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The Production Function Methodology for Calculating Potential Growth Rates & Output Gaps

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Abstract

This paper provides a detailed description of the current version of the Ecofin Council approved production function (PF) methodology which is used for assessing both the productive capacity (i.e. potential output) and cyclical position (i.e. output gaps) of EU economies. Compared with the previous 2010 paper on the same topic, there have been two significant changes to the PF methodology, namely an overhaul of the NAWRU methodology & the introduction of a new T+10 methodology.

JEL Classification: C10, E60, O10.

Keywords: Production function methodology, potential growth rates, output gaps.

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CONTENTS

INTRODUCTION

The concepts of potential growth and the output gap form a crucial part of the toolkit for assessing the cyclical position of the economy and its productive capacity. These concepts have become an essential ingredient in the fiscal surveillance process emanating from the Stability and Growth Pact and in evaluating the effectiveness of the structural reform agenda pursued in the context of the priorities identified in the European Semester process and in the "Europe 2020" programme. Potential growth constitutes a summary indicator of the economy's capacity to generate sustainable, non-inflationary, growth whilst the output gap is an indication of the degree of overheating or slack relative to this growth potential.

Estimating the output gap is difficult since potential growth is not directly observable whilst actual GDP is subject to significant historical / forecast revisions. Given the large uncertainty surrounding output gap estimates, due care must be taken in interpreting their size and evolution. Whilst mindful of these uncertainties, the potential growth and output gap forecasts produced by the ECOFIN Council approved production function methodology have been providing essential information to policy makers since their initial release in 2002. This information has been used by policy makers for their ongoing discussions regarding the appropriate mix of macroeconomic and structural policies in the various EU economies, with the former geared to eliminating cyclical slack and the latter being used to raise the output potential of their respective economies.

Given the importance of this work, the EU's Economic Policy Committee (EPC) has a dedicated working group (i.e. the "Output Gap Working Group" - OGWG) which meets regularly to discuss the operational effectiveness & relevance of the existing production function methodology. The working papers for the discussions in this group are generally prepared by the Commission services (DG ECFIN), although from time to time some papers are presented by non-Commission members of the group. Periodically, the Commission services produce a paper which tries to succinctly summarise the work which has been done in this area over a specific period of time, with the present paper updating the last published paper on this topic which appeared in 2010[1].

1. How should one interpret the potential output concept ? Any meaningful analysis of cyclical developments, of medium term growth prospects or of the stance of fiscal and monetary policies are all predicated on either an implicit or explicit assumption concerning the rate of potential output growth. Such pervasive usage in the policy arena is hardly surprising since potential output constitutes the best composite indicator of the aggregate supply side capacity of an economy and of its scope for sustainable, non-inflationary, growth.

Given the importance of the concept, the measurement of potential output is the subject of contentious and sustained research interest. Of course since it is an unobserved variable, before starting to measure it, one must firstly clarify exactly what one means by the concept. It signifies different things to different people, especially when discussed over various time horizons, with the concept appreciated differently when placed in a short, medium or long term perspective:

[1] ECFIN Economic Paper No. 420 (2010) "The production function methodology for calculating potential growth rates and output gaps". This 2010 paper was in turn an update of the ECFIN Economic Paper No. 247 (2006) “Calculating potential growth rates & output gaps – A revised production function approach" and the ECFIN Economic Paper No. 176 (2002) “Production function approach to calculating potential growth and output gaps : Estimates for the EU Member States and the US”.

- Over the ***short run***, the physical productive capacity of an economy may be regarded as being quasi fixed and its comparison with the effective / actual output developments (i.e. in output gap analysis) shows by how much total demand can develop during that short period without inducing supply constraints and inflationary pressures.
- Over the ***medium term***, the expansion of domestic demand when it is supported by a strong upturn in the amount of productive investment may endogenously generate the productive output capacity needed for its own support. The latter is all the more likely to occur when profitability is high and is supported by an adequate wage evolution with respect to labour productivity.
- Finally, over the ***long run***, the notion of full employment potential output is linked more to the future evolution of technical progress (or total factor productivity) and to the likely growth rate of labour potential.

These medium and long run considerations should always be kept in mind when discussing potential output since the latter is often seen in an excessively static manner in some policy making fora, where the growth of capacity is often presented as invariant not only in the short run (where such an assumption is warranted) but also over the medium & long runs as if the labour & TFP components of growth & their knock-on effects on fixed investment projections had no impact on productive capacity.

2. Measuring Potential Growth for Use as an Operational Surveillance Tool : Notwithstanding the importance of the concept, and the consequent desire for clarity, the measurement of potential growth is far from straightforward and, being unobservable, can only be derived from either a purely statistical approach or from a full model based econometric analysis. It is clear however that conducting either type of analysis requires a number of arbitrary choices, either at the level of parameters (in statistical methods) or in the theoretical approach and choice of specifications, data and techniques of estimation (in econometric work).

In other words, all the available methods have "pros" and "cons" and none can unequivocally be declared better than the alternatives in all cases. Consequently, what matters is to have a method adapted to the problem under analysis, with well defined limits and, in international comparisons, one that deals identically with all countries. This was the approach which was adopted in the earlier 2002, 2006 & 2010 papers on this topic where it was stated clearly that the objective was to produce an economics based, production function, method which could be used for operational EU policy surveillance purposes.

The preference for an economic, as opposed to a statistical, approach was driven by a number of considerations. For example, with an economics based method, one gains the possibility of examining the underlying economic factors which are driving any observed changes in the potential output indicator and consequently the opportunity of establishing a meaningful link between policy reform measures with actual outcomes. An additional advantage of using an economic estimation method is that it is capable of highlighting the close relationship between the potential output and NAWRU concepts, given that the production function (PF) approach requires estimates to be provided of "normal" or equilibrium rates of unemployment. At a wider level, another advantage is the possibility of making forecasts, or at least building scenarios, of possible future growth prospects by making explicit assumptions on the future evolution of demographic, institutional and technological trends.

However, whilst economic estimation would appear to overcome, at least partially, many of the concerns in terms of appraising policy effectiveness which are linked to statistical approaches, on the negative side difficulties clearly emerge with regard to achieving a consensus amongst policy makers on the modelling and estimation methods to be employed. Policy makers are fully aware of these latter trade-offs which make any decision making process, regarding the specific details of the PF approach to calculating potential output, a difficult one to undertake in practice.

Since the primary use of the methodology is as an operational surveillance tool, it is important that the agreed methodology respects a number of basic principles given the politically sensitive nature of the dossier. As the previous versions of the present paper have stressed, the main operational requirements for the PF approach are as follows :

- Firstly, it has to be a relatively simple and fully transparent methodology where the key inputs and outputs are clearly delineated;

- Secondly, equal treatment for all of the EU's Member States needs to be strictly assured; and

- Finally, given that the estimates are used for budgetary surveillance purposes, it is important to produce unbiased estimates of the past and future evolution of potential growth by seeking to avoid both false optimism or unjustified pessimism.

This third requirement of prudence / unbiasedness was in fact one of the explicit demands made when policy makers called in the late 1990's for a new method to be developed for assessing structural budget balances since it was felt that past surveillance exercises had on a number of occasions produced an excessively optimistic picture of the degree of budgetary improvement in the upswing phase of previous cycles. This "false" optimism was linked to some extent with the cyclicality of the trend GDP estimates which had been calculated using the HP filter statistical method and via which the estimates of structural budget balances had been generated. Consequently, one of the key objectives of replacing the earlier HP filter methodology was to reduce the degree of cyclicality of the trend growth estimates to an absolute minimum in order to avoid the mistakes of the past[2]. However, despite all the improvements made over the intervening years, this issue of cyclicality is still very much a source for concern, as reflected in the experiences with the method in the pre- & post-crisis periods.

3. Recent modifications to the PF methodology: Relative to the previous 2010 paper, the most important changes to note regarding the operation of the PF methodology over the last number of years are as follows :

a) **New technical extension rules for the estimation of the NAWRU and new NAWRU specifications:** The single most important change since the 2010 paper has undoubtedly been to the NAWRU methodology (see section 2 & annex 1 for a full description of the changes). EPC members formally approved in March 2014 the following two changes in the NAWRU

[2] Note : in the post-crisis period, 2010-2014, the HP filtered output gap for the EU has been significantly less negative than the equivalent output gap produced with the PF method – in fact over the period as a whole, using the Spring 2014 Commission services forecasts, the EU's output gap was around 1% point less negative when estimated with the HP filter.

part of the official T+5 methodology (with these NAWRU changes introduced for the first time in the Spring 2014 forecasting exercise) :

- **New technical extension rules for the NAWRU** : Instead of the previous extension rule for the medium term NAWRU of taking 50% of the change in the previous year, the new approach takes 50% of the most recent NAWRU change in T+3, followed by a flat extension rule in T+4 and T+5.

- **New NAWRU specifications :** Following the Commission's proposal to introduce a non-centered NAWRU, based on the notion of an "all encompassing Phillips Curve", the EPC endorsed a new Keynesian Phillips Curve (NKP) specification for 21 of the 28 Member States, and the traditional Keynesian Phillips Curve (TKP) specification for the remaining 7 countries, namely Belgium, Germany, Italy, Luxembourg, Malta, the Netherlands and Austria. Bearing in mind the importance of the stability principle, the Commission committed itself to using these EPC endorsed NKP / TKP country preferences for a period of 3 years.

b) EPC endorsement of the T+10 methodology as the starting point for the Ageing Working Group's (AWG) 2015 Ageing Report : In May 2014, building on its March 2014 agreement on the T+5 NAWRU methodology, the EPC endorsed the use of the overall T+10 methodology as the starting point for the 2015 Ageing Report. Section 4 of the current paper provides an overview of the rationale behind the development of the T+10 methodology, as well as a description of its individual components.

c) Other modifications : Two other changes should be noted :

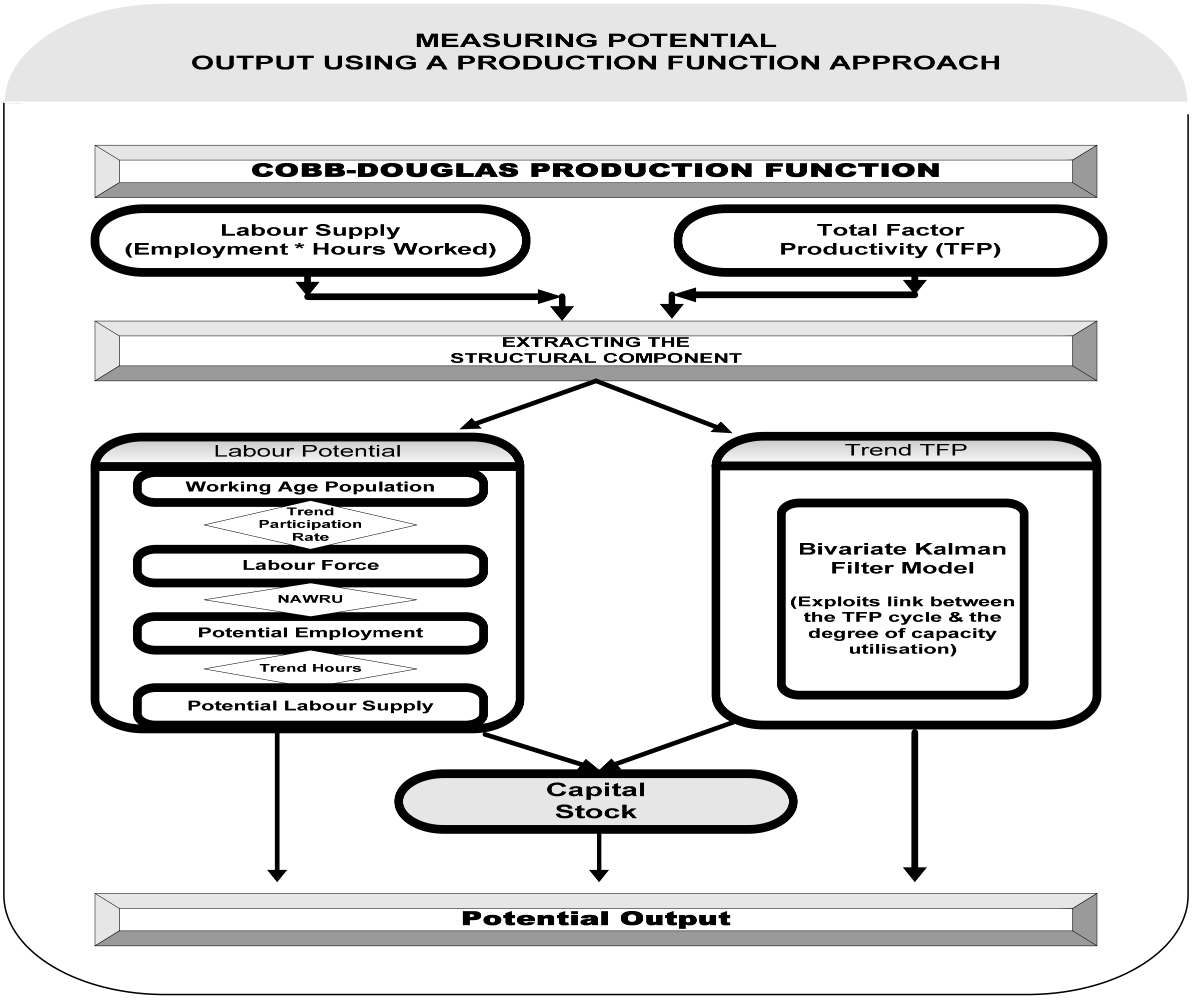
- Firstly, the Kalman filter approach used to estimate the trend TFP and NAWRU components of the PF methodology, which previously had been applied to just a subset of the 28 EU Member States, is now applied to all 28 countries.
- Secondly, the population of working age has now been extended to cover the age group 15 to 74 years (compared with 15-64 previously)

4. Structure of Paper : In terms of content, the paper is laid out as follows. Section 1 provides an overview of the PF methodology as it currently operates. Section 2 goes on to provide a detailed description of the recently approved changes to the NAWRU methodology, with the previous TKP specification being replaced by a NKP specification for many countries. The gains from such a change, as well as a comparison between the NAWRU and structural unemployment concepts, are discussed in "Box 2". Section 3 focusses on the TFP methodology, with its essential features remaining unchanged compared with the description given in the 2010 paper. Section 4 is devoted to the new T+10 methodology, as approved by the EPC in May 2014. The conclusions section discusses the strengths & limitations of the PF methodology as well as its essential operating principles. Supplementary information is provided in annexes 1-6.

SECTION 1: A SHORT OVERVIEW OF THE OVERALL PRODUCTION FUNCTION APPROACH

1.1 Main Features of Methodology[3]

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[4] : In more formal terms, with a production function, GDP (Y) is represented by a combination of factor inputs - labour (L) and the

[3] This PF methodology is applicable to all of the EU's member states. The HP filter approach is only used as a “back-up” method. For the 12 "new" Member States, 1995 has been chosen as the common starting date since too many transitional issues were biasing the pre-1995 data.

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

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

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

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[5]. 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.

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[4] **CHOICE OF PRODUCTION TECHNOLOGY – WHY USE COBB-DOUGLAS ?** One of the big advantages of using Cobb-Douglas is undoubtedly its simplicity, in that it is easy to make sense out of the coefficients imposed. The Cobb Douglas assumption greatly simplifies estimation of output elasticities, conditional on an assumption on returns to scale. With a high average degree of competition in the goods market, the output elasticities can be equated to their respective factor shares. Thus, there is only one parameter to estimate. While a large variety of views on alternative specifications to the Cobb-Douglas approach of constant factor shares are available, one needs to be aware of the implications associated with these alternatives. For example, if one chooses to adopt an elasticity of less than 1, one is left with the problem of explaining why wage shares have fallen recently. If one goes for the alternative assumption of using an elasticity of greater than 1, then the lack of econometric evidence to support using such a function needs to be taken into account. Consequently, given the difficulties associated with the alternatives, the Cobb-Douglas assumption of unity appears to be a reasonable compromise. In addition, of course, if one were to use a CES function with an elasticity of 0.8 or 1.2 the results would not differ very strongly from Cobb-Douglas. Finally, the aggregation problem associated with having a mixture of low and high skilled workers in the workforce would also appear to lend support to the Cobb-Douglas view. In this regard, if you aggregate over both sets of workers, one would come close to Cobb-Douglas, with low skilled workers having a high elasticity of substitution (EoS) with capital (EoS > 1) balancing out the low EoS associated with high skilled workers (EoS < 1). High skilled workers have generally a low EoS since such workers are regarded as being more complementary to K. This view regarding the distinction between low and high skilled workers is supported in a paper by Krussell et al. published in *Econometrica* in September 2000.

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

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 quite constant since net investment in any given year is only a tiny fraction of the capital stock figures[6]. 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**[7] : 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 population of working age[8]. 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

[6] An exception to this "rule" has been the recent financial crisis where the large fall in investment rates led to deep declines in the contribution of capital to potential output growth. An area for future research is whether using potential capital could reflect this fall in investment rates and whether it should be added to potential output growth.

[7] Since Eurostat and the OECD have agreed that the national accounts (as opposed to the labour force survey) is the preferred source for labour input data, the production function approach now uses the national accounts for the labour input variables i.e. for hours worked and employment.

[8] The OGWG has extensively discussed the possibility of replacing the actual population of working age (POPW) series in the production function method with a smoothed series. These discussions were initiated by a number of complaints from specific Member States that POPW changes (driven essentially by migration flows) were generating erratic and often counterintuitive shifts in their potential growth rates. Following a number of notes from the Commission services on this issue and discussions in the working group, it is now clear that it would be inappropriate to smooth the overall POPW series since the migration component of POPW (rather than births and deaths i.e. the natural increase component) is the only part of the series which has both cyclical & structural elements and consequently smoothing the total series would risk removing a substantial amount of valuable information. The OGWG agreed that the only viable solution would be to just smooth the migration component but this will be difficult since official EU-wide migration statistics are very poor, with a particular problem with respect to the migration statistics for the working age cohorts. In a follow-up discussion in the OGWG on this issue, Eurostat gave a short presentation on the present state of, and the future prospects for, EU migration statistics. Unfortunately, despite having agreed a new regulation in 2007 for collecting comparable migration data in the EU member states, it is clear that Eurostat is not yet in a position to provide the Commission services with the type of data needed to split the POPW series in the manner suggested. To do so in the future, Eurostat will have to provide long series of emigration and immigration data, as well as regular updates and projections. Until Eurostat are in a position to provide the necessary migration data, it will not be possible to introduce such a change in the method i.e. a split of the POPW series into a smoothed "net migration" component combined with the actual "natural increase" component.

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

1.2 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 utilization. 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 utilization 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 utlization 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:

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

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

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 2013 set of population projections.

- **4. Participation rate changes :** On the basis of the forecasts by ECFIN's desk officers 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[9].

- **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.

[9] Over recent forecasting exercises, for calculating trend labour force participation rates and trend hours worked, a lambda of 10 instead of 100 has been used in the HP filter. In terms of an explanation for this change, with respect to participation rates, an analysis of recent developments in actual participation rates suggest a flattening out in trend participation rates rather than further increases and consequently the smoothing parameter has been adjusted to better reflect this emerging new situation. Use of a lambda of 100 would have given rise to an excessively optimistic medium term trend for participation rates. With regard to hours worked, the situation is the opposite to that for participation rates, with the long run pattern of falls in the number of hours worked per worker changing recently towards a less negative contribution. Again a lambda of 10 allows one to better reflect this more recent change in actual hours worked in the trend series. The hours worked and participation rate series are of course interlinked, with much of the increase in participation rates over recent years due to an inflow of part-time workers into the workforce, with negative knock-on effects in terms of hours worked per worker. This pattern, as mentioned earlier, now appears to be changing towards a less positive trend for participation rates which, in turn, is accompanied by a less negative hours worked trend. The combined effect of these changes is however relatively small since they tend to offset each other.

