1.4	3.4	2.7	3.0	0.4	-0.3	4.0	3.2	2.5	1.5	0.7
MT	t	2.4	2.0	1.9	0.5	0.1	1.5	1.2	2.8	-1.3	-1.6	1.4	1.4	4.1	-2.7	-2.7
MT	t+1	2.3	2.2	2.8	-0.5	-0.7	2.0	1.9	4.1	-2.1	-2.2	1.6	1.8	3.7	-2.1	-1.9
MT	t+2	2.6	1.6	4.1	-1.5	-2.4	2.0	0.8	3.7	-1.7	-2.9	1.9	1.8	6.3	-4.4	-4.5
MT	t+3	2.8	1.8	3.7	-0.9	-1.9	2.1	0.9	6.3	-4.2	-5.4	1.9	2.2	5.0	-3.1	-2.9
MT	Avg t t+1	2.4	2.1	2.4	0.0	-0.3	1.8	1.6	3.5	-1.7	-1.9	1.5	1.6	3.9	-2.4	-2.3
MT	Avg t+2 t+3	2.7	1.7	3.9	-1.2	-2.2	2.1	0.8	5.0	-3.0	-4.2	1.9	2.0	5.7	-3.8	-3.7
MT	Avg t t+3	2.5	1.9	3.1	-0.6	-1.2	1.9	1.2	4.2	-2.3	-3.0	1.7	1.8	4.8	-3.1	-3.0
NL	t						-0.7	-0.9	-1.1	0.4	0.2	-0.4	-0.8	-0.5	0.1	-0.3
NL	t+1						1.3	0.7	-0.5	1.8	1.2	1.1	0.9	1.0	0.1	-0.1
NL	t+2						1.6	2.5	1.0	0.6	1.5	1.6	1.7	2.0	-0.4	-0.3
NL	t+3						1.6	2.7	2.0	-0.4	0.7	1.6	1.9	2.2	-0.6	-0.3
NL	Avg t t+1						0.3	-0.1	-0.8	1.1	0.7	0.4	0.1	0.3	0.1	-0.2
NL	Avg t+2 t+3						1.6	2.6	1.5	0.1	1.1	1.6	1.8	2.1	-0.5	-0.3
NL	Avg t t+3						1.0	1.3	0.4	0.6	0.9	1.0	0.9	1.2	-0.2	-0.2
PL	t	4.0	4.0	5.0	-1.0	-1.0	2.5	2.7	1.6	0.9	1.2	1.5	1.1	1.3	0.2	-0.2
PL	t+1	4.0	3.7	1.6	2.4	2.1	2.9	2.6	1.3	1.6	1.3	2.5	2.2	3.3	-0.8	-1.1
PL	t+2	3.7	4.3	1.3	2.4	3.0	3.2	3.6	3.3	-0.1	0.3	3.8	3.7	3.6	0.2	0.0
PL	t+3	3.9	4.0	3.3	0.6	0.7	3.8	3.5	3.6	0.2	-0.1	4.3	3.8	2.7	1.6	1.1
PL	Avg t t+1	4.0	3.9	3.3	0.7	0.6	2.7	2.7	1.4	1.3	1.2	2.0	1.7	2.3	-0.3	-0.6
PL	Avg t+2 t+3	3.8	4.1	2.3	1.5	1.9	3.5	3.6	3.5	0.0	0.1	4.1	3.7	3.2	0.9	0.6
PL	Avg t t+3	3.9	4.0	2.8	1.1	1.2	3.1	3.1	2.4	0.7	0.7	3.0	2.7	2.7	0.3	0.0
PT	t						-3.0	-3.3	-4.0	1.0	0.8	-2.3	-2.3	-1.1	-1.2	-1.2
PT	t+1						0.6	0.3	-1.1	1.7	1.4	0.6	0.6	0.9	-0.3	-0.3
PT	t+2						2.0	1.6	0.9	1.1	0.7	1.5	1.6	1.5	0.0	0.1
PT	t+3						2.4	2.1	1.5	0.9	0.6	1.8	2.2	1.4	0.4	0.8
PT	Avg t t+1						-1.2	-1.5	-2.6	1.4	1.1	-0.9	-0.9	-0.1	-0.7	-0.7
PT	Avg t+2 t+3						2.2	1.8	1.2	1.0	0.6	1.7	1.9	1.4	0.2	0.4
PT	Avg t t+3						0.5	0.2	-0.7	1.2	0.9	0.4	0.5	0.7	-0.3	-0.2
RO	t	1.5	1.5	1.1	0.4	0.4	1.7	1.4	0.6	1.1	0.7	1.6	1.6	3.5	-1.9	-1.9
RO	t+1	4.0	3.7	0.6	3.4	3.0	3.1	2.9	3.5	-0.4	-0.7	2.2	2.2	3.0	-0.8	-0.7
RO	t+2	4.5	2.9	3.5	1.0	-0.6	3.6	3.7	3.0	0.6	0.7	2.4	3.6	3.8	-1.4	-0.2
RO	t+3	4.7	2.8	3.0	1.7	-0.1	3.9	3.8	3.8	0.1	0.0	3.0	3.8	4.8	-1.8	-1.0
RO	Avg t t+1	2.8	2.6	0.8	1.9	1.7	2.4	2.1	2.1	0.3	0.0	1.9	1.9	3.2	-1.3	-1.3
RO	Avg t+2 t+3	4.6	2.9	3.2	1.4	-0.4	3.8	3.7	3.4	0.4	0.4	2.7	3.7	4.3	-1.6	-0.6
RO	Avg t t+3	3.7	2.7	2.0	1.6	0.7	3.1	2.9	2.7	0.4	0.2	2.3	2.8	3.8	-1.5	-1.0