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

$$I = IYPOT * YPOT$$

$$K = I + (1 - dep)K(-1)$$ [10]

3. POTENTIAL OUTPUT

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

4. OUTPUT GAP

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

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

SECTION 2: NEW METHODOLOGY FOR CALCULATING "NON-CYCLICAL" UNEMPLOYMENT RATES – THE NAWRU METHODOLOGY

2.1 : NAWRU ESTIMATION : THE NOTION OF AN "ALL ENCOMPASSING PHILLIPS CURVE"

The NAWRU is implicitly defined as the equilibrium point of a dynamic system of labour supply and labour demand equations. This equilibrium concept is linked to the Phillips curve debate which is crucial in monetary policy discussions (see Phelps (1967) and Friedman (1968)). The Phillips curve embodies the process through which wages adjust to economic conditions, with adjustment delays reflecting the effects of limited information in the formation of expectations or institutional rigidities. In particular, this implies that different assumptions regarding the formation of expectations have a bearing on the specification of the Phillips curve. Notable cases include the static or adaptive expectation case which yields the traditional Keynesian Phillips (TKP) curve specification and the rational expectations case which yields the new-Keynesian Phillips (NKP) curve.

A change to the method for calculating the NAWRU was recently implemented, with estimates based on the revised method first reported in the context of the Spring 2014 EC Forecast Report.[11] The change consists in extending the Phillips curve framework by considering the case of rational expectations (i.e. the NKP) in addition to the static and adaptive expectation cases (i.e. the TKP) which were the only cases considered in the past. The motivation for extending the framework stems from evidence that the rational expectations specification avoids producing excessively pro-cyclical NAWRUs under certain circumstances. Moreover, as stressed in the next sub-section, the TKP and the NKP specifications are based on identical concepts of the labour market, differing only in terms of underlying timing and expectation assumptions. As such, considering both the TKP and the NKP provides a more encompassing implementation of the Phillips curve concept, which covers a wider set of alternative expectation assumptions.

The next section briefly describes formally the TKP and the NKP and their underlying theoretical framework, stressing similarities and differences across the two specifications (see annex 1 for more details). In the third section, we discuss the empirically observed difference across the two methods. Implementation of ECFIN's approach, including a brief discussion of the results for unemployment rate estimations in the Spring 2014 European Economic Forecast, are described in detail in the last section. In addition, in Box 1 we outline the distinction between the NAWRU and structural unemployment concepts and describe recent results for both of these indicators. This Box calls for cautious interpretation, when identifying the causes of the developments in the NAWRU. In particular, changes in the NAWRU are sometimes interpreted as a sign of a structural change. Whilst this is true, careful analysis of developments in the NAWRUs shows in fact that they can be driven by both structural and non-structural factors.

[11] Details of the methodological change are provided in the present paper. Such details were also provided in the Spring 2014 EC Forecast Report in Box I.1 entitled " The revised methodology for calculating output gaps" and in the EC Quarterly Report on the Euro Area, Vol.13, Issue 1, April 2014 in the section entitled "New estimates of Phillips curves and structural unemployment in the euro area".

2.2 : ALL ENCOMPASSING PHILLIPS CURVE - THEORETICAL IMPLEMENTATION

Formally, a standard bargaining model of the labour market can be used to derive the Phillips curve and to stress similarities across the TKP and NKP specifications (see annex 1 for details). This framework shows that the TKP and the NKP are based on identical labour market concepts and only differ in terms of timing and expectation formation assumptions. The revised ECFIN method considers both the TKP and the NKP and can thus be seen as adopting an all encompassing Phillips curve implementation approach, which now covers a wider (i.e. including rational expectations) set of alternative expectation assumptions.

The similarity across the TKP and the NKP can also be stressed by noting that both models share the same theoretical root, namely the fundamental Phillips curve relationship that postulates a negative relationship between cyclical unemployment and the *expected growth rate of real unit labour costs*:

$$\Delta rulc_t^e = -\lambda(u_t - u_t^*) \qquad (1)$$

The way expectations are formed then needs to be specified to obtain a relationship that can be used for practical purposes. Alternative Phillips curve specifications differ in the way they model such expectations. In early work, the TKP curve generally assumed no uncertainty about productivity growth and assumed static or adaptive inflation expectations. It also commonly assumed that workers use lagged nominal unit labour cost growth to forecast inflation. This set of assumptions yields the standard 'accelerationist' form of the Phillips curve, linking the unemployment gap inversely to the *change in the growth rate of nominal unit labour costs*:

$$\Delta^2 nulc_t = -\lambda(u_t - u_t^*) \qquad (2)$$

Allowing for adaptive expectations, the Phillips curve can alternatively be formulated with more lags and other exogenous variables (in particular, labour productivity growth Δyl). Also, uncertainty as to whether wage setters are targeting consumer price inflation or the GDP deflator can be addressed by adding a 'terms of trade' (tot) indicator, resulting in the following more general specification, which is the general TKP specification considered by ECFIN:

$$\Delta^2 nulc_t = \sum_i \rho_i \Delta yl_{t-i} + \sum_i \omega_i \Delta tot_{t-i} - \sum_i \lambda_i (u_{t-i} - u_{t-i}^*) \qquad (3)$$

In recent years, the NKP curve has been introduced in the macroeconomic literature (Roberts (1995); Galì and Gertler (1999)). It differs from the TKP, essentially, in the way expectations are formed. Rational expectations and somewhat different timing assumptions are introduced. The different timing assumptions include different timing for wage setting, relying on a middle of period rather than a beginning of period concept, having implications on the information set available to wage setters.

Moreover, the literature on NKP concedes that a purely forward-looking specification, as implied by rational expectations, is not realistic (see Galì and Gertler (1999)). Therefore, empirical applications often use a 'hybrid NKP', allowing for a combination of backward- and forward-looking behaviour. This produces the following specification

$$\Delta rulc_t = \beta(s\Delta rulc_{t+1}^e + (1-s) * rulc_{t-1}) - \lambda(u_t - u_t^*) \text{ with } \beta \leq 1 \text{ and } 0 \leq s \leq 1 \qquad (4)$$

where the parameter s indicates the share of forward looking wage setters. The timing assumptions mentioned above imply that in the NKP framework wage setters can use current period information for wage negotiations that occur during the year. Therefore, unlike the TKP, it does not require expectations to be formed for current real unit labour cost developments. Only expectations as to future real unit labour cost growth, which appear in the NKP specification because wage contracts are assumed to span more than one period, are needed and computed on the basis of rational expectations (see Galì (2011)). Intuitively, the forward looking (RULC) component in eq. (4) reflects wage setters' efforts to minimise the extent to which wages deviate from productivity and inflation developments in a framework where wages are set in advance.

Assuming the unemployment gap follows an AR(2) process and solving for the backward solution yields the empirical form of the (hybrid) new-Keynesian Phillips curve, the general NKP specification considered by ECFIN:

$$\Delta rulc_t = \alpha \Delta rulc_{t-1} - \beta_1 (u_t - u_t^*) + \beta_2 (u_{t-1} - u_{t-1}^*) \qquad \text{with: } \beta_1 < 0, \beta_2 > 0 \tag{5}$$

The parameter α determines the degree of forward-looking behaviour. The purely forward-looking case emerges if $\alpha = 0$. For $\alpha \approx 1$ forward-looking behaviour becomes irrelevant.

Overall, the NKP assumptions imply a specification for the Phillips curve that differs from the one obtained under TKP assumptions. Yet, as stressed above, it is important to bear in mind that the NKP still represents an implementation of the same fundamental theoretical relationship (i.e. eq. (1)) as the one used at the start of the TKP derivations. Considering both the TKP and the NKP can thus be viewed as merely investigating alternative ways of implementing the Phillips curve approach. In particular, reporting results for both specifications provides a more encompassing approach as to how expectations are assumed to be formed in the economy.

Note that equation (4) can also be used to stress the link between the TKP and the NKP. In particular, the TKP arises as a special case when s=0 (i.e. no forward looking behaviour), β=1 (i.e. no positive rate of time preference) and the timing that holds under the TKP is reintroduced, i.e. wage setters do not use all available information in the current period to form inflation expectations, relying instead on static (i.e. $\Delta p_t^e = \Delta p_{t-1}$) or adaptive expectations.

2.3 : EMPIRICS OF ALTERNATIVE PHILLIPS CURVE SPECIFICATIONS

In practice, the TKP specification implies a positive unemployment gap only if wage inflation declines over time relative to labour productivity growth (see eq. (2)). The reason for this is an implicit assumption that wage setters expect inflation to adjust quickly to a fall in the growth rate of nominal wages. In these circumstances, a low but constant nominal wage growth would therefore indicate that wage setters are intent on stabilising expected real wage growth (and do not wish to further adjust real wages in order to close the unemployment gap). Thus only a deceleration of nominal wage growth (or nominal unit labour costs) is signalling a positive unemployment gap.

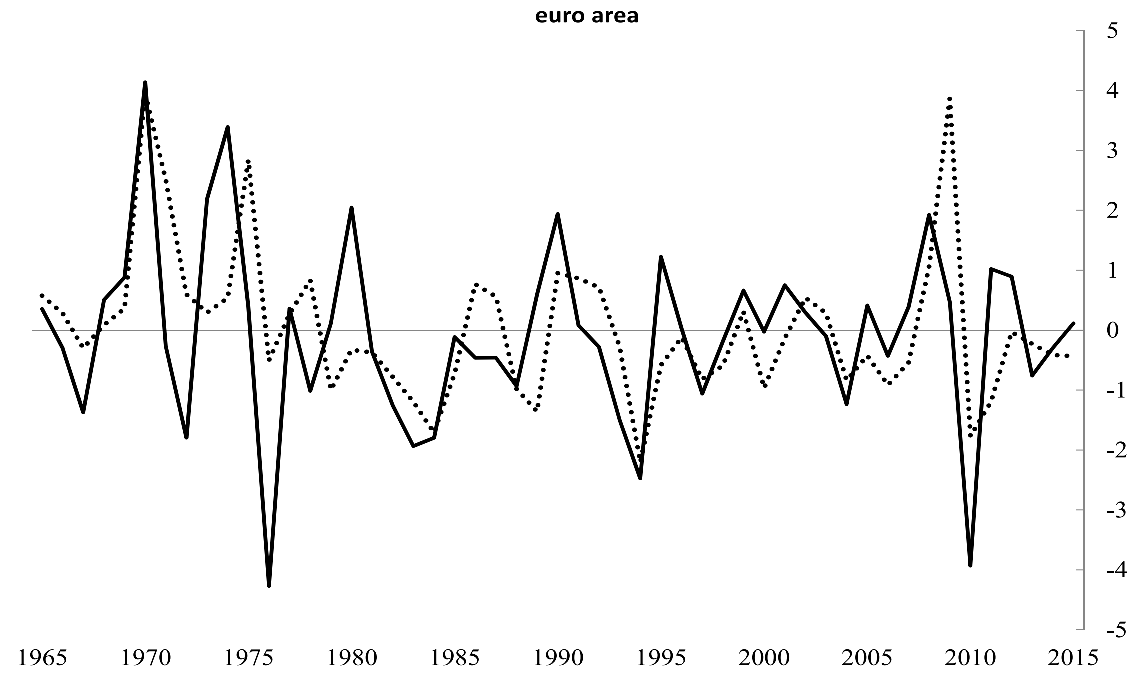
The NKP in contrast uses real unit labour cost growth directly (see eq. (5)) as an indicator of the unemployment gap and does not make a specific assumption about the speed of the price

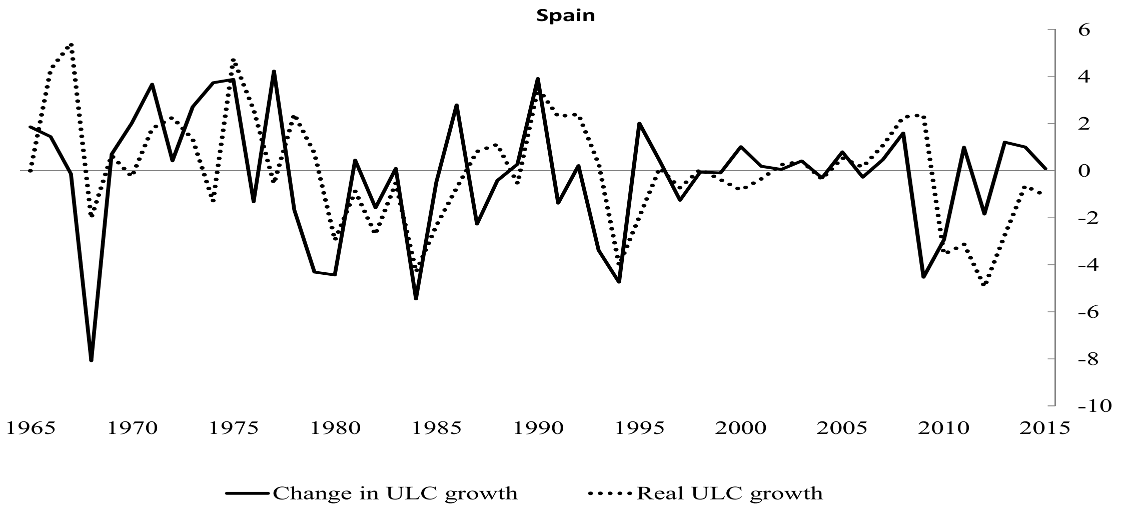
adjustment which wage setters expect when setting wages. Instead it is assumed that wage setters are well informed about current price inflation (e.g. by using information from professional forecasts). Note that especially when nominal wages fall strongly and prices show some inertia, the NKP indicator (i.e. $\Delta rulc_t$) declines more strongly (and persistently) than the TKP indicator (i.e. $\Delta^2 nulc_t$), thus signalling a larger unemployment gap and a less pro-cyclical NAWRU.

Graphs 1 and 2 and Table 1 in this section illustrate the differences in results based on the TKP and the NKP specifications. For this illustration we used the Winter 2014 as opposed to the Spring 2014 Economic Forecast data because this was the vintage serving as a benchmark for deciding on whether to implement TKP or NKP. The different behaviour of the two indicators in periods of large labour market adjustments can be illustrated by comparing $\Delta^2 nulc_t$ and $\Delta rulc_t$ for the case of Spain. Graph 1 shows that whilst the TKP indicator moved back rapidly to zero after 2009, the NKP indicator posted a more protracted negative development, indicating more persistent cyclical deviation in the Spanish labour market. Note also that these two indicators only diverge occasionally, with Graph 1 pointing to similar developments in Spain before the crisis and for the EA as a whole, generally. This confirms that the different evolution across the two indicators is associated with episodes of large labour market adjustments. Overall this suggests that for most countries in the euro area, the NAWRU results are not overly sensitive to the specification of the Phillips curve (i.e. to assumptions regarding expectations formation).

Graph 2 shows that the differences amongst the two labour cost indicators are reflected in the NAWRU estimates based on the two alternative specifications. For Spain, the NAWRU based on the NKP posts a more moderate recent increase, reaching 22% by 2015, compared to the 26.4% estimate obtained using the TKP model. On the other hand, for the EA as a whole, the results are more similar across the two models, with the two NAWRUs posting similar developments, reflecting the similar evolution of the two underlying labour cost indicators.

Graph 1: Alternative Labour Cost indicators

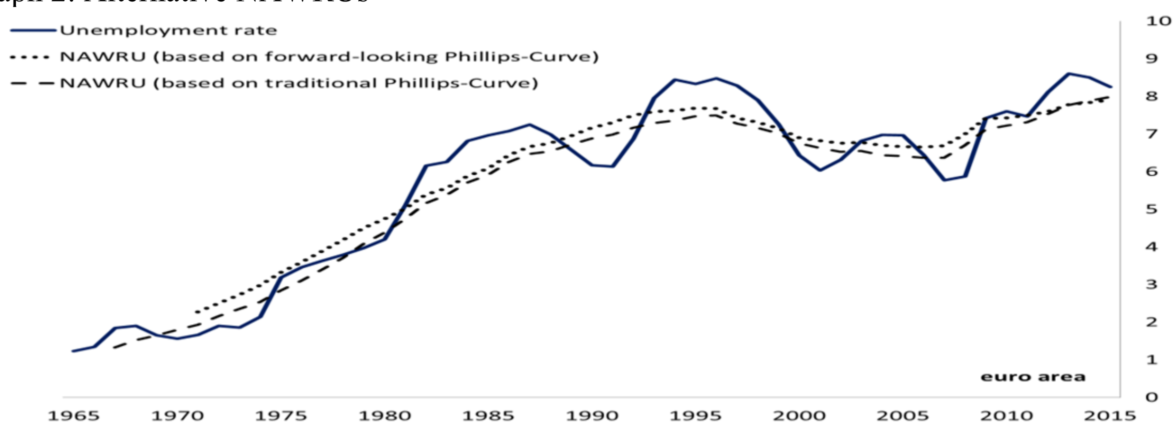


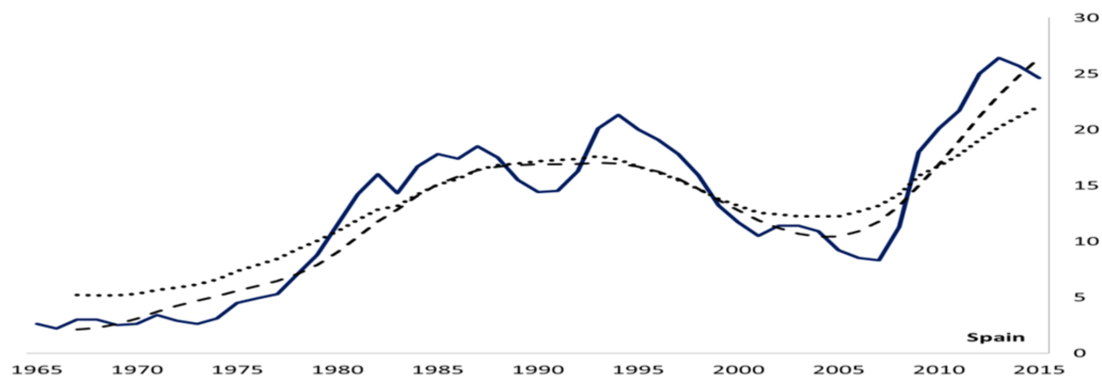


Note : GDP weighted average of euro-area countries for which long series are available for the alternative NAWRUs (i.e. AT, BE, DE, EL, ES, FI, FR, IE, IT, NL and PT)

Source: DG ECFIN calculations based on Eurostat data.

Graph 2: Alternative NAWRUs





Note: GDP weighted average of euro-area countries for which long series are available for the alternative NAWRUs (i.e. AT, BE, DE, EL, ES, FI, FR, IE, IT, NL and PT)

Source: DG ECFIN calculations based on Eurostat data.

In practice, the change in the method entails a shift to the NKP model for most countries. However, for seven countries (i.e. AT, BE, DE, IT, LU, MT and NL), the TKP model continues to be used in an effort to minimise unnecessary changes when econometric performance and the similarity of the results points to its validity. As the two models differ solely in terms of expectations assumptions, relying on a framework that features both the TKP and the NKP specifications can be interpreted as relying on a more encompassing implementation of the Phillips curve approach which covers a wider set of expectations assumptions.

Table 1 provides details regarding the impact of the methodological change on the key affected variables. As follows from above, the main determinant of this impact is the change in the labour cost indicator resulting from the difference in theory underlying the two model specifications. The table confirms that Spain is the most significantly affected country, with a downward revision in its NAWRU of 4.8pp in 2015. Downward revisions to the NAWRU are also noticeable, albeit to a lesser extent, for Ireland, Croatia, Cyprus and Portugal. A small number of countries also witness some upward revisions, in particular Estonia (in 2015) and Poland (in 2013). All these revisions reflect the reduced pro-cyclicality of the NAWRU estimates according to the NKP model compared to the previous estimates based on the TKP model.

Furthermore, as the NAWRU is a component of the production function approach which is used to compute output gaps, revisions to the NAWRU translate into revisions of the output gap estimates. On average, a 1.0 pp change in the NAWRU translates into a 0.65 pp change in the output gap. Revisions for the output gap are also shown in Table 1.

In turn, a revision to the output gap affects the structural balance estimates, with a 1 pp revision leading, on average, to a 0.4 p.p. revision to the structural balance. Revisions for this variable are also reported in the table.