Yg, like with like		Vintage 2011					Vintage 2012					Vintage 2013				
		MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I	MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I	MS	ECFIN	2016_I	MS minus 2016_I	ECFIN minus 2016_I
SE	t	4.6	4.2	2.7	1.9	1.5	0.4	0.3	-0.3	0.7	0.6	1.2	1.5	1.2	0.0	0.3
SE	t+1	3.8	2.5	-0.3	4.1	2.8	3.3	2.1	1.2	2.1	0.8	2.2	2.5	2.3	-0.1	0.2
SE	t+2	3.6	1.9	1.2	2.4	0.7	3.7	1.7	2.3	1.4	-0.6	3.6	2.3	4.1	-0.5	-1.8
SE	t+3	2.8	1.7	2.3	0.5	-0.5	3.6	1.7	4.1	-0.5	-2.4	3.9	2.3	3.3	0.6	-1.1
SE	Avg t t+1	4.2	3.3	1.2	3.0	2.2	1.9	1.2	0.5	1.4	0.7	1.7	2.0	1.8	-0.1	0.2
SE	Avg t+2 t+3	3.2	1.8	1.8	1.4	0.1	3.7	1.7	3.2	0.5	-1.5	3.8	2.3	3.7	0.0	-1.4
SE	Avg t t+3	3.7	2.6	1.5	2.2	1.1	2.8	1.4	1.8	0.9	-0.4	2.7	2.1	2.7	0.0	-0.6
SI	t	1.8	1.9	0.6	1.2	1.3	-0.9	-1.4	-2.7	1.8	1.3	-1.9	-2.0	-1.1	-0.8	-0.9
SI	t+1	2.2	2.5	-2.7	4.9	5.2	1.2	0.7	-1.1	2.3	1.7	0.2	-0.1	3.0	-2.8	-3.1
SI	t+2	2.3	3.0	-1.1	3.4	4.1	2.2	2.2	3.0	-0.8	-0.9	1.2	1.4	2.9	-1.7	-1.5
SI	t+3	2.8	3.3	3.0	-0.2	0.2	2.2	2.6	2.9	-0.7	-0.3	1.6	1.7	2.5	-0.9	-0.8
SI	Avg t t+1	2.0	2.2	-1.0	3.0	3.2	0.2	-0.4	-1.9	2.0	1.5	-0.9	-1.0	1.0	-1.8	-2.0
SI	Avg t+2 t+3	2.6	3.1	1.0	1.6	2.1	2.2	2.4	3.0	-0.8	-0.6	1.4	1.6	2.7	-1.3	-1.1
SI	Avg t t+3	2.3	2.7	0.0	2.3	2.7	1.2	1.0	0.5	0.6	0.5	0.3	0.3	1.8	-1.6	-1.6
SK	t	3.4	3.5	2.8	0.6	0.7	1.1	1.8	1.5	-0.4	0.3	1.2	1.0	1.4	-0.2	-0.5
SK	t+1	4.8	4.4	1.5	3.3	2.9	2.7	2.9	1.4	1.3	1.4	2.9	2.8	2.5	0.4	0.3
SK	t+2	4.8	3.0	1.4	3.4	1.6	3.6	2.9	2.5	1.1	0.4	3.3	4.3	3.6	-0.3	0.7
SK	t+3	4.8	3.0	2.5	2.3	0.5	3.7	2.8	3.6	0.1	-0.8	3.6	4.4	3.3	0.3	1.1
SK	Avg t t+1	4.1	4.0	2.2	1.9	1.8	1.9	2.3	1.5	0.4	0.9	2.1	1.9	2.0	0.1	-0.1
SK	Avg t+2 t+3	4.8	3.0	2.0	2.8	1.0	3.7	2.8	3.1	0.6	-0.2	3.5	4.4	3.4	0.0	0.9
SK	Avg t t+3	4.5	3.5	2.1	2.4	1.4	2.8	2.6	2.3	0.5	0.3	2.8	3.1	2.7	0.0	0.4
UK	t	1.8	1.7	2.0	-0.2	-0.3	0.8	0.5	1.2	-0.4	-0.7	0.6	0.6	2.2	-1.6	-1.6
UK	t+1	2.7	2.1	1.2	1.5	0.9	2.0	1.7	2.2	-0.2	-0.4	1.8	1.7	2.9	-1.1	-1.1
UK	t+2	2.9	2.8	2.2	0.7	0.7	2.7	2.3	2.9	-0.2	-0.5	2.3	1.8	2.3	0.0	-0.5
UK	t+3	2.9	3.2	2.9	0.0	0.3	3.0	2.7	2.3	0.7	0.3	2.7	2.1	1.8	0.9	0.3
UK	Avg t t+1	2.3	1.9	1.6	0.7	0.3	1.4	1.1	1.7	-0.3	-0.6	1.2	1.1	2.5	-1.3	-1.4
UK	Avg t+2 t+3	2.9	3.0	2.5	0.4	0.5	2.9	2.5	2.6	0.3	-0.1	2.5	1.9	2.1	0.4	-0.1
UK	Avg t t+3	2.6	2.4	2.0	0.5	0.4	2.1	1.8	2.1	0.0	-0.3	1.9	1.5	2.3	-0.4	-0.8

8.2. POTENTIAL GROWTH AND OUTPUT GAP REVISIONS: COMMISSION VERSUS MEMBER STATES (SCP UPDATES)

The tables in this annex show the revisions in growth in potential output and output gaps between what was forecast by the Member States in the framework of the SCP and by ECFIN in their Spring forecast round and the realised values in Spring 2016 (2015 is the latest year with realised data). The revisions are given for t to t+3, whenever available, and an average of the absolute error for the four years. This is repeated for all countries.

Although countries show different results some conclusions can be drawn:

- The differences in potential output growth are very small and very comparable between ECFIN and the Member States, with those of ECFIN being slightly smaller.

- The revisions in output gaps are larger than those in potential output growth and the errors in those of ECFIN are mostly similar or smaller than the Member States forecasts (the exceptions being Cyprus, Denmark, Hungary and Latvia).