Importantly, despite the fact that the structural balance figures are revised for some countries, the implications for the excessive deficit procedures (EDPs) under the fiscal surveillance framework are limited. In particular, for the purposes of assessing delivery of the policy commitments under the EDP, specifically the delivery of the recommended fiscal effort, the change in the structural balance is corrected in order to remove the impact of any changes in the country's potential growth compared to when the initial EDP recommendation was made. Effectively, this correction offsets the impact of any methodological change on the structural balance[12]. This is designed to allow governments to make their medium-term fiscal plans with an appropriate degree of certainty. The impact of the methodological change on the adjusted structural balance is less than 0.1 pp in all cases.

[12] Please note that this corrected structural balance calculation is not shown in Table 1.

Table 1: **Impact of methodological change on selected variables**

(in p.p	NAWRU			Output gap			Structural balance		
	2013	2014	2015	2013	2014	2015	2013	2014	2015
BE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BG	0.9	0.4	0.0	0.7	0.3	0.0	-0.2	-0.1	0.0
CZ	0.2	0.0	-0.2	0.2	0.0	-0.2	-0.1	0.0	0.1
DK	-0.2	-0.2	-0.3	-0.1	-0.2	-0.2	0.1	0.1	0.1
DE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EE	-0.2	0.6	1.2	-0.2	0.4	0.9	0.1	-0.1	-0.3
IE	-0.3	-0.7	-1.1	-0.2	-0.5	-0.8	0.1	0.3	0.4
EL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ES	-3.3	-4.1	-4.8	-2.5	-3.2	-4.0	1.2	1.5	1.9
FR	0.0	-0.2	-0.3	0.0	-0.1	-0.2	0.0	0.1	0.1
HR	-1.8	-2.1	-1.9	-1.4	-1.6	-1.4	0.6	0.6	0.6
IT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CY	-0.9	-1.7	-2.9	-0.6	-1.2	-2.3	0.3	0.5	1.0
LV	-0.4	-0.2	0.0	-0.3	-0.2	0.0	0.1	0.1	0.0
LT	-0.4	-0.5	-0.8	-0.3	-0.4	-0.6	0.1	0.1	0.2
LU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HU	0.0	0.1	0.2	0.0	0.1	0.1	0.0	0.0	-0.1
MT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PL	1.4	0.9	0.0	1.0	0.6	0.0	-0.4	-0.2	0.0
PT	-1.3	-1.2	-1.3	-1.0	-0.9	-0.9	0.4	NA	NA
RO	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0
SI	0.1	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
SK	0.1	-0.1	-0.4	0.1	-0.1	-0.3	0.0	0.0	0.1
FI	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
SE	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
UK	-0.1	-0.2	-0.3	-0.1	-0.2	-0.2	0.0	0.1	0.1
EA18	-0.6	-0.7	-0.9	-0.3	-0.4	-0.5	0.1	0.2	0.2
EU28	-0.3	-0.5	-0.7	-0.2	-0.3	-0.4	0.1	0.1	0.2

Source: European Commission estimates (based on the Spring 2014 forecasts)

2.4 : APPLICATION OF THE NAWRU ESTIMATION METHOD

This section illustrates the application of the NAWRU estimation method, describing the various steps involved and reporting the results obtained in the context of the Spring 2014 EC forecast round.

2.4.1 : The model selection step

As stressed in Section 2.2, the TKP and NKP specifications are based on identical labour market concepts. Given that it is difficult to map complex labour market dynamics into a simple framework, ECFIN considers both models, following an all encompassing Phillips curve implementation approach. Note that it is the case that neither the TKP nor the NKP are uniformly better fitting models for all countries. The all encompassing approach thus tends to allow better fitting at the country level.

In practice ECFIN inspects the fit of the Phillips curve and the signalling properties of the indicators (i.e. significance of the β coefficient – see Table 2 below), and identifies which Phillips curve specification (i.e. TKP or NKP) performs best for each individual country (see last column in Table 2). In the event that both models yield a similar level of performance, preference is given to the NKP in view of the fact that both models tend to yield broadly similar NAWRUs and in view of the additional advantages of the NKP over the TKP in terms of:

- simplicity (i.e. less explanatory variables compared to TKP);
- ease of interpretation (i.e. micro-founded model with rational expectations);
- less prone to yield excessively pro-cyclical NAWRU estimates (see Box 1);

In practice, in the event of a comparable performance between the TKP and NKP specifications, ECFIN is also open to identifying the preferred model in close consultation with the Member States concerned. At this juncture, this is the case for Germany, France and Italy, with significance at the 5% level for the TKP and at the 10% level for the NKP. The same applies to cases, such as Belgium, for which both specifications are significant at the 5% level.

Finally, in the cases of Luxembourg and Malta, due to data limitations, the NKP specification yields an implausible NAWRU profile. For those countries, ECFIN currently recommends using the TKP specification.

In the framework, the model selection step is foreseen to take place every 3 years. That is, once a Phillips curve specification (i.e. TKP or NKP) is identified as the preferred one, it remains in place for 3 years.

Table 2 : Comparison of regression results for the alternative NAWRU specifications

Country	New Keynesian Phillips Curve Specification (NKP)		Traditional Keynesian Phillips Curve Specification (TKP)		Commission Preference
	β Coef	T-stat	β Coef	T-stat	NKP / TKP
Belgium	-0.93	-2.64 **	-1.00	-2.73 **	**TKP/NKP**
Bulgaria	-2.91	-3.45 **			**NKP**
Czech Republic	-1.02	-2.00 *	-0.81	-1.20	**NKP**
Denmark	-0.71	-2.63 **	-0.32	-1.60	**NKP**
Germany	-0.56	-1.96 *	-0.83	-2.60 **	**TKP/NKP**
Estonia	-1.01	-2.17 **	-1.59	-2.33 **	**NKP**
Ireland	-0.86	-1.88 *	-0.59	-1.78 *	**NKP**
Greece	-0.45	-0.93	-0.19	-0.81	**NKP**
Spain	-0.45	-2.41 **	-0.49	-3.04 **	**NKP**
France	-0.63	-1.98 *	-0.52	-2.17 **	**TKP/NKP**
Croatia	-1.07	-1.92*			**NKP**
Italy	-0.92	-1.73*	-3.19	-2.92 **	**TKP/NKP**
Cyprus	-1.02	-1.61			**NKP**
Latvia	-1.54	-3.83 **	-0.93	-2.22 **	**NKP**
Lithuania	-1.00	-4.95 **	-0.29	-1.32	**NKP**
Luxembourg	-3.74	-2.27 **	-0.57	-1.93 *	**TKP (Sample is too short)**
Hungary	-1.51	-1.92*	-2.14	-1.72	**NKP**
Malta	-0.03	-0.01	-1.90	-1.45	**TKP**
Netherlands	-0.67	-1.42	-0.41	-2.47 **	**TKP**
Austria	-0.75	-1.39	-0.67	-2.10 **	**TKP**
Poland	-0.67	-1.86*	-0.12	-1.54	**NKP**
Portugal	-1.38	-2.40 **	-0.80	-1.45	**NKP**
Romania	-4.22	-4.62 **	-9.06	-1.92 *	**NKP**
Slovenia	-1.06	-2.20 **	-2.79	-2.25 **	**NKP**
Slovakia	-0.57	-1.99 *	-0.28	-1.21	**NKP**
Finland	-1.10	-3.65 **	-0.26	-1.16	**NKP**
Sweden	-1.03	-2.33 **	-0.17	-0.87	**NKP**
UK	-1.10	-3.07 **	-1.92	-3.68 **	**NKP**

** Shows statistical significance at the 5-percent level; * Shows statistical significance at the 10 percent level.

The following approximation of critical values is used: For the TKP and NKP specifications for the old member states, a critical value of 2.021 applies at the 5% significance level and 1.684 at the 10% significance level. For the TKP model for the new member states a critical value of 2.131 applies at the 5% significance level and 1.753 at the 10% significance level. For the NKP model for the new member states, a critical value of 2.120 applies at the 5% significance level and 1.746 at the 10% significance level.

These calculations are based on the following determination of degrees of freedom: In the TKP model we assume that we need to estimate 5 parameters: the intercept, a coefficient for the unemployment gap and on average 3 coefficients for 3 exogenous variables. In the NKP model we assume that we need to estimate 4 parameters: the intercept, a coefficient for the unemployment gap, a coefficient for the lagged dependent variable and on average 1 coefficient for an exogenous variable. In the old member states around 50 observations are available. In the new member states around 20 observations are available.

2.4.2 : The "non-centering" issue

A specific detail that differs across the TKP and NKP specifications requires particular attention. Whilst the NKP set up imposes a zero-mean restriction on the unemployment gap, the TKP model does not impose such a restriction on the unemployment gap series. Note that this restriction is equivalent to imposing that the NAWRU average be equal to the unemployment rate average. That is, those two series need to be centered with respect to each other. Instead, in the TKP model, such centering is not imposed. In turn, the average level of the NAWRU based on the TKP and the NKP specifications may differ. In practice, if the TKP model yields a NAWRU that does not post an average that is broadly in line with that of the unemployment rate series, then this NAWRU will also appear shifted (upwards or downwards) with respect to the NKP based NAWRU.

Note that imposing a zero-mean unemployment gap restriction in the context of the TKP model is being considered. However, the merit of changing the settings of the TKP model to impose such a restriction is still being assessed. Thus, during a transitional period, the TKP model is left unchanged and to address the issue of NAWRUs posting different average levels across the two models, an additional step is used to mitigate the impact of the zero-mean restriction on the NKP based NAWRUs. The aim is to bring those NAWRUs more in line with the settings used under the TKP model, rendering the two approaches more comparable and minimizing the impact of adding the NKP model to the overall NAWRU estimation framework. This step introduces the notion of a mean-adjusted, non-centered, NKP based NAWRU. Mean adjustment of the NKP NAWRU's is carried out as follows:

1. The mean difference between the unadjusted NKP NAWRU and the TKP NAWRU is computed.
2. If the mean difference is positive, the NKP NAWRU is shifted downwards by the amount of this difference. Following this step, the two NAWRUs post an equal average value.

This implies that the NAWRU estimation framework accepts a lower mean NAWRU if the unadjusted (i.e. previously centered) NKP NAWRU was posting a higher mean NAWRU than the TKP NAWRU. Note that the reverse situation – i.e. the need to adjust the NKP NAWRU upwards – is currently not envisaged as it would concern only a limited number of countries and imply only a limited shift, which appears unwarranted in view of uncertainty surrounding those estimates. For illustrative purposes, the individual country adjustments implemented in the context of the Spring 2014 forecast round are reported in Table 3. Note that currently, for 7 countries (i.e. Belgium, Germany, Italy, Luxembourg, Malta, the Netherlands and Austria), the TKP framework is used to estimate the NAWRUs. For the other 21 countries, the NKP-based NAWRUs are used. The downward adjustment of the NKP based NAWRU's for cases in which the mean is higher than what would be obtained using the TKP model concerns 17 countries, as shown in Table 3 below. Note that the comparison of the mean of the NAWRU obtained for the NKP and TKP specifications is computed on overlapping periods – i.e. periods for which the NAWRU is available for both the TKP and the NKP specifications.

Table 3 : NKP Adjustment Factors (Adjustment factors correct for a positive difference between the mean of the NKP-based NAWRU and the mean of the TKP-based NAWRU)

Member State	NKP Adjustment Factor
Austria	TKP model used
Belgium	TKP model used
Bulgaria	--
Cyprus	-0.08
Czech Republic	-0.06
Germany	TKP model used
Denmark	-0.51
Estonia	--
Greece	-0.92
Spain	-0.67
Finland	-0.72
France	-0.26
Croatia	-0.30
Hungary	-0.20
Ireland	-0.43
Italy	TKP model used
Lithuania	-0.29
Luxembourg	TKP model used
Latvia	-0.19
Malta	TKP model used
Netherlands	TKP model used
Poland	--
Portugal	-0.28
Romania	--
Sweden	-0.94
Slovenia	-0.08
Slovakia	-0.05
UK	-0.15

2.4.3 Some stylized facts emerging from the EC's Spring 2014 Forecast Exercise

The EC's Spring 2014 Economic Forecasts are the first forecast exercise in which the all-encompassing Phillips curve methodology has been applied. In this section we show some stylized facts emerging from these economic forecasts. Graphs 3-7 show results for the NAWRUs and actual unemployment rates in the euro area, the EU as a whole, as well as in a number of selected countries whose trends are broadly representative of three groups of countries, formed according to whether their NAWRUs were increasing, decreasing or comparably stable in the aftermath of the economic crisis.

Graph 3 shows that non-cyclical unemployment in the euro area (EA 18) posted a steady decrease in the mid-1990s as a result of the labour market reforms. This improvement was then halted by the recent crisis. The recent rise in the NAWRU suggests that the increases in unemployment seen in the aftermath of the crisis are, to some extent, likely to last beyond the

cyclical upturn. However, these recent increases in the euro-area NAWRU should not be interpreted as a sign of big structural changes at the current juncture. Rather, in most countries, the increases reflect the effects of shocks that, in the presence of various rigidities, have a long-lasting impact on unemployment rates (see Box 1).

Graph 4 shows that the developments of both the NAWRU and the unemployment rate in the EU-28 area are similar to those observed in the euro area: we observe a steady decrease of the NAWRU in the EU-28 area from the mid-1990s as a result of the labour market reforms, which was then halted by the recent crisis. Compared to the EA-18 area, both the NAWRU and the unemployment rate are currently higher in the EU-28 area.

Graph 5 shows the development of the actual unemployment rate and the NAWRU in Germany, representing the group of countries with a decreasing NAWRU in the aftermath of the economic crisis. The only other countries displaying this pattern are Poland and Slovakia. In these countries the size of the shock resulting from the economic crisis appears to have been smaller and pre- and post-crisis policy responses seemed to have a positive impact. In Germany, for example, the decline in the NAWRU seems related to certain aspects of the Hartz reforms (see Box 1). Notwithstanding these positive developments, the graph shows that Germany experienced a steady increase in the NAWRU over the 1980's and up until the pre-financial crisis period, as was also the case for Austria. In the case of Germany, a vital factor in explaining the increase in the NAWRU was the unification-related structural break (d'Auria et al 2010). In Austria the rise was rather driven by an increase in the tax wedge (ibid.).

Graph 6 shows the development of the actual unemployment rate and the NAWRU in Finland, representing the group of countries with a comparably stable NAWRU in the aftermath of the economic crisis. Countries belonging to this group are Finland, Malta and Sweden. In these countries the shock resulting from the economic crisis appears to have been comparably small and the labour market was able to largely absorb the subsequent effects.

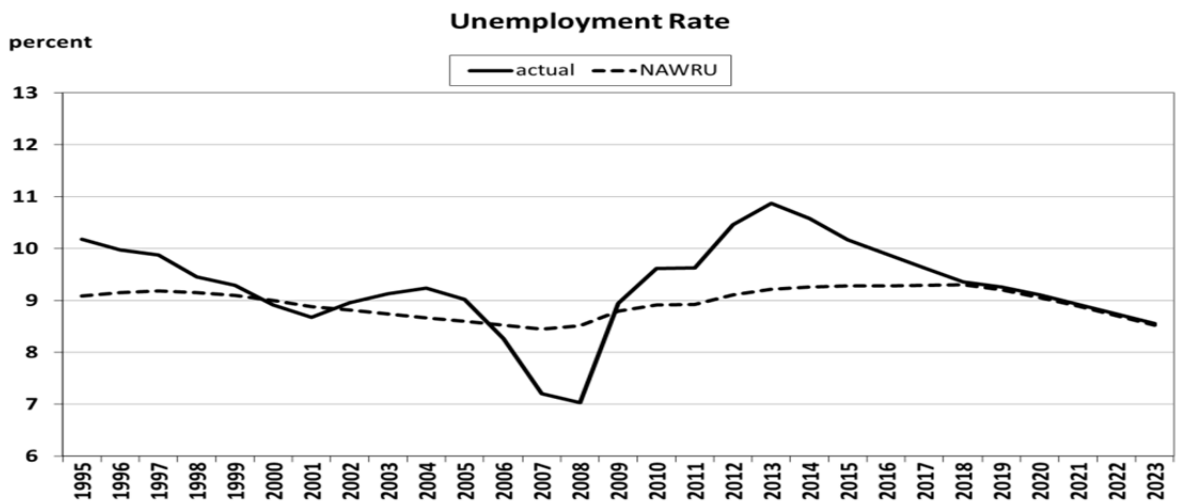
Graph 7 shows the development of the actual unemployment rate and the NAWRU in Spain, representing the group of countries with an increasing NAWRU in the aftermath of the economic crisis. A rise in the NAWRU points to a persistent deterioration in the labour market performance. Identifying the causes of the deterioration calls, however, for cautious interpretation (see Box 1). In Spain, for instance, the decline in the run-up to the crisis and subsequent surge in the NAWRU in Spain appears mostly attributable to non-structural factors, such as unsustainable developments in the housing sector. The build-up and subsequent unwinding of imbalances has caused large economic shocks (leading to a need for sectoral reallocation) which have a persistent effect on the performance of the labour market. The group with increasing NAWRUs is the largest group and, besides Spain, it comprises Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Greece, France, Croatia, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, the Netherlands, Portugal, Romania, Slovenia and – characterised by a very slight increase, which is now stabilizing - the United Kingdom.

Graph 3: Unemployment rate and the NAWRU for the euro area (EA18)

Note: The NAWRU series displays the GDP weighted average NAWRU series of euro-area (EA18) countries. For new member states the series were not available from the mid 1990s onwards. They were extended using values computed based on a Hodrick Prescott filter using the harmonized unemployment rate.

Source: DG ECFIN calculations based on Eurostat data.

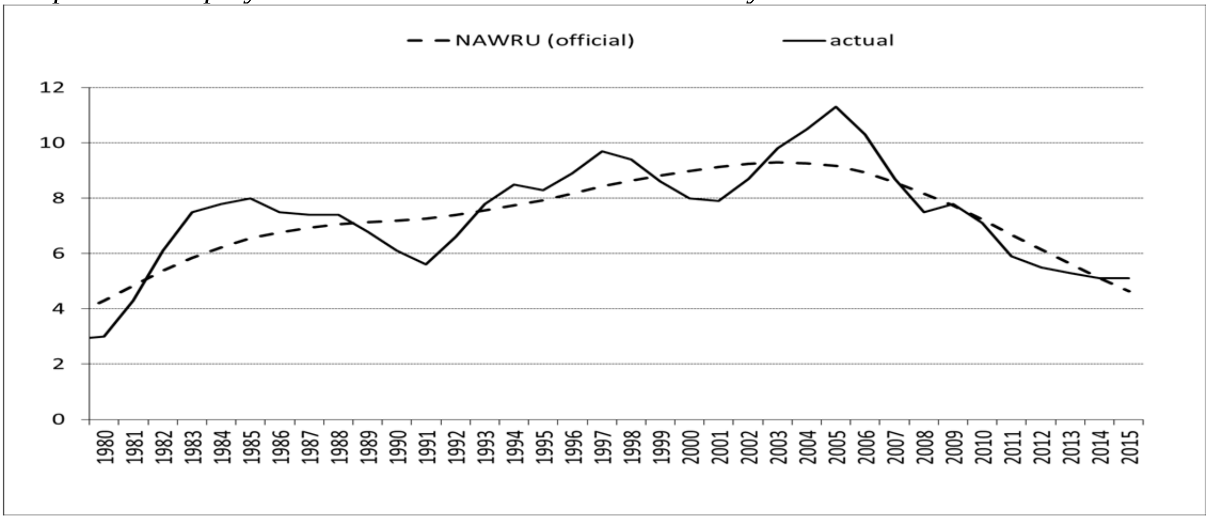
Graph 4: Unemployment rate and the NAWRU for the EU28 area



Note: The NAWRU series displays the GDP weighted average NAWRU series of EU 28 countries. For new member states the series were not available from the mid 1990s onwards. They were extended using values computed based on a Hodrick Prescott filter using the harmonized unemployment rate.

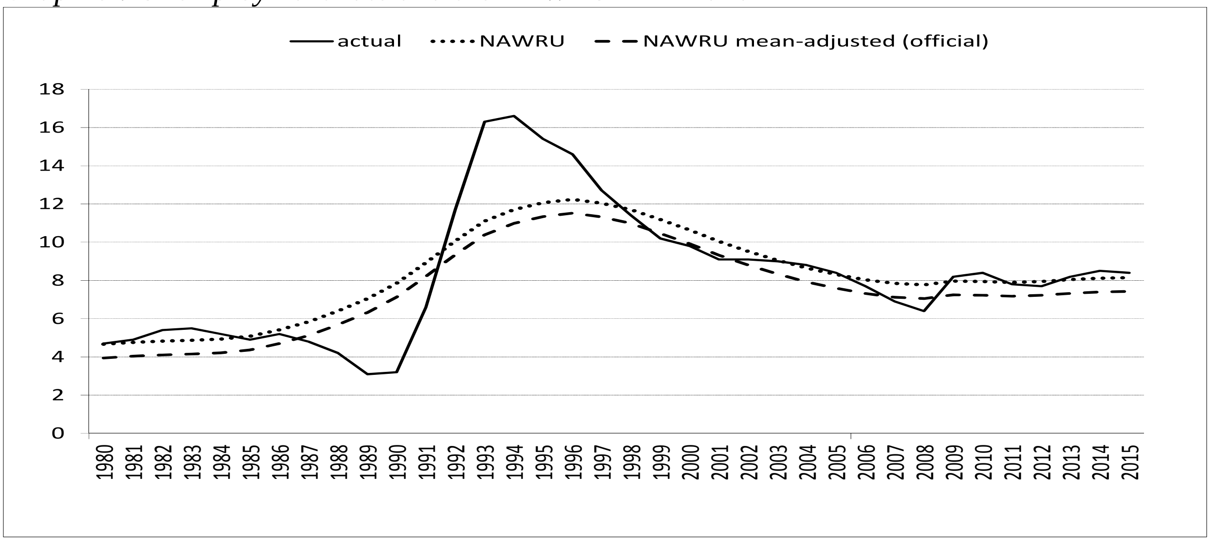
Source: DG ECFIN calculations based on Eurostat data

Graph 5: Unemployment rate and the NAWRU in Germany



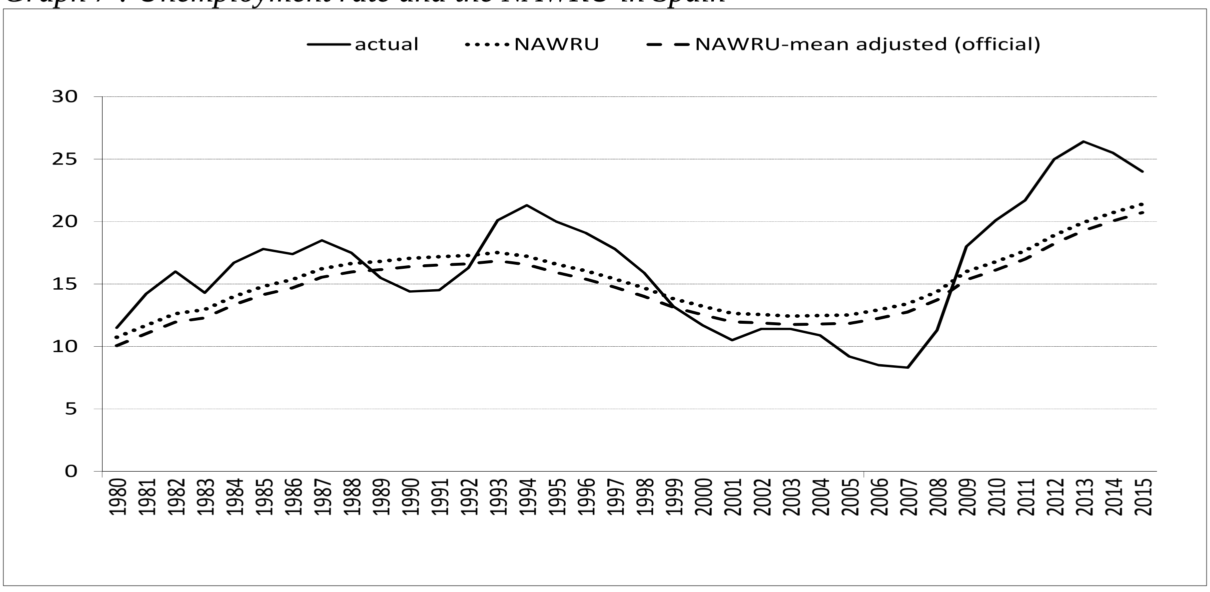
Source: DG ECFIN calculations based on Eurostat data.

Graph 6 : Unemployment rate and the NAWRU in Finland



Source: DG ECFIN calculations based on Eurostat data.

Graph 7 : Unemployment rate and the NAWRU in Spain



Source: DG ECFIN calculations based on Eurostat data.

Box 1: NAWRU versus Structural Unemployment

Careful analysis of developments in the NAWRUs produced by the new methodology shows that they can be driven by both structural and non-structural factors (see Orlandi (2012)).

The cyclicality of the NAWRU firstly stems from the fact that crisis-related shocks (e.g. unwinding of unsustainable developments), especially boom-bust episodes in the housing market that can trigger a lengthy process of deleveraging in the construction sector, have a statistically significant impact on the NAWRU. The real interest rate and Total Factor Productivity (TFP) growth variables, which control more generally for the presence of such shocks, also play a part in driving NAWRU developments.

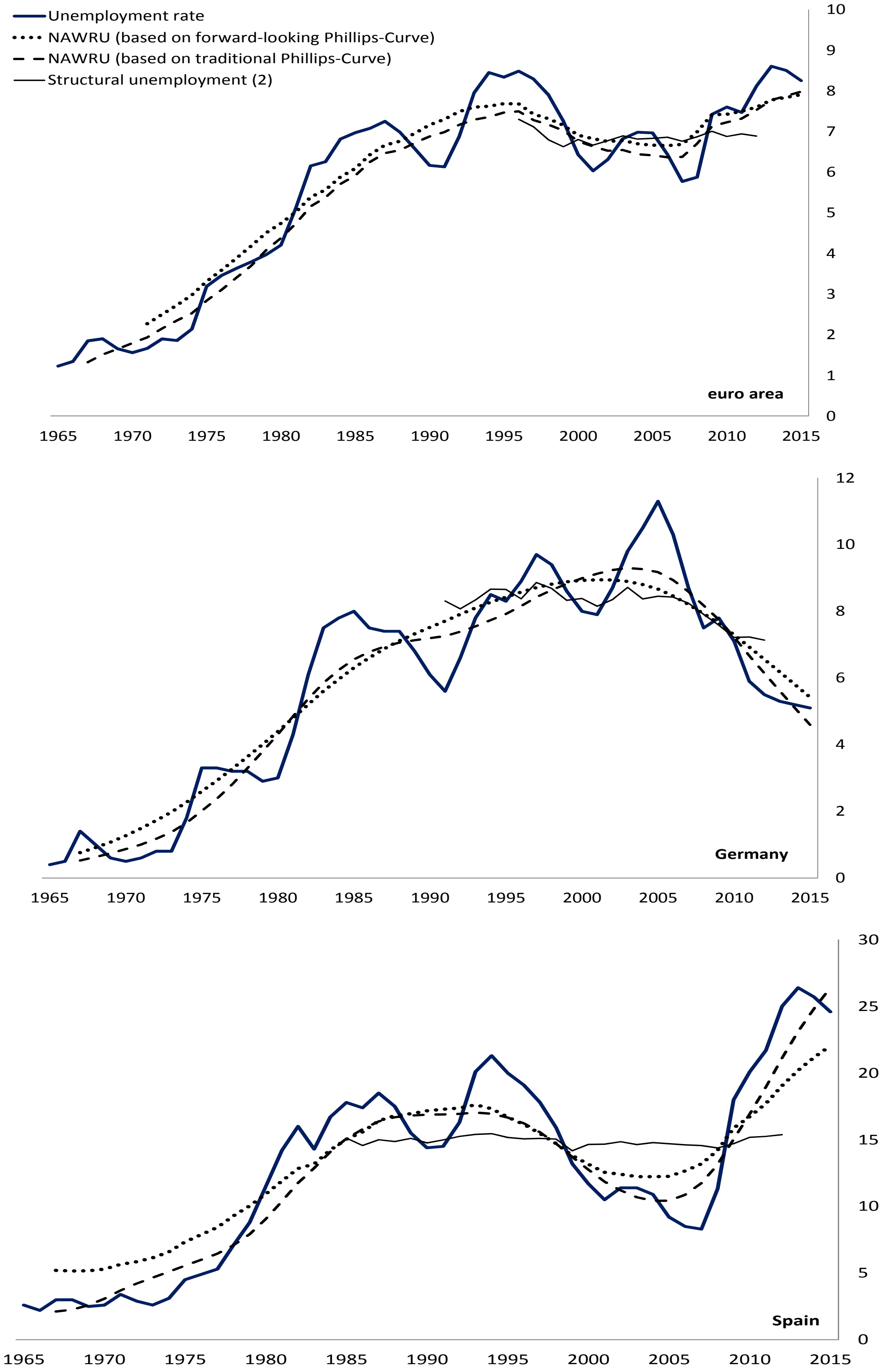
Intuitively, the cyclicality of the NAWRU stems from the fact that real wages adjust slowly to labour demand shocks in the presence of real rigidities. Therefore the adjustment to the shocks happens partly through protracted changes in the unemployment rate. Therefore, adding various rigidities (e.g. real wage rigidity, cyclical price mark-ups or sluggish adjustment of the reservation wage) to the traditional labour market model can be shown to yield a NAWRU that is not solely determined by structural factors.

Overall, in this context, it appears useful to distinguish between the NAWRU and a narrowly defined notion of structural unemployment affected only by structural factors, depicted in Graph 1 by the 'structural unemployment' series. The latter represents the portion of the NAWRU that, according to econometric results, is explained by structural features of the labour market. The NAWRU incorporates cyclical elements whilst structural unemployment should be based solely on policies, institutions, technology, etc.

As can be seen, the structural unemployment series has remained broadly stable during the crisis. Except for a notable decline due to structural labour market reforms in Germany, the change in the NAWRU in the euro area is not related to structural change. This is also the case in Spain, where structural unemployment has remained broadly stable.

Recent increases in the euro-area's NAWRU should therefore not be interpreted as a sign of big structural change at the current juncture. Rather, in most countries, the increases reflect the effects of shocks that, in the presence of various rigidities, have a long-lasting impact on unemployment rates. Note that, despite uncertainties, the NAWRU remains a useful policy indicator. It is a well-defined concept that provides useful information on the nature of unemployment rate developments. In particular, it identifies risks of persistent labour market deteriorations that may not always be caused by structural phenomena.

Graph 1: **Alternative NAWRU estimates, euro area, Germany and Spain (1)** *(1965-2015, in %)*



(1)GDP weighted average of euro-area countries for which alternative NAWRUs have been computed (i.e. AT, BE, DE,
EL, ES, FI, FR, IE, IT, NL and PT). For AT, both NAWRUs are based on the backward-looking model, as the forward looking
model yields econometrically unsatisfactory results.
(2)Component of the NAWRU explained only by structural determinants (see Orlandi (2012), op. cit.).
Source: DG ECFIN calculations based on Eurostat data.

To sum up, the decline in the NAWRU at the euro-area level and in countries like Spain in the run-up to the crisis appears mostly attributable to non-structural factors such as unsustainable developments in the housing sector. The build-up and subsequent unwinding of imbalances has caused large economic shocks (requiring sectoral reallocations) which have a persistent effect on the performance of the labour market. However, in some countries, structural factors have also played a role in driving NAWRU developments. In Germany, for example, the decline in the NAWRU seems related to some aspects of the Hartz reforms (e.g. the change in the period of eligibility for unemployment benefit appears to have contributed to a decline in the NAWRU over recent years). This suggests that large-scale reforms, as currently being enacted in some countries, will tend to translate into a gradual lowering of the NAWRU over the coming years.

A risk factor, which should be taken into account for future developments in the NAWRU and also structural unemployment, stems from the development in the matching of skills in the EU. Indeed, the reallocation process has been characterized by growing skill mismatches, particularly in Greece, Spain and Portugal (in Germany, however, a decrease in skill mismatch was observed). Worsening skill mismatch and a resulting rise in long-term unemployment rates are therefore seen as a risk factor for the development of structural unemployment. Our NAWRU projections are based on historical experiences about the speed in which the NAWRU increases and decreases over time. Crucial for the adjustment is the time needed to reallocate the newly unemployed into alternative employment opportunities in expanding industries, and whether countries can avoid "hysteresis effects" whereby a severe loss in human capital endowments, induced by long spells of unemployment, lead to long-lasting exclusion from the labour market.

SECTION 3: METHODOLOGY FOR CALCULATING TOTAL FACTOR PRODUCTIVITY (TFP)

3.1 : TFP TREND-CYCLE DECOMPOSITION : PROBLEMS WITH THE OLD HP FILTER METHOD & OVERVIEW OF THE NEW KALMAN FILTER APPROACH

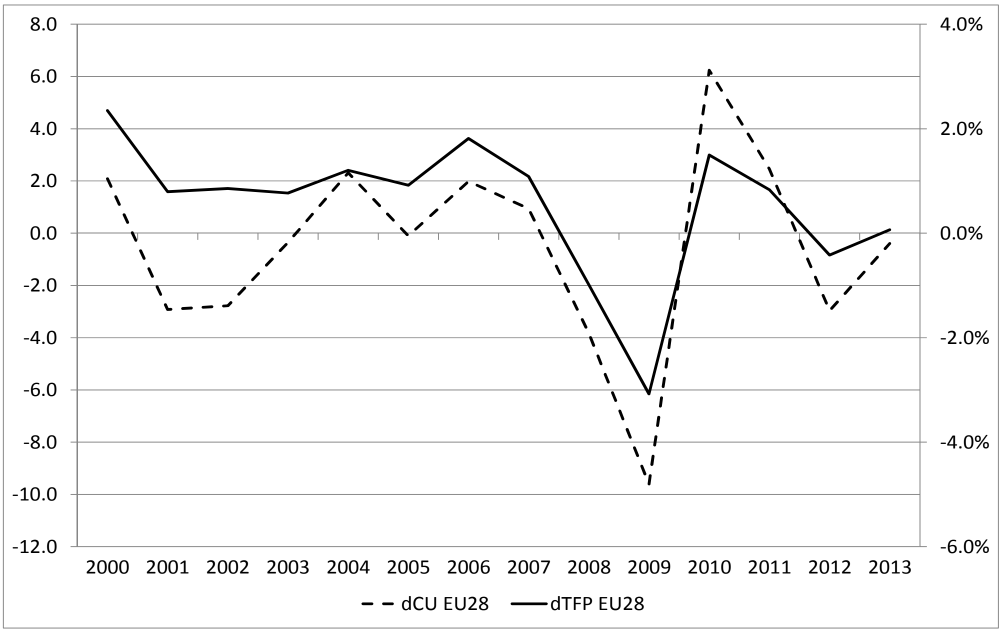
In Autumn 2010 the previously used Hodrick-Prescott (HP) method for detrending TFP was replaced with a new Kalman filter based approach which exploits the link between TFP and capacity utilization. This decision was taken by the EPC in order to address a number of problems with the HP filter method, especially its tendency to produce imprecise estimates at the end of the sample period, most notably close to turning points. The KF method partly addresses these shortcomings by exploiting the relationship between TFP and the capacity utilization indicator, which carries information that cannot be extracted in real time from the TFP series alone. In particular, the capacity utilization indicator has two important characteristics which make it suitable for the task:

- Firstly, it is measured with acceptable precision and without revisions. This is helpful in reducing TFP trend estimate revisions due to periodic updates of the underlying series.[13]

- Secondly, it strongly co-moves with the unobserved cyclical component of TFP, hence enabling unbiased extraction of the TFP cycle even at the end of the sample.

Graph 3.1 displays the TFP (spring 2014 vintage) and capacity utilization composite indicator series (in differences) for the EU28. An inspection of the graph confirms that the two series are strongly correlated. The simple coefficient of correlation is about 0.85.

Graph 3.1 : EU Capacity utilization and TFP (in differences)



Source: Commission services

[13] It should be understood however that such revisions will never be completely eliminated.

KF Approach - A joint model for TFP and capacity utilization: The bivariate KF method exploits the link between the TFP cycle and capacity utilization that arises in the Cobb-Douglas framework. Its basic structure is similar to the Phillips-curve augmented unobserved component model proposed by Kuttner (1994) for estimating potential output and output gaps in the US.

As explained earlier in Section 1, TFP is related to the labour efficiency (E_L) and capital efficiency (E_K) levels of the available technology and to labour and capital capacity utilization (U_L and U_K respectively) according to:

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

where constant α represents the labour share of income. Since efficiency is a persistent process whereas capacity utilization depends on current economic conditions, equation (3.1) suggests a TFP-decomposition into a trend P and a cycle C such that TFP = P × C with:

$$P = E_L^{\alpha} E_K^{1-\alpha} \qquad C = U_L^{\alpha} U_K^{1-\alpha}$$

The first relationship has no empirical relevance since efficiency is not measured. Capacity utilization measures are instead available, although so far without discriminating between the different production factors. Only an aggregate capacity utilization series, for example series U, can be readily obtained. By construction, we expect U and U_K to be significantly correlated. Given that the average hours worked per employee series already contains some cyclical movements, the link with labour utilization should be somewhat looser. However, if there are fluctuations in the degree of labour hoarding that are not captured by the hours worked series, a correlation between labour and capital utilization may nevertheless be present. It is thus assumed:

$$u_L = \gamma u_K + \varepsilon \qquad 0 < \gamma$$

where lowercase letters denote logarithms and ε is a random shock, with its properties defined in annex 2. Hence log-TFP is related to capacity utilization through:

$$tfp = p + (1 - \alpha + \alpha\gamma)\,u + \alpha\,\varepsilon$$

This link is exploited to detrend TFP through the following bivariate model:

(3.2) $$\begin{aligned} tfp_t &= p_t + c_t \\ u_t &= \mu_U + \beta\, c_t + e_{Ut} \qquad \beta > 0 \end{aligned}$$

where the small-case letters indicate log-levels of their large-case letter counterparts and e_{Ut} is a White Noise random shock.[14] The value of β can be considered a formal quantitative

[14] For three countries, namely Finland, France and Slovenia we allow for an AR(1) random shock:

$$e_{Ut} = \delta_U e_{Ut-1} + a_{Ut} \qquad |\delta_U| < 1$$

This element has been added to better fit the data for the aforementioned countries. However, it does not have a strong theoretical underpinning and it may be dropped in the future.

measure of the link between capacity utilization and TFP. System (3.2) must be completed with assumptions about the unobserved components dynamics. Their general structure as well as the specific assumptions made for each of the Member States are given in annex 2.

Construction of the capacity utilization composite indicator: Capacity utilization (CU) in the EU is measured by combining two types of indicators: the Capacity Utilization indicator and a set of Economic Sentiment indicators. Both are part of the European Commission's Business and Consumer Survey Programme (see the European Economy Special Report 5/2006 for details). The Economic Sentiment indicators are used to proxy for measures of capacity utilization in services and construction, for which direct indicators of capacity utilization have, so far, not been available.[15]. Annex 3 gives a detailed explanation of the method of calculating CU.

Model estimation: The model can be estimated using the standard maximum likelihood method or by applying a Bayesian approach. The latter is preferred as it overcomes a stability problem that can occur with maximum likelihood estimation whereby 0-coefficient estimates are obtained for structural shock variances. Another advantage of the Bayesian approach is that any additional information, possessed by modellers and policy makers, which is not captured in the data can however be easily incorporated into the analysis. For instance, some information is *a priori* available about the periodicity of the TFP cycle or the inertia of its trend.

In the Bayesian framework, all parameters are considered as random variables with an initial distribution that reflects prior knowledge. The estimation procedure aims at delivering posterior distributions of all unobserved quantities given both prior assumptions and observations. The likelihood is evaluated by the bivariate model (3.2) cast into a state space format so that the Kalman filter can be applied.

The framework allows for some flexibility in modelling choices. In particular, trend TFP can be modelled as an integrated series of order 1 or 2 (i.e. either I(1) or I(2) respectively). The choice of the order of integration is then data-driven and is done separately for each Member State.[16] Other details about the methodology and the prior distributions are given in annex 2. All computations are made by the programme GAP which has been developed in the Commission's Joint Research Centre and is downloadable from the "Output Gaps" internet website, together with a user-manual.