Table 8.1: **Potential GDP growth revisions for vintages 2011 until 2015**

Potential GDP Growth, Revisions		Vintage 2011		Vintage 2012		Vintage 2013		Vintage 2014		Vintage 2015	
		MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN
AT	V	0.4	0.2	-0.2	0.2	0.0	0.0	0.4	0.4	-0.3	-0.1
AT	V+1	0.4	0.3	0.2	0.3	-0.1	0.0	0.4	0.6		
AT	V+2	0.5	0.3	0.0	0.0	0.3	0.5				
AT	V+3	0.3	0.3	0.6	0.5						
AT	Av g ABS V V+3	0.4	0.2	0.2	0.3	0.1	0.2	0.4	0.5	0.3	0.1
BE	V	0.3	0.5	0.4	0.1	-0.1	0.2	0.0	-0.1	0.0	-0.2
BE	V+1	0.4	0.4	0.5	0.2	0.1	0.1	0.0	0.1		
BE	V+2	0.9	0.7	0.4	0.3	0.1	0.1				
BE	V+3	0.8	0.8	0.4	0.2						
BE	Av g ABS V V+3	0.6	0.6	0.4	0.2	0.1	0.1	0.0	0.1	0.0	0.2
BG	V	1.8	1.4	0.6	-0.1	0.3	-0.2	0.1	0.2	-0.8	0.0
BG	V+1	1.2	1.5	0.5	0.0	-0.3	-0.5	0.5	0.4		
BG	V+2	1.4	0.9	0.6	-0.3	0.3	0.0				
BG	V+3	1.3	0.3	1.0	0.2						
BG	Av g ABS V V+3	1.4	1.0	0.7	0.1	0.3	0.2	0.3	0.3	0.8	0.0
CY	V	1.1	1.1	1.8	1.8					1.3	1.3
CY	V+1	1.2	0.9	2.6	3.5						
CY	V+2										
CY	V+3										
CY	Av g ABS V V+3	0.6	0.5	1.1	1.3					1.3	1.3
CZ	V	1.0	0.4	0.4	1.0	0.8	0.1	0.0	0.0	-0.5	-0.5
CZ	V+1	1.1	0.5	0.3	1.0	0.4	-0.3	0.0	-0.1		
CZ	V+2	1.6	1.4	0.8	0.9	0.0	-0.2				
CZ	V+3	2.3	1.0	0.5	0.8						
CZ	Av g ABS V V+3	1.5	0.8	0.5	0.9	0.4	0.2	0.0	0.1	0.5	0.5
DE	V			0.2	0.2	-0.2	-0.1	0.1	0.0	-0.1	-0.2
DE	V+1			0.2	0.3	-0.2	-0.2	0.1	-0.1		
DE	V+2			-0.2	-0.5	-0.3	-0.4				
DE	V+3			-0.1	-0.7						
DE	Av g ABS V V+3			0.2	0.4	0.2	0.2	0.1	0.0	0.1	0.2
DK	V	0.5	0.5	0.3	-0.4	0.5	0.2	0.8	0.3	0.4	0.0
DK	V+1	0.4	0.3	0.0	-0.3	-0.1	0.1	0.2	0.4		
DK	V+2	0.4	0.0	0.2	-0.2	0.1	0.5				
DK	V+3	0.3	0.1	0.6	0.1						
DK	Av g ABS V V+3	0.4	0.2	0.3	0.2	0.2	0.3	0.5	0.3	0.4	0.0
EE	V	-0.3	-1.0	-1.6	-0.4	0.7	1.0	0.5	0.1	-0.6	0.1
EE	V+1	-0.3	-1.0	-1.1	-0.5	1.1	1.4	0.5	0.2		
EE	V+2	-1.2	-1.5	-0.2	-0.2	1.3	0.8				
EE	V+3	-0.3	-0.4	0.5	-0.3						
EE	Av g ABS V V+3	0.5	1.0	0.9	0.3	1.0	1.1	0.5	0.2	0.6	0.1
EL	V										
EL	V+1										
EL	V+2										
EL	V+3										
EL	Av g ABS V V+3										
ES	V	0.6	0.4	-0.4	-0.2	-0.2	-1.0	-0.1	-0.1	0.2	0.1
ES	V+1	1.6	1.1	-0.1	0.2	-0.3	-1.2	-0.4	-0.2		
ES	V+2	1.9	2.2	-0.2	0.5	-0.7	-0.5				
ES	V+3	1.8	1.5	-0.6	0.7						
ES	Av g ABS V V+3	1.5	1.3	0.3	0.4	0.4	0.9	0.3	0.1	0.2	0.1

Potential GDP Growth, Revisions		Vintage 2011		Vintage 2012		Vintage 2013		Vintage 2014		Vintage 2015	
		MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN
FI	V	0.6	0.8	0.3	0.2	0.5	0.5	0.3	0.1	0.2	0.1
FI	V+1	0.6	0.9	0.4	0.4	0.7	0.6	0.4	0.2		
FI	V+2	0.8	1.2	0.9	0.9	1.0	0.7				
FI	V+3	1.1	1.5	0.9	0.8						
FI	Av g ABS V V+3	0.8	1.1	0.6	0.6	0.7	0.6	0.4	0.2	0.2	0.1
FR	V			0.4	0.2	0.0	-0.1	0.5	0.0	0.0	0.2
FR	V+1			0.3	0.3	0.0	-0.1	0.4	0.1		
FR	V+2			0.2	0.0	0.4	0.1				
FR	V+3			0.6	0.1						
FR	Av g ABS V V+3			0.4	0.1	0.1	0.1	0.5	0.1	0.0	0.2
HR	V										
HR	V+1										
HR	V+2										
HR	V+3										
HR	Av g ABS V V+3										
HU	V	1.0	0.3	0.5	0.1	0.0	-0.1	-0.4	-0.5	-0.1	-0.3
HU	V+1	1.5	0.2	0.5	0.0	-0.1	-0.4	-0.6	-0.8		
HU	V+2	1.5	0.2	0.4	-0.9	-0.6	-1.1				
HU	V+3	1.2	-0.3	-0.1	-1.8						
HU	Av g ABS V V+3	1.3	0.2	0.4	0.7	0.2	0.6	0.5	0.7	0.1	0.3
IE	V	-0.5	0.2	0.2	-0.3	-0.1	-0.5	-0.5	-0.8	-1.7	-1.3
IE	V+1	-0.2	0.4	0.5	-0.3	-0.3	-0.2	-0.5	-0.8		
IE	V+2	0.2	0.4	-0.5	-0.4	-0.7	-1.0				
IE	V+3	-0.4	0.0	-1.1	-1.3						
IE	Av g ABS V V+3	0.3	0.2	0.6	0.6	0.4	0.5	0.5	0.8	1.7	1.3
IT	V	0.2	0.4	0.2	0.3	0.4	0.0	0.3	0.4	0.1	0.2
IT	V+1	0.7	0.9	0.0	0.3	0.3	0.1	0.4	0.3		
IT	V+2	0.6	1.0	0.3	0.4	0.4	0.3				
IT	V+3	0.9	0.9	0.5	0.6						
IT	Av g ABS V V+3	0.6	0.8	0.3	0.4	0.4	0.2	0.4	0.3	0.1	0.2
LT	V	0.2	-0.2	-0.1	-0.4	-0.2	-0.2	-0.2	0.6	0.6	0.5
LT	V+1	0.2	0.0	-0.1	0.0	-0.2	-0.6	-0.1	0.7		
LT	V+2	0.0	-1.3	-0.3	-1.1	-0.3	-0.6				
LT	V+3	-0.3	-1.2	-0.4	-1.0						
LT	Av g ABS V V+3	0.2	0.7	0.2	0.7	0.2	0.5	0.2	0.6	0.6	0.5
LU	V	0.7	1.2	0.2	0.1	-0.4	-0.5	-0.3	-0.7	-0.6	-0.8
LU	V+1	0.8	1.3	0.1	0.5	-0.5	-0.3	-0.3	-0.7		
LU	V+2	1.0	2.2	-0.4	-0.1	-0.9	-1.1				
LU	V+3	0.4	1.8	-0.9	-0.7						
LU	Av g ABS V V+3	0.7	1.6	0.4	0.4	0.6	0.6	0.3	0.7	0.6	0.8
LV	V	-0.6	-1.2	-0.2	0.3	0.6	0.1	0.7	0.7	0.3	0.0
LV	V+1	-0.9	-1.6	-0.3	-0.1	0.5	0.7	1.0	0.7		
LV	V+2	-1.2	-1.4	0.3	-0.4	1.3	1.0				
LV	V+3	-0.7	-0.9	1.1	-0.2						
LV	Av g ABS V V+3	0.9	1.3	0.5	0.2	0.8	0.6	0.9	0.7	0.3	0.0
MT	V	0.8	0.7	0.2	-0.3	-0.2	-0.3	-0.9	-1.2	-1.1	-0.8
MT	V+1	0.8	0.8	0.2	-0.2	-0.6	-0.3	-1.4	-1.8		
MT	V+2	1.1	0.3	-0.3	-0.9	-2.0	-1.8				
MT	V+3	0.7	0.1	-1.4	-2.5						
MT	Av g ABS V V+3	0.8	0.5	0.5	1.0	0.9	0.8	1.2	1.5	1.1	0.8