[15] The Commission started collecting Capacity Utilization indicators for services in 2011. The series is planned to be officially published at the end of 2014, at which point experiments will start in order to replace the Economic Sentiment indicator. Note also that Ireland interrupted its business surveys in 2008. For this reason no CU indicator is used for this country in more recent years. For another three countries (Romania, Bulgaria and Croatia) the CUBS series are too short to be used so that a univariate KF model is estimated instead.

[16] At this moment in time the I(1) assumption is preferred for all Member States.

3.2 : ILLUSTRATIVE RESULTS: POST-CRISIS TFP TRENDS IN THE EU

Model validation: As mentioned in the previous sub-section, the β-coefficient in equation (3.2) measures the strength of the relationship between capacity utilization and the TFP cycle. Table 3.1 reports the posterior mean and 90%-confidence intervals obtained with the 2009 TFP vintage for all EU countries.[17] As can be seen, for all countries the 90%-confidence interval excludes 0: hence the TFP-CU common cycle hypothesis is not refuted by the data. Model (3.2) also foresees that β should be greater than 1. Indeed, this prediction is confirmed for all countries for which the CU indicator is available, with the lowest posterior mean of β for Ireland and Portugal (about 1.15) and the highest for Spain (2.44). These results confirm the earlier visual observation, using graph 3.1, that there is a strong statistical link between capacity utilization and the TFP cycle.

Table 3.1 : Posterior mean and 90%-confidence band for β-coefficient

EU15			***EU13***		
Country	***Posterior mean***	***90% interval***	***Country***	***Posterior mean***	***90% interval***
Austria	1.56	[0.89;2.16]	Bulagria	#N/A	#N/A
Belgium	1.51	[0.92;2.12]	Croatia	#N/A	#N/A
Denmark	1.54	[1.16;1.91]	Cyprus	2.05	[0.69;3.22]
Finland	2.03	[1.41;2.61]	Czech Republic	1.21	[0.53;1.79]
France	1.75	[1.12;2.26]	Estonia	1.74	[1.15;2.32]
Germany	1.5	[0.91;2.16]	Hungary	1.34	[0.57;1.85]
Greece	1.22	[0.82;1.65]	Latvia	1.15	[0.62;1.65]
Ireland	1.14	[0.53;1.69]	Lithuania	1.38	[1.01;1.76]
Italy	2.18	[1.69;2.58]	Malta	1.34	[0.21;2.33]
Luxemburg	1.5	[0.83;2.24]	Poland	1.34	[0.65;2.06]
Netherlands	1.96	[1.47;2.41]	Romania	#N/A	#N/A
Portugal	1.15	[0.5;1.77]	Slovakia	1.75	[0.76;2.68]
Spain	2.44	[1.77;3.13]	Slovenia	1.33	[0.71;1.93]
Sweden	1.81	[1.22;2.35]			
UK	1.41	[0.95;1.85]			

(**Notes**: The 90%-confidence interval is the smallest region of the β-posterior distribution that contains 90% of the distribution. The results in the table are obtained with the TFP spring 2014 vintage).
Source: Commission services

Total Factor Productivity performance in the EU since the year 2000 : As shown in graph 3.2, actual TFP in the EU slowed down sharply following the bursting of the dot-com bubble in 2001; then partially recovered over the period 2003-2006; and had started to deteriorate again before experiencing the huge hit provoked by the economic and financial crisis of the late 2000s. These actual TFP developments for the post-2000 period as a whole, translate into a very slow, but continuous deterioration in the trend TFP performance, with

[17] As mentioned previously, a univariate model is used in the case of Romania, Bulgaria and Croatia. Therefore, for these countries coefficient β does not exist.

EA18 TFP trend growth rates falling from about 1% in 2000 (or slightly above that for EU28) to only about 0.3% in 2013 (see graph 3.2).

Graph 3.2 : EU TFP and TFP trend (growth rates)

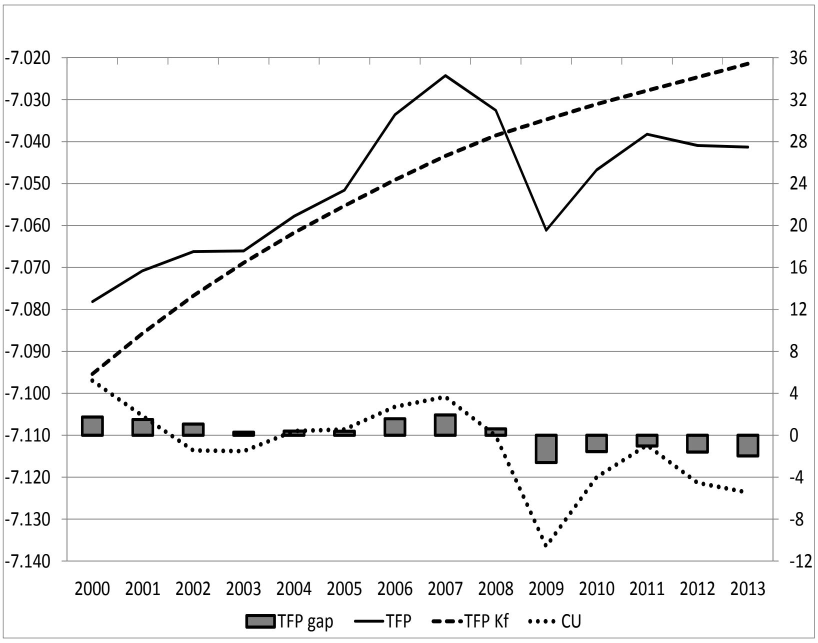
Source: Commission services

This persistent fall in trend TFP is considered to be only marginally explained by the temporary factors due to the crisis. In fact, the current TFP trend estimation method deals very well with extracting the cyclical part of actual TFP. As can be seen on Graph 3.3, the slowdown in trend TFP is much less than the slowdown in actual TFP. Consequently, the Commission's current estimates of potential TFP are much more optimistic than what could be inferred from a univariate analysis of actual TFP (using, for example, the standard Hodrick-Prescott filter). To understand this important result it is best to look at the TFP gap (see Graph 3.3), which captures that part of the TFP slowdown which is of a purely cyclical nature. As explained above, the TFP gap should be closely linked to the capacity utilization (CU) fluctuations in the same period and therefore should widen (become more negative) if capacity utilization in the economy falls. As is visible on the graph, the CU indicator fell to an unprecedented low during the crisis, indicating that much of the fall in the actual TFP was indeed cyclical. In fact, it can be calculated that capacity utilization developments explain

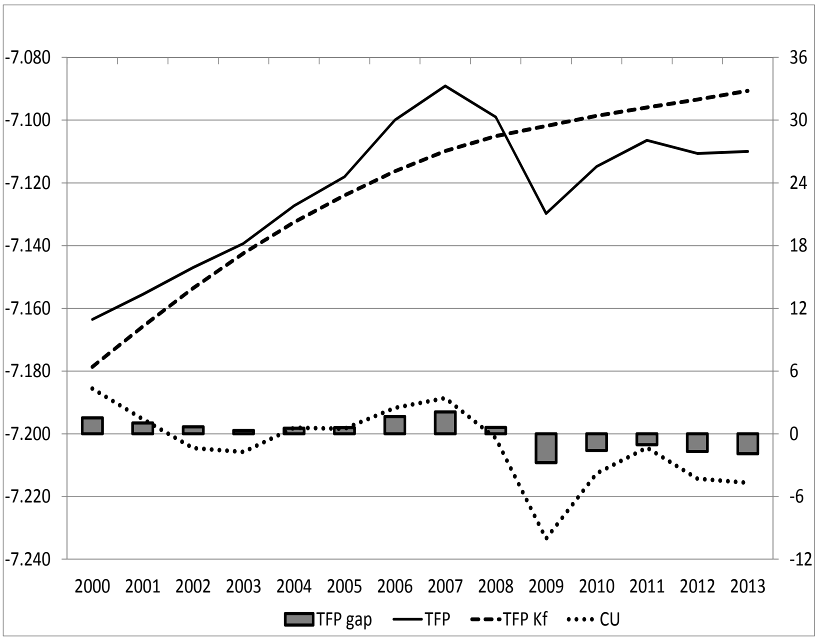
about 80% of the observed increase in the TFP gap in the EU28 (and above 95% in the EA18).[18]

Graph 3.3 : EU Capacity utilization and TFP (both in differences and rescaled)

EA18



EU28



Source: Commission services

The very strong link between the capacity utilization indicator used in the estimation and the TFP gap is illustrated in Graph 3.4. Clearly, the cyclical movements in TFP across time are very well reflected in changes in the utilization of productive capacity by companies.

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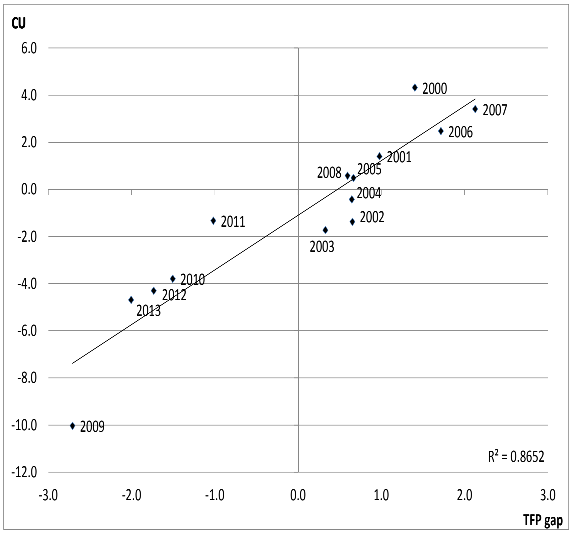
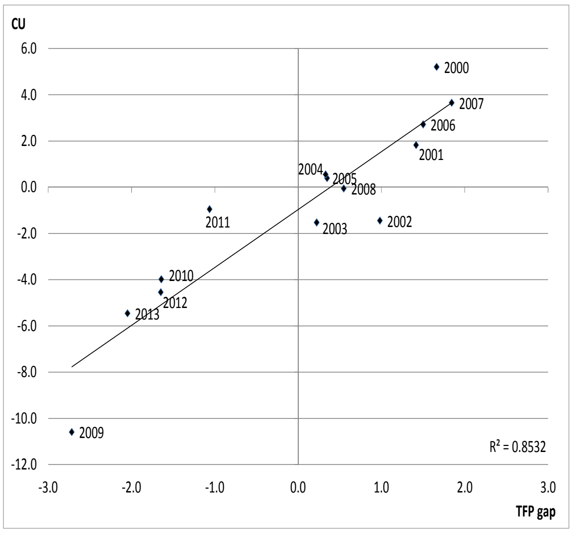
(18) From the model (3.2), it must hold that $\Delta tfp - \Delta p = \Delta c = (1/\beta) \times u + error$. From the above identity it follows that for the method to explain the data well it is required that the ratio of $(1/\beta) \times u$ and the growth rate of the TFP gap be close to 100%, which would be consistent with a small estimation error. The EU-wide ratios are found by using a weighted average of national betas.

Graph 3.4 : Capacity utilization (CU) versus TFP gap

EU28



EA18



SECTION 4: DESCRIPTION OF THE NEW T+10 METHODOLOGY

4.1. Introduction : With the launch of the Europe 2020 Strategy, the implementation of the European Semester, as well as periodic exercises such as the Ageing Report, the EPC considered it necessary to have a set of integrated, no policy change, macroeconomic projections which covered the period up to T+10. The EPC consequently decided in November 2011 to give a mandate to the OGWG to come up with a new T+10 projection methodology ("in time to be used for the European Semester of 2013"), which would take as its starting point the OGWG's existing methodology for producing potential growth rate projections up to T+5. Based on this mandate, the OGWG developed a T+10 methodology which was endorsed by the EPC in November 2012, on an interim basis, for use in the 2013 Semester.

Building on the EPC agreement reached in November 2012, and guided by a new (EPC endorsed) mandate and work programme, the OGWG met six times over the period to May 2014 in order to address the concerns raised by specific EPC members regarding the interim 2012 agreement. Over this 1 ½ year period, the OGWG made good progress on improving the overall T+10 methodology (most notably with respect to addressing pro-cyclicality concerns with the T+5 NAWRU methodology and in agreeing pragmatic solutions to overcome the breaks in participation rates in T+6, as well as reaching a compromise solution regarding the partial lifting of the investment exceptions for Germany and Malta – see annex 4 for details). Whilst it is accepted that there are a number of outstanding issues which have still to be discussed in the OGWG regarding T+10 (most notably, specific points on stabilizing the long run NAWRU anchor; the need to further fine-tune the approach for dealing with TFP persistence issues; & the approach to be taken in trying to integrate T-1 labour & product market reforms into the analytical framework), nevertheless due to the considerable progress which has already been achieved, the EPC endorsed the use of the new T+10 methodology for use as the starting point for the 2015 Ageing report[19].

This section has two main purposes :

- Firstly, to give a short overview of the key components of the T+10 methodology as endorsed by the EPC in May 2014 and of the implications for potential growth from applying this methodology to the Spring 2014 Commission services projections; &

- Secondly, to describe the key advantages which the T+10 methodology (applied to the Spring 2014 baseline projections) has as the starting point for the 2015 Ageing Report & why this is superior to the T+5 approach adopted for the previous, 2012, Ageing Report.

[19] Please note that it is currently not possible to predict whether any of these discussion streams will lead to any proposals to change the May 2014 T+10 methodology. With respect to stabilizing the T+10 anchor, on the basis of the current proposals, the impact, if finally agreed, on the T+10 projections would be extremely small. The main effect of any change would be to improve the economic interpretation of any adjustments to the NAWRU anchor. Regarding the integration of the impact from more recent reform measures, one of the options for dealing with this issue is to ask Eurostat and the OECD to consider speeding up the production of the indicators used in the current methodology. Finally, with regard to TFP, there is a strong likelihood that discussions on this item will eventually conclude that there is no need to change the current T+10 methodology.

4.2. Key components of T+10 methodology & the potential growth rate implications from applying it to the Spring 2014 forecasts

4.2.1 Key components : A detailed description of all the main elements of the T+10 framework is provided in Annex 4, with the bullet points below providing a short summary of the most important aspects of each of the five main components (NAWRU, TFP, Capital Formation; Labour Force Participation Rates & Hours Worked) :

- **NAWRU**[20] : The NAWRU framework incorporates economic rationale into the T+10 NAWRU forecast, relying on a set of four labour market economic indicators (i.e. unemployment benefit replacement ratio; tax wedge; active labour market policies; & union density) and a set of macro control variables (i.e. TFP; real interest rate; employment in construction; & the T+5 NAWRU) to guide the forecast beyond T+5. This approach allows for a decomposition of the NAWRU into structural drivers and medium term cycles & for a prediction between T+6 and T+10 which reverts the NAWRU back towards the long run structural unemployment rate. A simple convergence rule towards the T+10 NAWRU is applied & a so-called prudent rule is built into the approach in order to override the calculations in cases where the T+10 NAWRU forecast is deemed to be surrounded by a relatively high degree of uncertainty for a particular country.

- **TFP** : The approach which underpins the T+10 projections, relies on the same bivariate Kalman Filter (KF) methodology which is currently used for producing trend TFP projections up to T+5. This approach has the advantage of allowing for the production of internally consistent projections at any time horizon and hence offers the additional benefit of parsimony (i.e. one method is used for both the T+5 and T+10 TFP trend projections).

- **Capital Formation** : The capital formation assumptions adopted for the T+10 exercise take account of the heterogeneity in country specific circumstances, most notably with respect to their respective structural transition processes. Consequently, for the "new" member states, an investment rule approach (univariate AR model up to T+10) is adopted whereby future investment projections are linked to historical past trends, as well as to the short term forecasts from country experts. For the "old" member states, the AWG's capital rule is linked to the investment rule approach with a ten year transition period, starting in T+6. The capital rule is based on the idea that over the long run the growth in capital should be broadly equal to the growth in potential output. Two countries have temporary exceptions to this capital rule approach, namely Germany and Malta.

- **Trend Participation Rates** : With respect to the extension of the trend labour force, the mandate given to the OGWG was to explore the use of the AWG's Cohort method for projecting the rate of participation of the labour force up to T+10. The "Cohort Simulation Model" (CSM) is the specific, and very detailed, application of the Cohort method as used and developed by the AWG. It has two main purposes: firstly, for preparing the long-term macro projections up to 2060, and secondly for evaluating the impact of national pension reform plans on the labour force. The decision was taken to use the results obtained from the AWG's model as the only pragmatic choice for implementing the Cohort method in the

[20] The introduction of structurally determined terminal conditions for NAWRU levels convergence has been the most difficult change to be agreed upon in the T+10 exercise given the well known difficulties in estimating robust structural estimates and in agreeing sensible convergence paths / speeds towards those estimates.

projections up until t+10, with the key issue stressed in the OGWG's work programme for 2013 being the need to devise a method for smoothing the (sometimes large) breaks in participation rates in the year the Cohort method is introduced. This break is due to the linking of two very different participation rate forecast methodologies in T+6 (i.e. the time series driven OGWG approach, with the more demographics driven Cohort method). Following a number of discussions in the OGWG over the last 18 months, a technical transition rule for smoothing the breaks in participation rates was finally agreed by the EPC in May 2014.

- **<u>Hours Worked</u>** : The current T+10 method assumes broad stabilisation in average hours worked after T+5. The resulting projections for the t+6/t+10 period are comparable to those from the AWG & result in practically constant overall average hours worked over this period of time.

4.2.2 : Implications for potential growth rates from applying the improved T+10 methodology to the Spring 2014 Commission services projections : The detailed tables and graphs from applying the improved T+10 methodology to the Spring 2014 forecasts for the main EU aggregates, are contained in annex 6. Consequently, the present section only focusses on providing a graphical overview of the main impact of applying the T+10 methodology at the level of the EU as a whole, as well as including a summary table to show the impact for each of the 28 Members for each year over the period to 2023 (see Table 1).

Regarding the EU as a whole, graph 1 shows that the EU is expected to slowly recover over the period to T+5, with the pace of recovery accelerating a little over the period to T+10 as the EU's growth rate moves back toward its pre-crisis level. This relatively optimistic scenario is driven by an improvement in TFP growth rates, as restructuring efforts start to pay off, as well as by a recovery in those areas of the EU's economy which were most badly affected by the financial crisis, namely investment rates and labour markets. With respect to labour markets, whilst the current T+10 projections point to continuing increases in participation rates and falls in structural unemployment, unfortunately this positive news is being increasingly offset by negative population of working age trends. In overall terms, the results shown in graph 1 (EU as a whole) and table 1 (the individual country results) indicate that the structural challenges which the EU's Member States have had to face following the financial crisis are gradually being corrected. However, it is also clear that persistent efforts remain necessary to reverse long-lasting, negative, trends with respect to TFP; to continue the healing process provoked by the financial crisis; and finally, to counter the forthcoming impact of ageing populations on growth.