Potential GDP Growth, Revisions		Vintage 2011		Vintage 2012		Vintage 2013		Vintage 2014		Vintage 2015	
		MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN
NL	V			0.2	0.6	0.0	-0.1	-0.1	0.0	0.0	-0.2
NL	V+1			0.5	0.9	0.4	-0.1	-0.4	-0.1		
NL	V+2			0.8	0.7	0.1	0.2				
NL	V+3			0.5	0.7						
NL	Av g ABS V V+3			0.5	0.7	0.2	0.1	0.2	0.0	0.0	0.2
PL	V	0.3	0.4	-0.6	-0.2	0.1	-0.3	0.0	0.0	0.2	0.2
PL	V+1	0.5	0.5	0.0	0.4	-0.1	-0.6	0.1	0.0		
PL	V+2	0.6	0.9	0.1	-0.1	-0.1	-0.6				
PL	V+3	0.7	0.2	0.1	-0.3						
PL	Av g ABS V V+3	0.5	0.5	0.2	0.3	0.1	0.5	0.1	0.0	0.2	0.2
PT	V			1.1	0.1	-0.5	-0.5	0.1	0.3	0.2	-0.3
PT	V+1			1.7	1.0	-0.4	0.0	-0.1	0.1		
PT	V+2			1.0	0.7	-0.2	0.8				
PT	V+3			0.9	1.0						
PT	Av g ABS V V+3			1.2	0.7	0.4	0.4	0.1	0.2	0.2	0.3
RO	V	-0.9	-0.1	0.5	0.5	0.1	0.3	0.4	0.1	-0.4	-0.3
RO	V+1	1.3	-0.3	0.3	0.3	0.3	0.5	-0.1	-0.2		
RO	V+2	2.1	-0.2	0.3	0.5	0.1	0.6				
RO	V+3	2.3	-0.2	0.3	0.2						
RO	Av g ABS V V+3	1.7	0.2	0.4	0.4	0.2	0.5	0.3	0.2	0.4	0.3
SE	V	-2.1	-2.0	0.4	-0.4	0.3	-0.3	0.8	0.5	-0.9	-0.4
SE	V+1	-2.5	-1.7	0.2	-0.2	-0.2	-0.2	0.2	0.3		
SE	V+2	-2.5	-1.8	0.3	-0.7	0.5	0.0				
SE	V+3	-2.3	-2.2	1.0	-0.6						
SE	Av g ABS V V+3	2.4	1.9	0.5	0.5	0.3	0.2	0.5	0.4	0.9	0.4
SI	V	0.7	1.4	1.0	0.9	0.2	-0.4	-0.9	-0.5	0.3	0.1
SI	V+1	1.6	1.2	1.2	1.3	-0.1	-0.4	-1.2	-0.4		
SI	V+2	2.6	2.7	1.0	0.7	-1.4	-0.6				
SI	V+3	2.2	2.0	-0.5	0.3						
SI	Av g ABS V V+3	1.8	1.8	0.9	0.8	0.6	0.4	1.1	0.5	0.3	0.1
SK	V	0.9	0.1	0.0	0.2	0.7	0.5	-0.4	0.1	-0.2	-0.2
SK	V+1	1.8	0.3	0.0	-0.2	1.0	0.8	-0.6	0.0		
SK	V+2	1.3	0.3	0.8	0.1	0.4	0.7				
SK	V+3	1.9	0.7	0.3	-0.1						
SK	Av g ABS V V+3	1.5	0.3	0.3	0.2	0.7	0.7	0.5	0.0	0.2	0.2
UK	V	2.4	1.2	0.4	0.4	0.0	0.0	0.5	-0.2	0.5	0.0
UK	V+1	1.6	0.4	0.5	0.5	0.0	-0.2	0.1	-0.1		
UK	V+2	0.8	0.7	0.4	0.1	0.1	-0.4				
UK	V+3	0.2	0.6	0.3	0.0						
UK	Av g ABS V V+3	1.2	0.7	0.4	0.2	0.0	0.2	0.3	0.1	0.5	0.0

Table 8.2: **Output gap revisions for vintages 2011 until 2015**

Output Gap Revisions		Vintage 2011		Vintage 2012		Vintage 2013		Vintage 2014		Vintage 2015	
		MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN
AT	V	-2.5	-1.1	-0.2	-0.3	0.2	0.2	0.6	0.5	-0.7	-0.3
AT	V+1	-1.3	-0.2	-0.1	0.5	0.5	0.3	1.5	0.9		
AT	V+2	-0.9	0.4	0.5	0.8	2.3	1.3				
AT	V+3	-0.5	0.5	2.2	1.3						
AT	Av g ABS V V+3	1.3	0.5	0.7	0.7	1.0	0.6	1.1	0.7	0.7	0.3
BE	V	-1.5	-0.1	-0.7	-0.4	0.5	-0.2	-0.4	0.3	-0.3	-0.4
BE	V+1	0.3	0.6	-0.1	0.6	0.5	-0.5	0.2	0.7		
BE	V+2	0.6	1.3	0.4	0.2	0.4	0.1				
BE	V+3	1.3	0.8	0.2	0.7						
BE	Av g ABS V V+3	0.9	0.7	0.3	0.5	0.5	0.2	0.3	0.5	0.3	0.4
BG	V	-1.2	-1.2	-1.0	-1.9	-0.1	-0.4	-1.3	-1.4	-0.1	0.0
BG	V+1	0.2	0.4	-0.1	-0.9	-0.3	0.0	-0.6	-0.9		
BG	V+2	1.0	-0.3	0.5	-0.3	-0.4	-0.1				
BG	V+3	1.5	0.5	0.7	0.0						
BG	Av g ABS V V+3	1.0	0.6	0.6	0.8	0.3	0.2	1.0	1.1	0.1	0.0
CY	V	0.0	-0.9	0.0	-1.6					4.1	3.6
CY	V+1	1.4	1.4	0.9	4.1						
CY	V+2										
CY	V+3										
CY	Av g ABS V V+3	0.4	0.6	0.2	1.4					4.1	3.6
CZ	V	-1.5	-1.0	0.1	0.1	-0.3	0.0	-0.6	-0.5	0.0	-0.9
CZ	V+1	-0.5	1.3	1.0	1.1	-1.2	-0.1	-1.3	-0.5		
CZ	V+2	1.1	2.8	0.4	0.9	-2.3	-0.8				
CZ	V+3	0.7	2.1	-0.4	0.1						
CZ	Av g ABS V V+3	1.0	1.8	0.5	0.6	1.3	0.3	1.0	0.5	0.0	0.9
DE	V			-0.9	-0.8	0.2	0.1	-0.1	0.2	-0.4	-0.4
DE	V+1			0.1	0.2	0.2	0.3	0.3	0.4		
DE	V+2			0.3	0.3	0.3	0.7				
DE	V+3			0.4	0.7						
DE	Av g ABS V V+3			0.4	0.5	0.2	0.3	0.2	0.3	0.4	0.4
DK	V	0.3	0.1	0.7	2.2	-0.2	0.2	-0.3	-0.5	-0.5	-0.1
DK	V+1	0.4	0.2	1.3	3.2	0.0	0.3	-0.1	-0.8		
DK	V+2	1.8	3.2	1.4	3.3	-0.1	0.2				
DK	V+3	1.9	3.6	1.1	2.4						
DK	Av g ABS V V+3	1.1	1.8	1.1	2.8	0.1	0.2	0.2	0.6	0.5	0.1
EE	V	-3.0	-1.6	-1.0	-3.2	0.2	-0.1	-0.7	-0.6	-1.3	0.7
EE	V+1	-0.6	1.6	-0.4	-2.0	1.1	0.7	0.5	-0.2		
EE	V+2	-0.3	-4.4	1.1	-1.1	1.0	-0.1				
EE	V+3	1.4	-1.0	1.4	-1.0						
EE	Av g ABS V V+3	1.3	2.1	1.0	1.8	0.8	0.3	0.6	0.4	1.3	0.7
EL	V										
EL	V+1										
EL	V+2										
EL	V+3										
EL	Av g ABS V V+3										
ES	V	1.1	-1.0	2.1	0.2	1.0	3.4	-0.1	-0.3	-0.3	-0.1
ES	V+1	3.5	1.1	3.5	1.0	0.5	4.4	-0.8	-0.9		
ES	V+2	7.1	2.4	4.9	4.3	-0.8	2.3				
ES	V+3	7.8	5.6	4.4	2.6						
ES	Av g ABS V V+3	4.9	2.5	3.7	2.0	0.8	3.4	0.4	0.6	0.3	0.1