Graph 1 : Overview of the Potential Growth Rate Forecasts to 2023 for the EU28 (including trends for the labour, capital and TFP contributions to growth and their respective determinants)

EU28

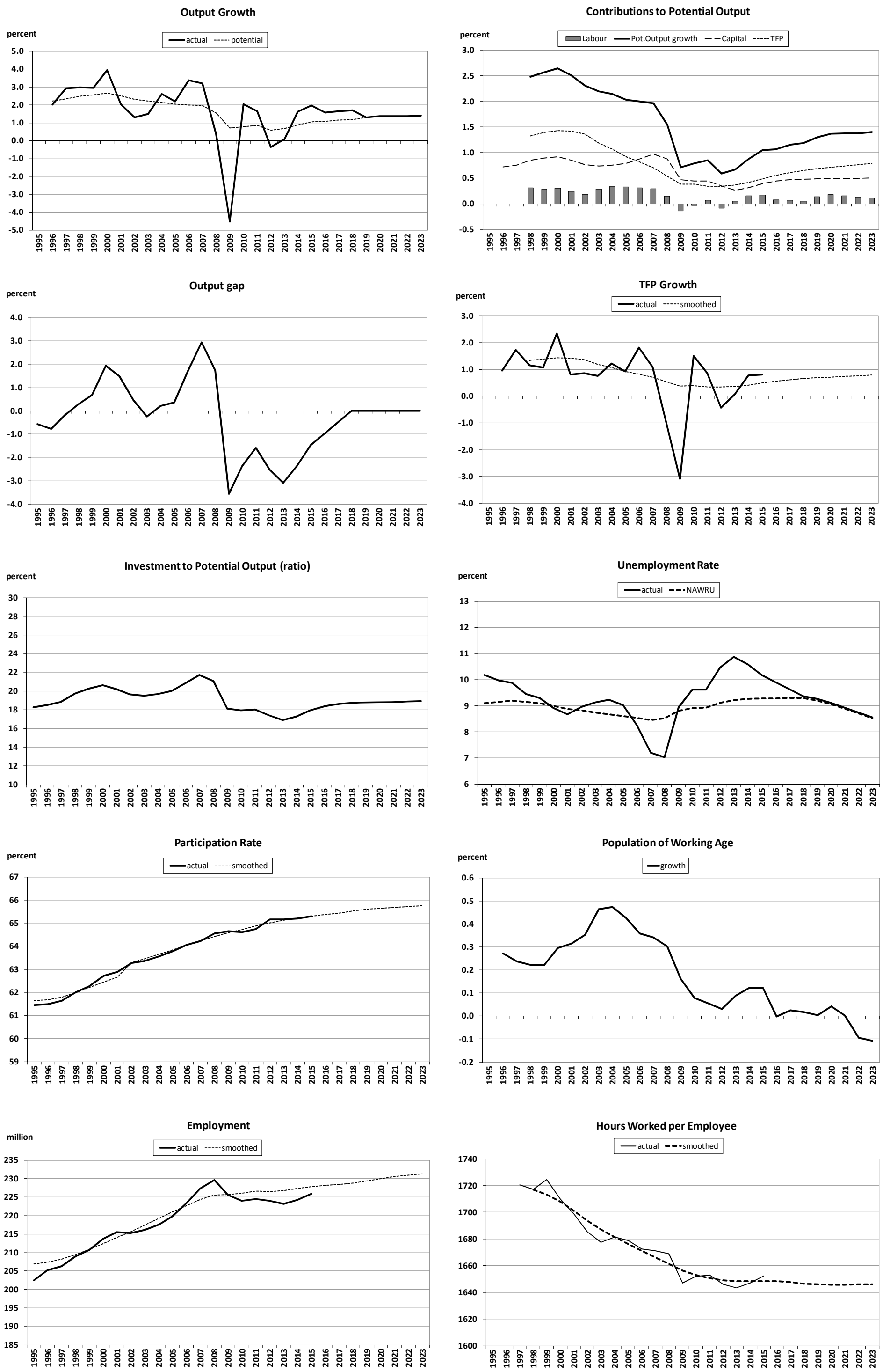


Table 1 : Potential Growth Rates for the 28 Member States and the Euro Area / EU28 Aggregates (2013-2023)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
BE	0.7	0.8	1.0	1.3	1.4	1.4	1.5	1.5	1.5	1.4	1.4
DE	1.4	1.5	1.5	1.1	1.0	1.1	1.1	1.2	1.1	1.0	1.0
DK	0.6	0.9	1.2	1.5	1.8	1.9	2.1	2.1	2.2	2.2	2.2
EL	-3.5	-3.0	-2.8	-2.2	-1.2	-1.0	-0.4	0.1	0.4	0.6	0.7
ES	-0.4	-0.3	-0.1	0.3	0.7	0.7	1.3	1.7	1.9	2.1	2.2
FR	1.0	1.0	1.1	1.3	1.3	1.2	1.2	1.2	1.2	1.3	1.3
IE	0.5	1.3	2.0	1.4	1.3	1.3	1.4	1.4	1.4	1.4	1.4
IT	-0.4	-0.2	0.1	0.4	0.7	0.9	1.1	1.3	1.3	1.3	1.2
LU	1.4	1.3	1.3	2.3	2.5	2.6	2.9	3.0	3.0	2.9	3.0
NL	0.1	0.4	0.5	0.8	1.0	1.1	1.2	1.3	1.2	1.3	1.3
AT	1.1	1.3	1.5	1.4	1.6	1.7	1.8	1.9	1.8	1.6	1.6
PT	-0.7	-0.5	-0.3	0.0	0.5	0.6	1.3	1.7	1.9	2.1	2.2
FI	0.0	0.0	0.4	0.5	0.7	0.9	0.9	0.9	0.9	1.1	1.2
SE	2.2	2.2	2.3	2.1	1.9	1.8	1.8	1.9	2.0	2.1	2.2
UK	0.7	1.1	1.4	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.2
CZ	0.5	1.1	1.3	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.7
EE	2.1	2.5	2.8	2.6	2.3	2.4	2.2	2.0	1.8	1.6	1.6
HU	0.4	0.9	1.1	1.2	1.2	1.3	1.6	1.9	2.2	2.4	2.4
LV	1.9	2.3	2.9	2.6	2.8	3.0	2.9	2.6	2.3	2.0	1.9
LT	2.6	3.1	3.7	2.4	2.1	1.9	1.8	1.5	1.3	1.0	0.9
PL	3.2	3.2	3.4	3.1	2.8	2.7	2.6	2.6	2.6	2.6	2.6
SK	2.3	2.4	2.5	2.3	2.4	2.5	2.5	2.6	2.6	2.6	2.6
SI	-0.6	0.0	0.5	0.7	0.8	0.9	1.5	1.9	2.0	2.1	2.1
CY	-2.0	-2.3	-1.8	-0.5	0.9	1.7	2.7	2.8	2.7	2.4	2.2
MT	1.7	1.8	1.8	1.9	2.0	2.0	1.9	1.9	1.9	2.0	2.1
BG	1.4	2.0	2.3	2.6	2.7	2.8	2.9	2.7	2.5	2.3	2.2
RO	1.9	2.1	2.2	2.3	2.3	2.3	2.2	2.2	2.1	2.2	2.1
HR	-0.3	0.3	0.6	0.9	1.1	1.3	1.5	1.5	1.4	1.2	1.1
EA18	0.49	0.65	0.80	0.87	0.99	1.05	1.21	1.31	1.33	1.32	1.34
EU28	0.67	0.87	1.05	1.07	1.15	1.19	1.30	1.38	1.38	1.39	1.42

4.3 : Advantages of using the T+10 methodology as the starting point for the 2015 Ageing Report & why it is superior to the T+5 approach adopted for the previous, 2012, Ageing Report : As explained earlier, the launch of the Europe 2020 Strategy prompted the EPC to introduce a new T+10 methodology which would build on the existing T+5 approach. This T+5 approach had been used as the starting point for the 2012 Ageing Report. Once the preliminary T+10 method was agreed by the EPC to be used for the 2013 Semester, it became increasingly clear that to avoid any confusion for policy makers (which would obviously be provoked by having two different sets of GDP growth projections over the same time horizon from T+6 to T+10) that the emerging T+10 method would have to be used for the 2015 Ageing Report. With this in mind, the EPC initiated a work programme for the OGWG aimed at creating an economically sensible, no policy change, baseline forecast which integrated ECFIN's short (T+2) & medium term (T+5) projections into the AWG's long term forecasting framework. In particular, as stressed earlier, this work programme was, in particular, aimed at addressing the concerns of a number of countries regarding firstly the T+5 NAWRU methodology & secondly with the breaks in participation rates in T+6. The EPC now considers that the OGWG has made sufficient progress to warrant endorsement of the Spring 2014 T+10 numbers as providing a prudent and balanced set of projections which can be used as the starting point for the AWG's long term assessment of ageing populations up to 2060.

In more specific terms, relative to the T+5 methodology which was used for the 2012 Ageing report, the new EPC endorsed T+10 methodology has a number of important advantages for the quality of the analysis in the 2015 Ageing report, including :

- **1. More structural information** : The new T+10 approach marks a clear improvement with respect to the incorporation of additional information regarding the structural determinants of growth. This is explicitly the case with respect to the new T+10 NAWRU anchor (see below) and is implicitly driving the rationale behind the capital formation and participation rate forecasts over the period T+6 to T+10. There are a number of clear advantages from introducing more structural information into the T+10 methodology, including firstly, it makes it easier to explain why countries differ; secondly, it allows for a quantitative evaluation of structural reforms; & thirdly, it allows for a much more precise definition of what constitutes a no policy change scenario.

- **2. T+10 NAWRU anchor versus reversion to an arbitrary pre-crisis NAWRU level** : As discussed earlier and in Annex 4, the new T+10 NAWRU anchor represents a significant methodological improvement over the method used for the 2012 Ageing Report by anchoring medium term NAWRU developments to a long run unemployment rate which is estimated from the main structural determinants of labour market developments. Alternative approaches that do not rely on economic information were discussed and eventually abandoned by the OGWG. In particular, approaches relying on the concept of a return to some arbitrary pre-crisis level for the NAWRU appeared impractical. The econometric evidence presented and discussed in the OGWG clearly showed that the pre-crisis NAWRU levels were not sustainable in a large number of countries. Some countries were experiencing boom type phenomena in the run-up to the crisis. Therefore, picking a given year would not be adequate to measure a sustainable pre-crisis level for the NAWRU. In addition, difficult discussions would ensue in order to pick, for each country, an acceptable year. Taking averages across a number of years for all countries would also not solve the problem given that boom type events were found to affect periods rather than particular years in the run-up to the crisis. Also, the concept of a pre-crisis level would not be convenient to track reform efforts over time and to reflect those efforts in the T+10 NAWRU forecast.

- **3. "Structural" approach to investment** : The debate in relation to the assumption to be used for the T+10 capital formation projections was initiated with a discussion on the relative merits of pursuing a structural model of investment. This option was not pursued however since there would be only limited gains relative to the "capital rule" approach which was finally adopted. The latter approach effectively amounts to a structural model of investment since it links investment to its fundamental long run drivers, namely labour supply and TFP.

- **4. A more credible evolution for the path of participation rates** : The approach adopted for projecting participation rates up to T+10 constitutes a balanced mixture of the information emanating from time series trends with the solid structural information derived from the cohort method. With respect to the 2012 Ageing Report, the single biggest improvement is the introduction of a technical transition rule for smoothing the unacceptable breaks in participation rates which occurred in the forecasts used for the 2012 Report. The OGWG accepted that this break was not "data

driven" (i.e. it did not result from changes in the underlying datasets, with this hypothesis tested using the new EUROPOP 2013 population projections from Eurostat & the updated Cohort Simulation Model results) but was in fact clearly "methodology driven" (i.e. it resulted from linking two very different participation rate forecast methodologies in T+6, namely the time series driven OGWG approach, with the more demographics driven Cohort method from the AWG). Following the agreement reached in the OGWG, the EPC has now endorsed the introduction of this transition rule in the T+10 methodology as a pragmatic way of smoothing the link between the OGWG and AWG methodologies.

- **5. Internally consistent TFP projections up to T+10** : Despite the fact that the OGWG has, for the moment, abandoned its attempts to anchor the trend TFP projections using policy & structural variables (which have been identified in the literature as relevant determinants of long run TFP growth), nevertheless the current Spring 2014, T+6 to T+10 TFP projections, are arguably superior to those used in the 2012 ageing report since the T+5 & T+10 estimates are now both produced with the same bivariate Kalman Filter approach & consequently are internally consistent.

For all of the above reasons, the AWG & the EPC were persuaded of the advantages of the new T+10 methodology for the 2015 Ageing Report.

CONCLUSIONS

This paper has provided a detailed description of the current version of the Ecofin Council approved production function (PF) methodology which is used for assessing both the productive capacity (i.e. potential output) and cyclical position (i.e. output gaps) of economies. Compared with the previous 2010 paper, there have been two significant changes to the PF methodology, namely an overhaul of the NAWRU methodology & the introduction of a new T+10 methodology :

- **NAWRU** : The single most important change outlined in the present 2014 text undoubtedly relates to the new NAWRU methodology. As explained in section 2, the Phillips curve is used to estimate the non-cyclical part of unemployment (i.e. the NAWRU) and can be specified in various ways, reflecting different assumptions regarding the formation of expectations. The new approach extends the existing static / adaptive expectations framework to also cover rational expectations. As section 2 stresses, for the euro area as a whole, the different expectations assumptions yield similar NAWRU estimates, with all of them showing that the NAWRU increased in the aftermath of the financial crisis, suggesting a deterioration in the Euro Area's labour market performance beyond what could be considered merely cyclical. In interpreting the rise in the NAWRU, it is important to bear in mind that both structural and non-structural factors are driving developments. Analysis shows that, in the presence of rigidities, crisis-related events can have temporary, but nevertheless long-lasting, effects on labour market performance. Whilst the various expectations assumptions yield similar results for the Euro Area as a whole, this is not the case for some countries, most notably Spain, where the results vary more depending on the assumptions used.

- **T+10** : The second important change since the 2010 paper has been the work to date on the T+10 methodology. Whilst further work will be carried out to fine tune the methodology over the coming months / years, nevertheless sufficient progress has been made for the new T+10 methodology to be endorsed by the EPC in May 2014 for use in the 2015 Ageing Report. This extension of the existing T+5 approach was considered necessary by the EPC due to the launch of the Europe 2020 Strategy and the implementation of the European Semester. The new methodology will draw on the regular, T+2 focussed, Winter, Spring & Autumn forecasting exercises, to produce a set of integrated, no policy change, macroeconomic projections covering the period up to T+10. Use of the T+10 baseline in the 2015 Ageing Report constitutes a significant improvement over the T+5 approach adopted for the 2012 Report, given the greater structural underpinnings of the new T+10 framework (most notably with respect to its NAWRU, investment & participation rate components); the much more credible evolution for the potential output path over the period as a whole due to the smoother linking of the underlying time series derived / fundamentals driven methodologies; and finally the greater level of internal consistency which links the projections covering the T+5 and T+10 time horizons.

Whilst the degree of uncertainty surrounding potential growth and output gap estimates will hopefully be reduced due to the fine tuning of the NAWRU methodology, it is clear that uncertainty has not been, and never will be, completely eliminated. Whilst every effort is being made to produce reliable, real time, output gap estimates, policy makers need to be

reminded that there will never be a method which will remove the need for all revisions since uncertainty is an inherent part of the policymaking process. Consequently, potential growth and output gap revisions, due to, for example, forecast & data uncertainties, will inevitably remain a fact of life for policy makers to grapple with. In addition, distinguishing cyclical from structural factors in real time will continue to be prone to error, with a large element of judgement always being needed in assessing underlying potential output trends. In this respect the PF methodology can only ever be described as "work-in-progress" rather than a final product. We will always need to periodically fine-tune the method based on either the lessons learnt from individual country experiences; from evaluating the advantages / disadvantages of alternative specifications / estimation approaches; from exploiting / experimenting with new data sources; or from simply the need to keep the method consistent with developments in the literature (for example, work is currently been carried out on assessing the feasibility of using information about the financial cycle to produce "finance-neutral" output gaps, using an approach suggested by BIS researchers[21]).

[21] BIS Working Paper No.404 "Rethinking potential output : embedding information about the financial cycle"

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ANNEXES

Annex 1 : Detailed technical description of the new NAWRU methodology

Annex 2 : Detailed technical description of the TFP methodology

Annex 3 : Use of the capacity utilisation indicator in the TFP methodology

Annex 4 : An overview of the debate on the individual components of T+10

Annex 5 : T+10 NAWRU methodology: Detailed description of input data for the NAWRU anchor

Annex 6 : T+10 results – potential growth & output gap tables & graphs for Euro Zone, EU28, EU15, EU13 & the US (+ GDP per capita growth rate and levels decomposition)

ANNEX 1 : DETAILED TECHNICAL DESCRIPTION OF THE NEW NAWRU METHODOLOGY

This annex discusses various issues related to the Kalman Filter based NAWRU estimation methodology. First of all, it provides a description of the general theoretical framework underlying the NAWRU estimates. It starts from a standard model of the labour market, with explicitly formulated wage and labour demand equations. In particular it is shown how the Phillips curve, which links the change in wage inflation to the unemployment gap, is shifted by observed and unobserved shocks to the wage rule and the labour demand equation. Within this context the concept of structural unemployment or NAWRU can be discussed more clearly.

List of variables used in the following sub-sections:

w: log nominal wage rate
p^e: log expected price
b: log reservation wage (unemployment benefits)
y: log GDP
l: log employment
u: unemployment rate
a^w: shock to wage equation
π: inflation rate
m^p: price mark up
m^w: wage mark up

Labour market model underlying the TKP and the NKP

This section presents a standard model of the labour market and shows under which assumptions about wage setting (wage mark ups), expectations formation and information sets available to wage setters, either the traditional or the New Keynesian Phillips curve can be derived. The generic model is based on Blanchard and Katz (1999).

In a nutshell the framework shows that, in case there is nominal rigidity in wage setting, the unemployment gap is proportional to the 2nd difference of log NULC. Unless the structural or equilibrium unemployment rate –in this model it is entirely determined by parameters of the reservation wage and the wage mark up – is cyclical, the nominal rigidity itself does not induce any NAWRU cyclicality. Yet, the NAWRU becomes cyclical if the labour market is subject to additional frictions, implying that distinguishing between the NAWRU and structural unemployment is warranted in practice.

The labour market

Following standard textbooks, there are broadly four different hypotheses which try to describe the labour market: the neoclassical view, the efficiency wage approach, the wage bargaining theory and the search model. A generic wage rule covering all four hypothesis can be formulated as follows :

$$w_t - p_t^e = m_t^w + (1-\mu)b_t^e + \mu((y_t - l_t)^e - \omega m_t^{p,e}) - \lambda u_t \quad (1)$$

Workers / trade unions negotiate a nominal wage w_t at time t conditional on the price expectation p_t^e, on the expected level of the reservation wage b_t^e, on expected productivity $pr_t = y_t - l_t$ and on the unemployment rate u_t. As shown by Pissarides (1999), the four macroeconomic theories imply certain restrictions on the parameter values of equation (1): both the neoclassical and the efficiency wage models imply $\mu = 0$, i.e. wages are not directly linked to productivity. The wage bargaining and the search model allow instead for productivity to play a role. Within this latter class of models, the magnitude of productivity indexation depends crucially on the bargaining strength of workers. In an atomistic labour market without any market power for workers such as in the neoclassical model, wages would be equal to the reservation wage. By contrast, in a highly unionised labour market, μ would approach unity.

Theories also differ in the specification of the reservation wage. In the neoclassical model the reservation wage would be the value of leisure, a concept derived from a utility function for workers which is defined in terms of consumption and leisure. Consequently, in the neoclassical model, consumption and leisure time would be the arguments of b_t. While the value of leisure could also play a role under the other hypotheses, these generally stress a non-market wage as an alternative. The non-market wage could be for instance unemployment benefits, the value of home production or the income earned in the shadow economy.

Another important element is the concept of productivity entering the wage equation, namely either average labour productivity or "marginal productivity[22]". Under the neoclassical model, the search and efficiency wage hypothesis, the relevant concept seems to be "marginal productivity" while in bargaining models an average productivity concept applies. As will be shown below in situations where average and marginal productivity diverge, the two productivity concepts have implications for the structural unemployment rate and also for the short run adjustment of wages. The wage rule expressed in eq (1) is very similar to the rule formulated by Blanchard and Katz (1999). Here two generalisations are introduced. First, it is assumed that expectations not only have to be formulated about prices but also about the reservation wage and productivity and we allow for slightly more general expectations formation schemes. The second generalisation concerns the concept of productivity which enters the wage rule. We will explicitly distinguish between the average and marginal product of labour.

In order to close the model, labour demand must be specified. It is assumed that firms set labour demand at its profit maximising level by equating the marginal revenue product of labour to the real wage. The resulting first order condition of the optimisation problem is given by equation (2).

$$w_t - p_t = (y_t - l_t) - m_t^p \qquad (2)$$

It can be interpreted in two directions. Starting from the right hand side, eq. (2) determines the "demand wage for labour", which is the wage the firm is willing to pay for a given level of marginal productivity. Alternatively, for given real wages, it determines the marginal

[22] Marginal productivity and the demand wage for labour are used interchangeably. The term marginal productivity is not entirely correct. Marginal productivity corrected for the mark-up of prices over marginal cost would be the correct expression.

product of labour the firm is aiming for. Note that marginal and average productivity are not always proportional.