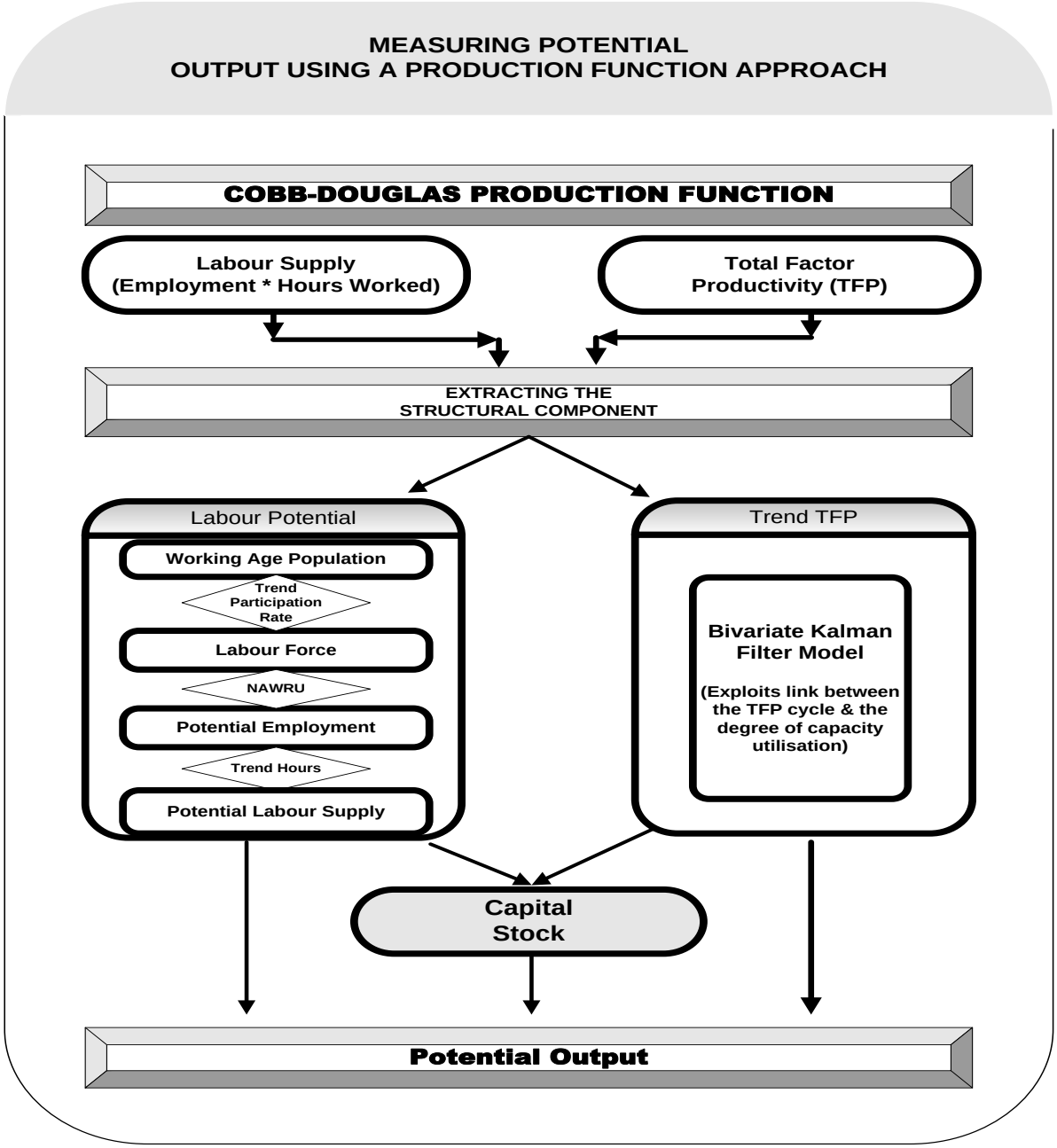
Output Gap Revisions		Vintage 2011		Vintage 2012		Vintage 2013		Vintage 2014		Vintage 2015	
		MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN
FI	V	0.2	-1.4	-1.7	-0.1	0.6	0.5	0.4	0.4	-0.3	-0.4
FI	V+1	1.5	-0.6	-1.0	0.8	0.9	0.7	0.8	0.8		
FI	V+2	0.9	0.4	0.2	1.6	1.9	1.5				
FI	V+3	2.0	1.7	1.2	2.3						
FI	Avg ABS V V+3	1.2	1.0	1.0	1.2	1.1	0.9	0.6	0.6	0.3	0.4
FR	V			-1.7	-0.5	-0.5	-0.6	0.1	-0.5	-0.2	-0.4
FR	V+1			-0.3	0.7	-0.3	-0.5	0.4	-0.2		
FR	V+2			0.0	1.0	0.4	0.1				
FR	V+3			0.5	1.3						
FR	Avg ABS V V+3			0.6	0.9	0.4	0.4	0.3	0.3	0.2	0.4
HR	V										
HR	V+1										
HR	V+2										
HR	V+3										
HR	Avg ABS V V+3										
HU	V	-0.8	0.0	0.4	1.3	0.9	-0.5	-0.8	-1.3	-0.5	0.1
HU	V+1	0.5	2.7	0.7	2.0	0.7	-1.0	-0.8	-1.2		
HU	V+2	1.8	3.9	1.5	0.7	-0.3	-2.3				
HU	V+3	2.6	2.1	0.3	-0.9						
HU	Avg ABS V V+3	1.4	2.2	0.7	1.2	0.6	1.3	0.8	1.3	0.5	0.1
IE	V	-0.4	-0.6	-1.3	0.1	0.8	1.1	0.2	-1.1	-1.3	-0.7
IE	V+1	1.6	0.4	-0.9	1.2	1.4	1.8	-0.7	-1.0		
IE	V+2	1.7	-0.3	1.2	1.4	1.1	-0.4				
IE	V+3	3.8	0.7	1.4	-0.9						
IE	Avg ABS V V+3	1.9	0.5	1.2	0.9	1.1	1.1	0.5	1.0	1.3	0.7
IT	V	0.2	-0.8	0.6	0.2	-0.3	0.3	0.9	0.6	-0.3	-0.6
IT	V+1	1.9	1.0	2.2	1.7	-0.1	0.4	1.1	1.0		
IT	V+2	4.5	2.8	1.9	2.0	1.2	1.3				
IT	V+3	4.2	3.0	2.8	2.7						
IT	Avg ABS V V+3	2.7	1.9	1.9	1.7	0.5	0.7	1.0	0.8	0.3	0.6
LT	V	-0.7	0.4	-0.7	-2.0	0.0	0.9	-2.7	-1.1	-0.4	0.3
LT	V+1	1.2	2.6	0.1	-1.6	0.1	1.7	-0.9	-0.8		
LT	V+2	1.1	-0.1	0.3	-0.4	-0.7	0.4				
LT	V+3	1.3	0.5	-0.2	-0.9						
LT	Avg ABS V V+3	1.1	0.9	0.3	1.2	0.3	1.0	1.8	0.9	0.4	0.3
LU	V	0.2	-0.4	-0.6	-0.4	0.6	0.8	0.1	1.0	0.7	-0.3
LU	V+1	1.9	1.0	0.4	0.3	0.1	0.2	-0.2	1.1		
LU	V+2	3.0	1.1	1.4	0.5	-0.9	0.4				
LU	V+3	4.0	1.2	2.6	0.8						
LU	Avg ABS V V+3	2.3	0.9	1.3	0.5	0.5	0.5	0.2	1.1	0.7	0.3
LV	V	-4.4	-1.0	0.5	-1.9	0.3	0.6	0.1	0.0	0.6	-0.3
LV	V+1	-1.3	2.2	0.5	-2.1	-0.2	0.3	0.8	1.2		
LV	V+2	0.3	-1.2	0.5	-2.4	0.4	-0.5				
LV	V+3	1.2	-1.7	1.2	-1.9						
LV	Avg ABS V V+3	1.8	1.5	0.7	2.1	0.3	0.5	0.5	0.6	0.6	0.3
MT	V	0.0	0.3	0.2	0.1	-0.3	-0.1	-0.3	-0.2	-1.1	-1.1
MT	V+1	0.0	0.5	0.5	0.8	-0.5	-0.3	-0.3	0.2		
MT	V+2	0.3	0.6	0.2	0.1	-0.3	-0.5				
MT	V+3	-0.3	-0.1	0.0	-0.3						
MT	Avg ABS V V+3	0.1	0.3	0.2	0.3	0.4	0.3	0.3	0.2	1.1	1.1

Output Gap Revisions		Vintage 2011		Vintage 2012		Vintage 2013		Vintage 2014		Vintage 2015	
		MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN	MS	ECFIN
NL	V			-0.5	-1.2	0.1	0.0	0.1	0.5	-0.8	-0.7
NL	V+1			0.6	-0.6	0.0	-0.1	-0.2	0.3		
NL	V+2			0.7	0.0	-0.1	0.2				
NL	V+3			0.3	0.7						
NL	Avg ABS V V+3			0.5	0.7	0.1	0.1	0.1	0.4	0.8	0.7
PL	V	-0.8	-1.0	1.4	-0.2	-1.9	-1.2	-0.4	-0.7	-0.3	-0.1
PL	V+1	0.0	-0.6	2.6	0.9	-2.7	-1.6	-0.2	-0.5		
PL	V+2	2.9	1.4	0.5	0.2	-2.6	-1.3				
PL	V+3	0.8	0.7	0.3	0.1						
PL	Avg ABS V V+3	1.1	0.9	1.2	0.4	2.4	1.3	0.3	0.6	0.3	0.1
PT	V			-0.3	-1.1	0.8	1.1	1.1	1.1	-1.4	-0.9
PT	V+1			1.0	0.5	0.6	0.5	1.1	0.8		
PT	V+2			1.6	1.3	1.9	0.8				
PT	V+3			2.7	1.8						
PT	Avg ABS V V+3			1.4	1.2	1.1	0.8	1.1	1.0	1.4	0.9
RO	V	1.6	-1.6	-1.3	-1.6	-1.0	-1.0	0.2	0.1	0.2	0.2
RO	V+1	2.5	0.9	-0.2	-0.7	-1.5	-1.8	-0.2	0.1		
RO	V+2	2.0	0.8	-0.4	-1.0	-2.1	-1.5				
RO	V+3	0.9	0.3	0.3	-0.2						
RO	Avg ABS V V+3	1.8	0.9	0.6	0.9	1.5	1.4	0.2	0.1	0.2	0.2
SE	V	-0.9	-1.1	-0.5	0.3	-0.6	0.4	-0.5	0.0	-0.5	-0.4
SE	V+1	2.0	0.8	1.4	1.0	-0.9	0.4	-0.1	0.1		
SE	V+2	3.4	1.5	1.5	1.1	-0.9	0.1				
SE	V+3	2.5	1.4	1.0	0.8						
SE	Avg ABS V V+3	2.2	1.2	1.1	0.8	0.8	0.3	0.3	0.1	0.5	0.4
SI	V	0.4	-1.8	-0.6	-1.7	-1.3	-0.6	0.0	0.3	0.0	-0.8
SI	V+1	1.8	0.7	1.2	-0.4	-1.6	-1.0	-0.4	-0.3		
SI	V+2	2.8	1.2	0.5	-0.3	-1.3	-1.0				
SI	V+3	1.4	1.2	0.8	-0.1						
SI	Avg ABS V V+3	1.6	1.2	0.8	0.6	1.4	0.9	0.2	0.3	0.0	0.8
SK	V	-1.7	-0.7	-1.7	-0.2	2.0	0.5	-0.3	-0.6	-1.8	-1.5
SK	V+1	0.3	1.5	0.0	1.8	1.6	0.4	0.4	-0.6		
SK	V+2	0.9	3.0	2.4	2.9	1.4	0.3				
SK	V+3	2.9	3.6	2.6	2.1						
SK	Avg ABS V V+3	1.5	2.2	1.7	1.8	1.7	0.4	0.4	0.6	1.8	1.5
UK	V	-1.2	-1.5	0.3	-1.3	-1.7	0.0	-0.5	0.0	-0.1	-0.2
UK	V+1	-0.9	-0.4	1.2	-0.6	-2.3	-0.8	-0.6	0.0		
UK	V+2	0.9	-0.1	-0.8	-1.1	-2.9	-1.2				
UK	V+3	-0.7	-0.3	-0.9	-1.0						
UK	Avg ABS V V+3	0.9	0.6	0.8	1.0	2.3	0.7	0.6	0.0	0.1	0.2

8.3. A SHORT OVERVIEW OF THE EU'S PRODUCTION FUNCTION METHODOLOGY

8.3.1. Main Features of Methodology

Instead of making statistical assumptions on the time series properties of trends and their correlation with the cycle, the production function approach makes assumptions based on economic theory. This latter approach focuses on the supply potential of an economy and has the advantage of giving a more direct link to economic theory but the disadvantage is that it requires assumptions on the functional form of the production technology, returns to scale, trend technical progress (TFP) and the representative utilisation of production factors. As shown in the diagram below, with a production function, potential GDP can be represented by a combination of factor inputs, multiplied with the technological level or total factor productivity (TFP). The parameters of the production function essentially determine the output elasticities of the individual inputs, with the trend components of the individual production factors, except capital, being estimated. Since the capital stock is not detrended, estimating potential output amounts therefore to removing the cyclical component from both labour and TFP.



Cobb-Douglas Production Function: In more formal terms, with a production function, GDP (Y) is represented by a combination of factor inputs - labour (L) and the capital stock (K), corrected for the degree of excess capacity (U_L, U_K) and adjusted for the level of efficiency (E_L, E_K). In many empirical applications, including the Quest model, a Cobb Douglas specification is chosen for the functional form. This greatly simplifies estimation and exposition. Thus potential GDP is given by:

$$(1) \qquad Y = (U_L L\ E_L)^{\alpha} (U_K K E_K)^{1-\alpha} = L^{\alpha} K^{1-\alpha} * TFP$$

where total factor productivity (TFP), as conventionally defined, is set equal to :

$$(2) \qquad TFP = (E_L^{\alpha} E_K^{1-\alpha})(U_L^{\alpha} U_K^{1-\alpha})$$

which summarises both the degree of utilisation of factor inputs as well as their technological level. Factor inputs are measured in physical units. An ideal physical measure for labour is hours worked which we use as our labour input. For capital we use a comprehensive measure which includes spending on structures and equipment by both the private and government sectors.

Various assumptions enter this specification of the production function, the most important ones are the assumption of constant returns to scale and a factor price elasticity which is equal to one. The main advantage of these assumptions is simplicity. However these assumptions seem broadly consistent with empirical evidence at the macro level. The unit elasticity assumption is consistent with the relative constancy of nominal factor shares. Also, there is little empirical evidence of substantial increasing / decreasing returns to scale (see, e.g. Burnside et al. (1995) for econometric evidence).

The output elasticities of labour and capital are represented by α and $(1-\alpha)$ respectively. Under the assumption of constant returns to scale and perfect competition, these elasticities can be estimated from the wage share. The same Cobb-Douglas specification is assumed for all countries, with the mean wage share for the EU15 over the period 1960-2003 being used as guidance for the estimate of the output elasticity of labour, which would give a value of .63 for α for all Member States and, by definition, .37 for the output elasticity of capital[26]. While the output elasticity for labour may deviate somewhat from the imposed mean coefficient in the case of individual Member States, such differences should not seriously bias the potential output results.

To summarise therefore, in moving from actual to potential output it is necessary to define clearly what one means by potential factor use and by the trend (i.e. normal) level of efficiency of factor inputs.

- *Capital:* With respect to capital, this task of defining potential factor use is straightforward since the maximum potential output contribution of capital is given by the full utilisation of the existing capital stock in an economy. Since the capital stock is an indicator of overall capacity there is no justification to smooth this series in the production function approach. In addition, the unsmoothed series is relatively stable for the EU and the US since although investment is very volatile, the contribution of capital to growth is generally quite constant (a notable exception to this "rule" was the 2009 financial crisis) since net investment in any given year is only a tiny fraction of the capital stock figures. In terms of the measurement of the capital stock, the perpetual inventory method is used which makes an initial assumption regarding the size of the capital / output ratio.