We also express the reservation wage as a fraction of a combination of productivity and m_t^p,

$$b_t = b_t^0 + (y_t - l_t) + \omega m_t^p \qquad (3)$$

where b_t^0 is the logarithm of the replacement rate. Note that as b_t^0 is allowed to vary over time, equation (3) is not restricting the dynamics of the reservation wage.

The wage setting rule and the labour demand equation is standard. First of all, labour market tightness, expressed by the level of the unemployment rate determines the wage claimed by wage setters. In addition, workers/trade unions set wages as a mark up over a linear combination of an expected reservation wage and expected labour productivity. Concerning productivity, wage setters may also take into account that the goods market is imperfectly competitive. With $(\omega = 0)$ wage setters ignore the price mark up, while with $(\omega = 1)$ they internalise that firms, while determining employment, take the marginal revenue product into account rather than simply the marginal product. The labour demand equation states that firms equate the real wage to the marginal revenue product, i.e. labour productivity adjusted for the decline in revenue that a monopolistically competitive firm expects from expanding production, due to a downward sloping demand curve. The reservation wage can be determined by numerous factors, e.g. by the generosity of the unemployment insurance system (where benefits will generally be linked to the level of labour productivity). Irrespective of unemployment insurance, per capita income (e.g. within the representative family) may itself affect the reservation wage via a wealth effect.

Equilibrium unemployment

This model determines an equilibrium unemployment rate (u_t^*) as the unemployment rate which emerges in the absence of shocks $(a_t^w = 0)$ and under correct price expectations $p_t^e = p_t$.

$$u_t^* = \frac{[m_t^w + b_t^0 + (1-\omega) m_t^p]}{\beta} \qquad (4)$$

The equilibrium unemployment rate is a positive function of the wage mark up, the ratio of the reservation wage to labour productivity and the price mark up (to the extent in which the price mark up is not internalised by workers/trade unions $(\omega < 1)$).

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The traditional Keynesian Phillips curve

The Phillips curve describes the dynamics of wages in a disequilibrium. For that purpose certain adjustment frictions have to be introduced into the model. The most important adjustment friction is a nominal wage rigidity friction introduced into the model by assuming that workers are slow in adjusting price inflation expectations. Generally it is assumed that workers have static inflation expectations, i.e. they expect that inflation for the current

period/year does not deviate significantly from realised inflation in the previous year. Concerning labour productivity it is often assumed that workers have good current information about productivity in their workplace. An important implicit assumption also made in the traditional model is that wages are set at the beginning of the period/year and remain fixed throughout the year. Formally, the implied expectations formation is :

$$\pi_t^e = \pi_{t-1} \quad (5)$$
$$\Delta(y_t - l_t)^e = \Delta(y_t - l_t) \quad (6)$$

Since in most derivations of the traditional Phillips curve, fluctuations of price mark ups do not play an important role, we assume here that price mark-up fluctuations can be neglected and we assume $m_t^p = m^p$ and $\omega = 1$. With this set of assumptions we also cover the special case of perfect competition in goods markets.

Using equations (1) and (4), we can express expected wages as a function of the unemployment gap and expected productivity (as targeted by workers):

$$w_t - p_t^e = (y_t - l_t)^e - \beta(u_t - u_t^*) + a_t^w \quad (7)$$

Using the expectations assumptions, the following dynamic relationship between nominal unit labour costs and the unemployment gap can be derived. According to eq. (4.1.10) an acceleration of the growth rate of NULC signals labour market tightness, i.e. actual unemployment below the equilibrium rate (and vice versa). In this model, this equilibrium unemployment rate is also referred to as the non-accelerating wage rate of unemployment (NAWRU).

$$\Delta^2 nulc_t = -\lambda(u_t - u_t^*) + a_t^w \quad (8)$$

Note also that the source for this relationship is the specification of nominal rigidities, namely the assumption of static inflation expectations – i.e. eq. (5). Without this rigidity, there is no systematic deviation between the actual and the equilibrium unemployment rate.

Alternative traditional Phillips curve specifications can also be envisaged. The simple standard case considered above assumed static expectations for inflation and no rigidity for productivity. Assuming instead that expectations follow a moving-average or an adaptive scheme would yield a broadly similar form for the specification of the Phillips curve. In practice, the moving-average expectations scheme adds a productivity term to the Phillips curve equation. Other expectations schemes (e.g. adaptive schemes) can also be envisaged as well as combinations of expectations schemes – i.e. assuming that inflation and productivity follow different schemes would imply yet other forms for the wage-Phillips-curve. Moreover, additional explanatory variables can be envisaged to control for additional effects such as a short run response of nominal wages to terms of trade (TOT) shocks. Note that the theoretical derivation of the wage equation was done in a closed economy context. Yet, open economy aspects are likely to play a role in wage setting, especially if there is a divergence between domestic and import prices and if wages are linked to the consumer price deflator. In that context, nominal wages would respond positively to the wedge between consumer price and GDP inflation. In order to capture this open economy aspect, a TOT variable can be added to the Phillips curve.

$$\Delta^2 nulc_t = \sum_i \rho_i \Delta yl_{t-i} + \sum_i \omega_i \Delta tot_{t-i} - \sum_i \lambda_i (u_{t-i} - u_{t-i}^*) \quad (9)$$

Note that such considerations however leave the fundamental relationship unchanged, with the 2nd differenced labour cost variable identifying / shaping the unemployment gap. This fundamental link between a 2nd differenced labour cost variable and the unemployment gap variable implies a so-called "accelerationist" type of Phillips curve form whereby the unemployment gap is related to the size of the change in the growth rate of the cost variable – i.e. to acceleration (or deceleration) in that variable. This implies a strong assumption on the behaviour of the unemployment gap. If the growth rate of the cost variable stabilises, even at low rate levels, the unemployment gap tends to disappear.

The rational expectations case embedded in the New Keynesian Phillips curve framework implies a fundamentally different specification for the Phillips curve compared to the TKP form, as described next.

The New Keynesian Phillips curve

Here we derive a Phillips curve specification with forward looking rational expectations (RE) of wage setters, namely the NKP form. The forward looking model differs from the TKP along two dimensions. First, and most importantly, wage setters set wages in the current period, taking into account economic conditions in the current and the following period. The forward looking element in wage setting is associated with a different timing assumption and this constitutes the second distinguishing feature. While in the traditional specification, wage setters determine wages at the beginning of the period (e.g. year) for the current period, using information from the previous period only, in the forward looking RE model it is assumed that wage setters make wage decisions in the middle of the period (or alternatively there are continuous wage settlements of different groups of workers and sectors over the whole period/year) and these wage contracts extend until the next period. Therefore current wage decisions must take into account expectations about economic conditions in $t+1$. Furthermore it is assumed that wage setting takes into account current period information (including nowcasts of professional forecasters).

In view of these timing conventions, it is assumed that wage setters do not have to form inflation expectations about current period variables. Instead, these prices are assumed to be known to economic agents up to a white noise error term. We keep the basic labour market model as represented by equations (1 to 3) – i.e. same underlying labour market as for the traditional Phillips curve case. However, since the RE assumption is used, nominal frictions are not resulting from information lags of labour market participants. Instead, the wage adjustment friction has to be modelled explicitly. In the New Keynesian literature, wage (and price) staggering is either modelled by assuming Calvo contracts (see Calvo (1983)) or by assuming wage and price adjustment costs (see Rotemberg (1982)). Both models yield similar results and typically result in countercyclical mark up fluctuations (see Rotemberg and Woodford (1999)).

Assuming that workers/trade unions face such wage adjustment costs, deviating from setting wage growth in line with productivity and inflation growth will generate a wage mark up, which can formally be expressed as below and which is a countercyclical process of the growth rate of real unit labour costs – i.e. the mark up is low in a boom ($\Delta \mathrm{rulc}^{\mathrm{e}}_{\mathrm{t+1}} < \Delta \mathrm{rulc}_{\mathrm{t}}$) and vice versa.

$$m_t^w = m^w + \gamma(\beta \Delta rulc_{t+1}^e - \Delta rulc_t) \tag{10}$$

Expectations formation:

$$\Delta rulc_{t+1}^{e} = E_t \Delta rulc_{t+1} \quad (11)$$
$$\Delta(y_t - l_t)^e = \Delta(y_t - l_t) \quad (12)$$
$$p_t^e = p_t \quad (13)$$

Like in the case of the traditional Philips curve we also assume here that workers fully internalise fluctuations in price mark ups when setting wages (i.e. $\omega = 1$). Using a wage setting rule (i.e. eq. (1)), assuming that $\mu = 1$ to enhance clarity and without loss of generality, and the equation for the wage mark up, the wage setting equation can be derived:

$$w_t - p_t = \gamma(\beta \Delta rulc_{t+1}^{e} - \Delta rulc_t) + (y_t - l_t) - m_t^p - \lambda(u_t - u_t^*) + a_t^w \quad (14)$$

Using the labour demand equation, we obtain the following Phillips curve :

$$\Delta rulc_t = \beta \Delta rulc_{t+1}^{e} - \frac{\lambda}{\gamma}(u_t - u_t^*) + \frac{1}{\gamma} a_t^w \quad (15)$$

Empirical applications of the purely forward-looking Phillips curve were confronted with a failure to match the persistence of inflation variables. This led to the development of a so-called hybrid form that allows for more persistence. It assumes a portion of the workers remain backward-looking and thus the PC features both a forward-looking part and a backward-looking component. In the hybrid case, eq. (4.2.6) becomes:

$$\Delta \mathrm{rulc}_t = \beta s E_t[\Delta \mathrm{rulc}_{t+1}] + \beta(1 - s)\Delta \mathrm{rulc}_{t-1} - \lambda(u_t - u_t^*)$$

Assuming the unemployment gap follows an AR(2) process it has the following backward solution:

$$\Delta rulc_t = \gamma_0 \Delta rulc_{t-1} + \gamma_1(u_t - \bar{u}) + \gamma_2(u_{t-1} - u_t^*)$$

with: $\gamma_0 < 1, \gamma_1 < 0, \gamma_2 > 0$

The parameter α determines the degree of forward-looking behaviour. The purely forward-looking case emerges if $\gamma_0 = 0$. For $\gamma_0 \approx 1$ forward-looking behaviour becomes irrelevant.

ANNEX 2: DETAILED TECHNICAL DESCRIPTION OF THE TFP METHODOLOGY

The model: For convenience, model (2.2) from section 2 is reproduced below, together with the dynamic specification of the unobserved components:

$$
\text{(2.2)} \qquad
\begin{aligned}
tfp_t &= p_t + c_t \\
u_t &= \mu_U + \beta\, c_t + e_{Ut} \\
e_{Ut} &= \delta_U e_{Ut-1} + a_{Ut} \qquad\qquad V(a_{Ut}) = V_U
\end{aligned}
$$

The unobserved components dynamic is such that:

$$
\text{(A1)} \qquad
\begin{aligned}
\Delta p_t &= \mu_{t-1} \\
\mu_t &= \omega(1-\rho) + \rho\, \mu_{t-1} + a_{\mu t} \qquad\qquad V(a_{\mu t}) = V_\mu \\
c_t &= 2A\cos(2\pi/\tau)\, c_{t-1} - A^2 c_{t-2} + a_{ct} \qquad V(a_{ct}) = V_c
\end{aligned}
$$

Prior assumptions

Let p(·) denotes a probability density function (pdf), p(·|·) a conditional pdf, E(·) represents the expected value E(· | ·) the conditional expected value, and θ denote the set of parameters in model (2.2)-(A1), i.e. $\theta \equiv (A, \tau, V_c, \omega, \rho, V_\mu, \mu_U, \beta, \delta_U, V_U)$. For the prior pdf p(θ) the following independence structure is imposed:

$$p(\theta) = p(A)\, p(\tau)\, p(V_c)\, p(\omega)\, p(\rho)\, p(V_\mu)\, p(\mu_U, \beta, V_U)\, p(\delta_U)$$

and the following pdfs were selected:

$p(A) = B \times I_{(0,1)}$
$p(\tau) = B \times I_{(2,32)}$
$p(V_c) = IG$
$p(\omega) = N \times I_{(0,.03)}$
$p(\rho) = N \times I_{(0,.99)}$
$p(V_\mu) = IG$
$p(\mu_U, \beta, V_U) = NIG$ that implies $p(\mu_U) = t$; $p(\beta) = t$; $p(V_U) = IG$
$p(\delta_U) = N \times I_{(0,.99)}$

where B is the Beta distribution, N is the Normal distribution, IG is the inverted Gamma distribution, NIG is the Normal inverted Gamma distribution, t is the Student-t distribution, and I_S is an index set for imposing the support S. All prior distributions are parameterized as in Bauwens et al. (1999).

Prior pdfs for ω, ρ, τ, A, β, μ_U, and δ_U are identical for EU15 and EU13 countries and remain unchanged between forecast rounds as detailed in Table A1 below:

Table A1: pdf, mean, standard deviation (SD) and range for ω, ρ, τ, A, β, μ_U, δ_U

EU15			EU13		
pdf	***mean , SD***	***range***	***pdf***	***mean , SD***	***range***
trend			***trend***		
ω ~ N	.015 , .01	I(0, 0.03)	ω ~ N	.015 , .02	I(-.02, .05)
ρ ~ N	.8 , .24	I(0, .99)	ρ ~ N	.8 , .24	I(0, .99)
cycle			***cycle***		
τ ~ B	8 , 3.5	I(2, 32)	τ ~ B	7 , 2	I(2, 17)
A ~ B	.42 , .17	I(0,1)	A ~ B	.42 , .17	I(0,1)
CU			***CU***		
β ~ t	1.4 , .7	I(0, 5)	β ~ t	1.4 , .7	I(0, 5)
μ_U ~ t	0 , .03	I(-.1, .1)	μ_U ~ t	0 , .03	I(-.1, .1)
δ_U ~ N	0 , .4	I(0, .99)	δ_U ~ N	0 , .4	I(0, .99)

The TFP annual growth is centred about a mean of 1.5%, with a standard deviation of 1 percentage point. The persistence of the slope of the trend has a mean of .8 with a relatively high standard deviation.

The mean cycle periodicity and amplitude are set a priori to 8 (7 for EU13) and .42, with standard deviation 3.5 and .17 respectively so as to not be excessively restrictive. Bounds equal to 2 and 32 (17 for EU13) are imposed to the periodicity parameter.

We use a NIG structure for the capacity utilization parameters μ_U, β, and V_U mainly for computational convenience. This assumption implies that the first two parameters have a marginal prior distribution of the Student type. We impose a positive support for β, expecting that the posterior accumulates mass on the 0-bound in the case negative values better fit the data. The AR(1) specification with parameter δ_U is used for Finland, France and Slovenia.

The priors on the variance of the shocks are calibrated to better fit the data. IG distributions with 6 degrees of freedom are selected so as to set the mean and standard deviations equal a priori. For spring 2014 forecast they were set as in Table A2 below:

Table A2: Mean and standard deviation of IG-variance priors

EU15				EU13			
Country	V_c (×10^{-4})	V_μ (×10^{-6})	V_U (×10^{-3})	*Country*	V_c (×10^{-4})	V_μ (×10^{-5})	V_U (×10^{-3})
Austria	2 , 2	10.4, 30	2.2 , 2.3	Bulgaria	22 , 22	9.2 , 9.6	-
Belgium	5 , 5	.3 , .3	3 , 3	Croatia	18 , 18	10.1 , 10.5	-
Denmark	4 , 3	4.1 , 4.1	60, 50	Cyprus	10 , 10	1.42 , 1.76	4 , 4
Finland	6 , 6	4.7 , 4.7	3, 3	Czech Republic	10 , 10	1.42 , 1.76	4 , 4
France	5 , 5	.3 , .2	2.5, 2.5	Estonia	18 , 18	1.42 , 1.76	4 , 4
Germany	3 , 3	2.4 , 2.4	3.5, 3.5	Hungary	15 , 15	.63 , .63	3 , 3
Greece	10 , 99.1	6.2 , 6.2	3, 3	Latvia	18 , 18	1.42 , 1.76	4 , 4
Ireland	14 , 14	21.4 , 21.4	3.5, 3.5	Lithuania	18 , 18	4.55 , 4.27	2.1 , 2.1
Italy	3 , 3	2.4 , 2.4	60, 60	Malta	18 , 18	3.25 , 3.29	10 ,10
Luxemburg	12 , 12	3.7 , 3.9	4.2, 4.2	Poland	5 , 5	1.42 , 1.76	6 , 6
Netherlands	3 , 3	.4 , .4	50, 50	Romania	18 , 18	10.1, 10.5	-
Portugal	7.3 , 7.3	6.8 , 6.2	6.5, 6.5	Slovakia	5 , 5	1.06 , 9.8	9 , 9
Spain	3 , 2	.5 , .5	1 , 1	Slovenia	11 , 11	1.05 , 1.18	1.1 , 1.1
Sweden	4 , 4	2.5 , 2.5	2 , 2				
UK	4 , 4	1.53 , 1.53	7 , 7				

Note: " – " countries without the capacity utilization equation.

From prior to posterior

Given the model and prior assumptions, the objective is to find the joint posterior distribution of the TFP trend and cycle and of the parameters conditionally on the data, i.e. $p(c^T, p^T, \theta| Y^T)$ where for any time series x we denote $x^T \equiv (x_1,x_2,\ldots,x_T)$, and $Y^T \equiv (TFP^T, U^T)$. Given model (2.2), no closed form expression for this posterior is available but draws from the posterior distribution $p(c^T,p^T, \theta \mid Y^T)$ can be obtained using a Gibbs sampling strategy. The full conditionals of interest are:

- $p(c^T,p^T |\theta, Y^T)$ and
- $p(\theta \mid c^T, p^T, Y^T)$

We first focus on simulating the unobserved components conditionally on model parameters. It is useful to cast equations (2.2)-(A1) into a state space format such that:

$$Y_t = H\,\xi_t$$
$$\xi_{t+1} = D + F\,\xi_t + w_{t+1},$$

where Y_t is the vector of observations at time t, $\xi_t = (p_t, \mu_t, c_t, c_{t-1}, e_{Ut})'$ is the state vector, and $w_t = (0, a_{\mu t}, a_{ct}, 0, a_{Ut})'$ is a Gaussian error vector with zero mean and singular variance matrix Q. The time-invariant matrices H, D, F and Q can be straightforwardly recovered. For instance H is definied by the vector (1,0,1,0,0) on the first row and (0,0,β,0,1) on the second one. As usual, $\xi_{t|k}$ and $P_{t|k}$ denote the conditional expectation $E(\xi_t \mid \theta,Y^k)$ and variance $V(\xi_t \mid \theta, Y^k)$. Samples from $p(c^T,p^T |\theta, Y^T)$ are obtained through $p(\xi^T |\theta, Y^T)$. Use is made of the Carter and Kohn (1994) state-sampler defined by the factorization:

$$p(\xi^T| \theta, Y^T) = p(\xi_T| \theta, Y_T)\, \Pi_{t=1,\ldots,T-1}\, p(\xi_t| \theta, Y^t, \xi_{t+1})$$

A draw from $p(\xi^T|\theta, Y^T)$ can be obtained as follows:

i. compute $\xi_{t|t}$, and $P_{t|t}$, t=2,…,T, via the diffuse Kalman filter (de Jong, 1991);
ii. given $\xi_{T|T}$, and $P_{T|T}$, sample ξ_T from $p(\xi_T|\theta, Y_T)=N(\xi_{T|T}, P_{T|T})$;
iii. for t=T-1 to t=2, sample backward ξ_t from $p(\xi_t|\theta, Y^t, \xi_{t+1}) = N(E[\xi_t|\theta, Y^t, \xi_{t+1}], V[\xi_t|\theta, Y^t, \xi_{t+1}])$.