- *Labour:* The definition of the maximum potential output contribution of labour input is more involved since it is more difficult to assess the "normal" degree of utilisation of this factor of production. Labour input is defined in terms of hours. Determining the trend of labour input involves several steps. In defining the trend input we start from the maximum possible level, namely the actual

[26] Since these values are close to the conventional mean values of 0.65 & 0.35, the latter are imposed for all countries.

population of working age. We obtain the trend labour force by mechanically detrending (using an HP filter) the participation rate. In a next step we calculate trend un/employment to be consistent with stable, non-accelerating, (wage) inflation (NAWRU). Finally, we obtain trend hours worked (potential labour supply) by multiplying trend employment with the trend of average hours worked. One of the big advantages of this approach is that it generates a potential employment series which is relatively stable whilst at the same time also providing for year-to-year changes to the series to be closely linked to long run demographic and labour market developments in areas such as the actual working age population, trend participation rates and structural unemployment.

- *Trend Efficiency :* Within the production function framework, potential output refers to the level of output which can be produced with a "normal" level of efficiency of factor inputs, with this trend efficiency level being measured using a bivariate Kalman filter model which exploits the link between the TFP cycle and the degree of capacity utilisation in the economy.

Normalising the full utilisation of factor inputs as one, potential output can be represented as follows:

(3) $$Y^P = (L^P E_L^T)^{\alpha} (KE_K^T)^{1-\alpha} .$$

8.3.2. Medium-Term (3 year) Extension

While the production function derived potential output estimates provide a good picture of the present output capacity of economies, they should not however be seen as forecasts of medium-term sustainable rates of growth but more as an indication of likely developments if past trends were to persist in the future. If, for example, a country's potential growth rate is 2% in 2014, it can only be sustained at that rate in future years if none of the underlying driving forces change. Any longer term assessment would need therefore to be based on a careful evaluation of the likelihood that present rates of growth for labour potential, productive capacity and TFP will persist over the time horizon to be analysed. It is important to stress that this technical extension is in no way a forecast for these years - it is simply an attempt to illustrate what would happen if the trends of recent years were to persist into the medium term. In more specific terms, on the basis of a number of explicit assumptions, including transparent ARIMA procedures, the potential growth rates for the medium term are calculated using the following key inputs:

1. *Trend Total Factor Productivity (TFP):* The TFP trend is estimated from the Solow residual by using a bivariate Kalman filter method that exploits the link between the TFP cycle and capacity utilisation. The Solow residual employed in the estimation process is calculated until the end of the short term forecast horizon using forecasts for GDP, labour input and the capital stock, which permits the extension of the TFP series by two additional observations. Since there are no forecasts of the degree of capacity utilisation in the economy, this means that the Kalman filter model is estimated with two missing values. During the estimation process, these missing values for capacity utlisation are, however, not problematic since the operation of the Kalman filter is not dependent on the availability of a forecast extension. The filter can in fact compute linear projections through a recursive procedure which yields the expected value of the TFP cycle on the basis of only the available observations. The Kalman filter in turn produces trend TFP forecasts by simply running the Kalman filter out of sample, over the required medium-term forecast horizon.

2. *NAWRU's:* The trend specification chosen for the NAWRU implies that the best prediction for the change in the NAWRU in future periods is the current estimate of the intercept. This basically implies that the slope of the NAWRU in the last year of the short-term forecasts should be used for the medium-term projection. Such a specification seems problematic for longer-term projections since it will eventually violate economic constraints (such as non-negativity of the NAWRU, for example, or balancing forces in the economy). An alternative specification which is

more consistent with the common notion of the NAWRU as a stable long run level of the unemployment rate would be a random walk without drift. This specification would imply a flat extrapolation of the last NAWRU value. Although this specification does not work well in estimation for European data where persistent trend changes of the unemployment rate can be observed, it may be a more plausible specification for the projections. The projections in practice constitute a compromise between these two concepts, with the medium-term NAWRU estimated according to the following rule:

a. $NAWRU_t = NAWRU_{t-1} + .5*(NAWRU_{t-1} - NAWRU_{t-2})$ for t = first year of the medium term extension

b. $NAWRU_t = NAWRU_{t-1}$ for t = all others years of the medium term extension

c. In forecasting the NAWRU, 50% of the most recent decline or increase is allowed for in the first year of the extension. After that the NAWRU is kept stable.

3. *Population of Working Age:* In terms of a projection for the population of working age for the medium-term (i.e. the three years following ECFIN's short-term forecast horizon), since Eurostat periodically produce long range population projections for all of the EU's Member States, it was decided that the most recent vintage of the Eurostat projections should be used. At present, ECFIN uses the Eurostat EUROPOP 2016 set of population projections.

4. *Participation rate changes:* On the basis of the forecasts by ECFIN's experts for the labour force and the population of working age for the individual countries, the implied total participation rate up to the end of the short-term forecasting period is produced and this latter series is extended on the basis of simple autoregressive projections. A further 3 years are added at the end of the series to limit the end point bias problem. The HP trend is then calculated on the whole series.

5. *Average Hours Worked:* Labour input in the method is decomposed into the number of employees and the average hours worked per employee. The hours worked series is extended using an ARIMA process. As for other components, the series is extended by 6 years, to avoid the end-point bias, and then smoothed. Only the first 3 years are then used for the medium-term extension.

6. *Investment to (potential) GDP ratio:* Since the purpose of the exercise is to get an estimate for potential output in the medium-term, the investment to potential GDP series is used as an exogenous variable, while investment itself is made endogenous. Generally, an AR process, allowing for a constant and a time trend, is specified and estimated using the full range of data, including ECFIN's short-term forecasts. For a constant investment to GDP ratio, investment responds to potential output with an elasticity equal to one.

8.3.3. Technical Specification of the Model Used

The model used can be summarised as follows:

Exogenous Variables

- POPW - (Population of Working Age)
- PARTS - (Smoothed Participation Rate)
- NAWRU - (Structural Unemployment)
- IYPOT - (Investment to Potential GDP Ratio)
- SRK - (Kalman Filtered Solow Residual)
- HOURST – (Trend, average hours worked)

Endogenous Variables

- LP - (Potential Labour Input)
- I - (Investment)
- K - (Capital Stock)
- YPOT -(Potential Output)

1. Potential Labour input

$$LP = (POPW * PARTS * (1 - NAWRU)) * HOURST$$

2. Investment and Capital

$$I = IYPOT * YPOT$$

$$K = I + (1 - dep)K(-1)$$ [27]

3. Potential Output

$$YPOT = LP^{.65} K^{.35} SRK$$

4. Output Gap

$$YGAP = (Y / YPOT - 1)$$

[27] The depreciation rate is assumed to remain constant over the projection period.

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