Steps i. and ii. involve standard results. If TFP has two more observations than capacity utilization at the sample end, then the filter is run on these two points with H reduced to its first row, the second series being treated as missing. Step iii. needs the conditional expectation $E[\xi_t|\theta, Y^t, \xi_{t+1}]$ and variance $V[\xi_t|\theta, Y^t, \xi_{t+1}]$. From the joint distribution of ξ_t and ξ_{t+1} conditional on θ, Y^t, we get:

$$E[\xi_t|\theta, Y^t, \xi_{t+1}] = \xi_{t|t} + P_{t|t} F' (P_{t+1|t})^{-1} (\xi_{t+1} - F\xi_{t|t})$$
$$V[\xi_t|\theta, Y^t, \xi_{t+1}] = P_{t|t} - P_{t|t} F' (P_{t+1|t})^{-1} F P_{t|t}$$

Because of the model structure, not all elements of the state need to be simulated. From (2.2)-(A1), given Y^t, knowledge of c_t determines both p_t and e_{Ut}. Hence for launching the algorithm, both c_T and c_{T-1} need to be sampled after which c_{t-1} is the only element to simulate. Since model (A1) does not have shocks on the trend level, c_{t-1} also determines μ_{t-1}. Still for our model specification, the algorithm can stop at t=2 since p_1, c_1, μ_1 and e_{U1} will be available.

We now turn to the second full conditional distribution, $p(\theta| c^T, p^T, Y^T)$. Several routes are possible: our strategy exploits model parameterization, prior block-independence and likelihood factorization in order to build three parameter blocks. Indeed the model structure implies that the density $p(c^T, p^T, Y^T|\theta)$ can be factorized as:

$$p(c^T, p^T, Y^T|\theta) = p(c^T|A,\tau,V_c)\, p(p^T|\omega, \rho, V_\mu)\, p(U^T|c^T, \mu_U, \beta, \delta_U, V_U)$$

Then the block-independence prior assumption makes the full conditional $p(\theta| c^T, p^T, Y^T)$ verifying:

$$p(\theta| c^T, p^T, Y^T) = p(A,\tau,V_c| c^T)\, p(\omega, \rho, V_\mu| p^T)\, p(\mu_U, \beta, \delta_U, V_U| c^T, U^T)$$

We first consider the conditional distribution $p(\omega, \rho, V_\mu| p^T)$. A single-move Gibbs scheme is used, so each parameter is sampled given the other two and the trend. Let ω_0 and $V_{\omega 0}$ denote prior mean and variance of the ω-prior distribution. The Normal prior assumption implies:

$p(\omega| \rho, V_\mu, p^T) = N(\omega_*, V_{\omega*})$ with

$$V_{\omega*} = \left[\frac{(T-2)(1-\rho)^2 + 1 - \rho^2}{V_\mu} + \frac{1}{V_{\omega 0}}\right]^{-1} \quad \text{and}$$
$$\omega_* = V_{\omega*}\left[\frac{(1-\rho)\sum_{t=3}^{T}(\Delta p_t - \rho\Delta p_{t-1}) + (1-\rho^2)\Delta p_2}{V_\mu} + \frac{\omega_0}{V_{\omega 0}}\right]$$

For the autoregressive parameter, we have:

$$p(\rho|\omega, V_\mu, p^T) \propto p(p^T|\rho, \omega, V_\mu)\, p(\rho)$$
$$\propto p(\Delta p_2|\rho, \omega, V_\mu)\, \Pi_{t=3,\dots,T}\, p(\Delta p_t|p^{t-1}\rho, \omega, V_\mu)\, p(\rho)$$

Let ρ_0 and $V_{\rho 0}$ denote prior mean and variance of the ρ-prior distribution, i.e. $p(\rho) \propto N(\rho_0, V_{\rho 0}) \times I_{(0,1)}$. The first term of the equation above verifies:

$$p(\Delta p_2 \mid \rho, \omega, V_\mu) \propto \exp(\rho^2 (\Delta p_2 - \omega)^2 / (2V_\mu))$$

while the product of the last two terms is such that:

$$\Pi_{t=3,\dots,T}\, p(\Delta p_t \mid p^{t-1}\, \rho, \omega, V_\mu)\, p(\rho) \propto N(\rho_*, V_{\rho *}) \times I_{(0,1)}$$

with

$$V_{\rho *} = \left[\frac{\sum_{t=3}^{T} (\Delta p_{t-1} - \omega)^2}{V_\mu} + \frac{1}{V_{\rho 0}} \right]^{-1}$$

$$\rho_* = V_{\rho_*} \left[\frac{\sum_{t=3}^{T} (\Delta p_t - \omega)(\Delta p_{t-1} - \omega)}{V_\mu} + \frac{\rho_0}{V_{\rho 0}} \right]$$

Hence, "draws" from the full conditional $p(\rho \mid \omega, V_\mu, p^T)$ can be obtained for instance via a Metropolis-Hastings scheme with proposal $q(\rho) = N(\rho_*, V_{\rho *}) \times I_{(0,1)}$ as above with acceptance probability:

$$\alpha = \min\left(1, \frac{p(\Delta p_2 \mid \rho', \omega, V_\mu)}{p(\Delta p_2 \mid \rho, \omega, V_\mu)} \right)$$

where ρ' is the candidate draw from q(ρ).

For the slope shock variance V_μ, the full conditional $p(V_\mu \mid \rho, \omega, , p^T)$ verifies:

$$p(V_\mu \mid \rho, \omega, , p^T) = IG(s_{\mu *}, \nu_{\mu *})$$

with

$$s_{\mu *} = s_{\mu 0} + (1 - \rho^2)(\Delta p_2 - \omega)^2 + \sum_{t=3}^{T} (\Delta p_t - \Delta p_{t-1} - \omega(1 - \rho))^2$$

$$\nu_{\mu *} = \nu_{\mu 0} + T - 1$$

where $\nu_{\mu 0} = 6$ is the number of degrees of freedom of the V_μ -prior distribution.

Focusing next on $p(A, \tau, V_c \mid c^T)$, we consider the full conditionals $p(A \mid \tau, V_c, c^T)$, $p(\tau \mid A, V_c, c^T)$ and $p(V_c \mid A, \tau, c^T)$. The first two verify:

$$p(A \mid \tau, V_c, c^T) \propto p(c_1, c_2 \mid A, \tau, V_c)\, \Pi_{t=3,\dots,T}\, p(c_t \mid c^{t-1}, A, \tau, V_c)\, p(A)$$

and

$$p(\tau \mid A, V_c, c^T) \propto p(c_1, c_2 \mid A, \tau, V_c)\, \Pi_{t=3,\dots,T}\, p(c_t \mid c^{t-1}, A, \tau, V_c)\, p(\tau)$$

Sampling directly from these conditionals is not possible but both densities are straightforward to evaluate. Program GAP uses the adaptive rejection Metropolis scheme (ARMS) proposed by Gilks et al. (1995, 1997); a Metropolis-Hastings step is a possible

alternative. For the distribution $p(V_c | A, \tau, c^T)$, the IG-conjugate framework implies (see Bauwens, Lubrano and Richard, 1999, p.304):

$$p(V_c | A, \tau, c^T) = IG(s_{c*}, v_{c*})$$

with:

$$s_{c*} = s_{c0} + (c_1 \;\; c_2)\, \Sigma_c^{-1} (c_1 \;\; c_2)' + \Sigma_{t=3,\ldots,T}\; a_{ct}^2$$
$$\nu_{c*} = \nu_{c0} + T$$

where ν_{c0}=6 represents the degrees of freedom of the V_c-prior distribution, Σ_c is the variance-covariance matrix of $(c_1 \;\; c_2)$ given A and τ re-scaled by the innovation variance V_c, i.e. $\Sigma_c = V[(c_1 \;\; c_2)|A, \tau, V_c]/V_c$.

It remains to sample from the full conditional distribution $p(\mu_U, \beta, \delta_U, V_U| c^T, U^T)$. When the AR(1)-coefficient δ_U is present, a further Gibbs step is implemented to sample from $p(\mu_U, \beta, V_U| \delta_U, c^T, U^T)$ and $p(\delta_U | \mu_U, \beta, V_U, c^T, U^T)$. This last is similar to sampling the trend AR(1)-coefficient ρ, so focus is put on $p(\mu_U, \beta, V_U| \delta_U, c^T, U^T)$ and we assume δ_U=0 for simplifying exposition. It is convenient to re-write the prior for μ_U, β as in:

$$p(\mu_U, \beta| V_U) = N(m_{U0}, V_U \cdot M_U^{-1})$$

where M_U is the precision matrix associated to the prior specification for μ_U and β. Let $Z_t \equiv (1 \;\; c_t)$ represent the regressors in (2.2), Z be the T×2 matrix of regressors, and U the T×1 vector of endogenous variables, $U \equiv U^T$. Standard results from the NIG-conjugate framework yield:

$$p(\mu_U, \beta, V_U| \delta_U, c^T, U^T) = NIG(m_{U*}, s_{U*}, M_{U*}, \nu_{U*})$$

with

$$M_{U*} = M_{U0} + Z'Z$$
$$m_{U*} = M_{U*}^{-1} [M_{U0}\, m_{U0} + Z'U]$$
$$s_{U*} = s_{U0} + \Sigma_{t=1,\ldots,T}\; a_{Ut}^2$$
$$\nu_{U*} = \nu_{U0} + T$$

where $\nu_{U0} = 6$ is the number of degrees of freedom of the V_U-prior distribution.

This closes the circle of simulations. Markov chains properties discussed in Tierney (1994) insure convergence to the joint posterior $p(c^T, p^T, \theta|Y^T)$. To check convergence, GAP uses the Geweke's statistic to test whether the first 50% and the last 20% draws of the chain have the same mean (see Geweke, 1992). For model (2.2) and the data we have considered, increasing the burn-in period was generally enough to overcome convergence problems. Once convergence is confirmed, posterior distributions of any quantity of interest as well as posterior moments can be easily obtained – GAP shows the posterior distributions of a broad selection of variables including parameters and unobserved components. A further model check via Box-plot of residuals autocorrelations is offered. More information can be found on the GAP site. Readers interested in further details about simulations or in model extensions are referred to Planas, Rossi and Fiorentini (2008).

ANNEX 3 : USE OF THE CAPACITY UTILISATION INDICATOR IN THE TFP METHODOLOGY

This annex gives a detailed account of the way DG ECFIN constructs the combined capacity utilization indicators (CUBS henceforth), which are used as a proxy for the unobserved true level of capacity utilization in the economies of the EU's Member States. This proxy is used in the Kalman filter-based approach for estimating the TFP trend, which exploits a theoretical link between TFP and capacity utilization.

Main elements of the CUBS indicator : The ***CUBS indicator*** consists of three main elements: a direct measure of capacity utilization in industry (CU) and two business sentiment (BS) indicators: economic sentiment indicator for the services sector (ESI.SERV) and economic sentiment indicator for the construction sector (ESI.BUIL). All the three series are provided by the Joint Harmonized EU Programme of Business and Consumer Surveys[23].

The ***CU indicator*** is derived from answers to question Q13 of the industry survey[24]. The aggregated historical series for all the EU countries based on this question can be found (along with aggregate series for other questions) on the Business and Consumer Surveys website, in 'download time series section'[25], in the file 'industry_total_sa_nace2.zip'. The availability of the CU indicator for all the 28 MS is given in Tables 1 and 2.

The original CU indicator coming from the Industry Survey is recorded in quarterly frequency. Since the econometric model for detrending TFP is estimated using annual data, the original series is aggregated along the time dimension by averaging the 4 quarterly observations reported for a given year. For the autumn forecast, when data from only 3 quarters of a given year are available, an average of observations from these 3 quarters is used. Observations from a year are not used at all for the purposes of the spring and winter forecasts in this year. The time-aggregation of the CU indicator is carried out in the file named 'CU annual [identifier of the forecast].xls',[26] which will be made available on the Circa website.

The ***ESI.SERV indicator*** is derived by DG ECFIN services from answers to questions Q1-Q3 of the services survey[27]. Similarly, the ***ESI.BUIL indicator*** is based on answers to questions Q3-Q4 of the construction survey[28]. The monthly series for both indicators can be found on the Business and Consumer Surveys website, in 'download time series section'[29], in the file 'esi_nace2.zip'. The availability of these indicators for all the EU's Member States is given in Tables 3-6.

For the purposes of the estimation, the ESI.SERV and ESI.BUIL indicators are transformed from monthly frequency into annual frequency by averaging the 12 monthly observations reported for a given year. For the autumn forecast, when data from only 9-10 months of a given year are available, an average of these observations is used. Observations from a year are not used at all in the spring and winter forecasts in this year. The time-aggregation of

[23] For details see the Special Report, 5/2006, http://ec.europa.eu/economy_finance/db_indicators/surveys/documents/studies/ee_bcs_2006_05_en.pdf and the User Guide, 2014, http://ec.europa.eu/economy_finance/db_indicators/surveys/documents/bcs_user_guide_en.pdf
[24] See Annex A.3.1 of the Special Report, 5/2006.
[25] The link is: http://ec.europa.eu/economy_finance/db_indicators/surveys/time_series/index_en.htm
[26] For example, for the winter 2014 forecast the [identifier of the forecast] is simply 'Winter 2014'.
[27] See Part A, section 3.6 and the Annex A.3.2 of the Special Report, 5/2006 for details.
[28] See Part A, section 3.6 and the Annex A.3.5 of the Special Report, 5/2006 for details.
[29] The link is: http://ec.europa.eu/economy_finance/db_indicators/surveys/time_series/index_en.htm

ESI.SERV and ESI.BUIL is carried out in the file named 'ESI annual [identifier of the forecast].xls', which will be made available on the Circa website.

Construction of the CUBS indicator

The three sectoral indicators described in the previous section are combined into the CUBS indicator. As is clearly visible from Tables 3-6, ESI.SERV (and, to a lesser degree, ESI.BUIL) tend to be shorter (start later) than CU. For this reason, for a majority of member states (in particular in the EU15 grouping) CUBS is based solely on the CU indicator in the first part of the sample. For every individual member state, CUBS becomes a weighted average of CU, ESI.SERV and ESI.BUIL only in the year when all the three indicators become available[30]. The weights used for combining the three indicators into one are taken to be the shares of the corresponding sectors in the total economy. Before the weighted average is calculated, each individual indicator is also rescaled so that its volatility matches the volatility of the value added series (provided by AMECO) of the given sector. This step is necessary because the volatilities of the sectoral indices reported in the Surveys do not correspond to the volatility of the economic activity in different sectors. Not rescaling the indicators would therefore bias the resulting aggregate CUBS indicator towards the sector with the most volatile survey index. An exact description of how the weights and the rescaling factors are calculated is given in the next section.

The construction of the combined CUBS indicator is done in the file 'CUBS [identifier of the forecast].xls', which will be made available on the Circa website. The construction of CUBS is done in the 'Combine ESI' sheet of this file. The sheet 'Weights and volatilities' contains the weights and the volatility rescaling factors. The final CUBS indicator is copied in the sheet 'CUBS'. The procedure for creating CUBS is as follows:

1. Copy the annual ESI.BUIL (rows 3-39), ESI.SERV (rows 43-79) and CU (rows 85-120) into the 'Combine ESI' sheet. Calculate the mean and the standard deviation of each indicator (rows 40-41, 80-81 and 121-122 for ESI.BUIL, ESI.SERV and CU respectively), *but only for the sample for which ESI.SERV is available for the given country*.[31]
2. Normalize each of the indicators with the mean and the standard deviation calculated as explained above. Rescale so normalized indices with the volatility rescaling factors for the corresponding sector (rows 124-237).
3. Calculate a weighted average of the normalized and rescaled series (rows 239-276) for every country for sample periods where all the three indicators are available. Calculate the means and the standard deviations of the so obtained series (rows 277-278).
4. Calculate the final CUBS indicator (rows 281-317) in the following way:
    a. For years in which the combined indicator calculated as explained in point 3 above is not available, use the original CU series.
    b. Where it is available, normalize it with the mean and the standard deviation calculated in rows 277-278. Then, rescale it with the mean and standard deviation of the original CU series, which was calculated in rows 121-122.

[30] Since for virtually all the Member States, ESI.SERV is shorter than ESI.BUIL, this means that CUBS becomes a combined indicator not earlier than ESI.SERV becomes available. It is conceivable to build CUBS based on two indicators (CU and ESI.BUIL) for those years when ESI.BUIL is, and ESI.SERV is not yet available. It was felt that, given the limited weight of the building sector in most European economies, this procedure would only excessively complicate the construction of CUBS.

[31] This is sufficient to guarantee that the mean and the standard deviation is calculated only for the period in which all of the three component indicators are available, see the earlier footnote.

Derivation of sectoral weights and volatility rescaling factors

As explained in the previous section, the calculation of the combined CUBS indicator requires additional information on the following points:

1. What should be the weight of each of the sectoral indicators in the combined indicator; and
2. What should be the volatility of each component indicator.

Both types of information are derived from the sectoral data on value-added from AMECO, the DG ECFIN annual macroeconomic database. The behaviour of the value-added (VA) series is the best available source of information on both the weight of every sector in the total economy and the relative volatility of economic activity in a particular sector.

In order to extract this information the sectoral value-added series (in log-levels) have been HP-filtered with HP parameter lambda=6.25, in line with the Uhlig-Ravn rule. The ***sectoral weight*** of a sector in a given year is then calculated as the trend value of VA for this sector divided by the sum of the VA trend values for all the three sectors. The weights are hence allowed to slowly evolve following the structural changes in the economy. The ***volatility rescaling factors*** are calculated as the standard deviation of VA in a sector relative to the standard deviation of VA in industry[32] over the appropriate sample. The standard deviations are calculated using the estimated cycle of VA for a given sector, and not the series itself.

The sectoral weights are in the sheet 'Weights and volatilities' of 'CUBS [identifier of the forecast].xls' file, rows 1-117. The volatility rescaling factors for construction are in row 121 of the same sheet, and for services in row 112.

Special cases : There are a number of countries for which the procedure spelt out above had to be adjusted due to the lack of some data. Below it is explained how these countries are dealt with:

1. ***Denmark***: ESI.SERV according to NACE2 is not available, bar for a few of the most recent months. The CUBS indicator for this country is based on an estimate prepared by DG ECFIN's business and consumer surveys unit using existing information on ESI.SERV on the NACE1 aggregation level.
2. ***France***: CU series on the NACE2 aggregation level are starting from 1991; however, on the NACE1 aggregation level they are available starting from 1985. Therefore, both series are combined to extend the CU index till 1985.
3. ***Ireland***: No information is available on NACE2 aggregation level. Existing CU, ESI.BUIL and ESI.SERV series available on NACE1 aggregation level end in 2008. These existing series are used for constructing the CUBS indicator until 2008. No information on Irish capacity utilization level is used for years following 2008.
4. ***Luxembourg***: ESI.SERV is not available for the whole sample period within the BCS framework. This data is, however, obtained from the national sources. The capacity utilization for industry used is available in the BCS.

The file 'Special Countries [identifier of the forecast].xls' contains frozen data for the above mentioned Member States.

Finally, it should be noted that for several Member States (especially those which joined in 2004 or later), the data display unusual behaviour at the beginning of the sample and are

[32] Hence for the CU indicator for industry the volatility rescaling factor is by definition 1.

therefore unreliable. For these countries we use shorter (starting at a later date) CUBS indexes than what would be technically possible. Finally, for a handful of Member States (Bulgaria, Croatia and Romania), the data is too short or too unreliable to be used at all. For these countries the TFP trend is estimated using a univariate Kalman Filter, without a CUBS series.

In Tables 7 and 8 the sample periods for the combined CUBS indicator, as used in the estimation for all of the 28 member states, are reported.

Table 1

	AT	BE	DE	DK	EL	ES	FI	FR	IE	IT	LU	NL	PT	SE	UK
First date	1996	1985	1985	1987	1985	1987	1993	1991	NA	1985	1985	1985	1987	1996	1985
Last date	To date	To date	To date	To date	To date	To date	To date	To date	NA	To date	To date	To date	To date	To date	To date

The availability of the CU indicator for EU15

Table 2

	BG	CY	CZ	EE	HU	LT	LV	MT	PL	RO	SI	SK	HR
First date	1992	2008	1991	1993	1996	1993	1993	2003	1992	2001	1995	1993	2008
Last date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date

The availability of the CU indicator for EU13

Table 3

	AT	BE	DE	DK	EL	ES	FI	FR	IE	IT	LU	NL	PT	SE	UK
First date	1996	1995	1995	2010	1997	1996	1996	1988	NA	1998	NA	1996	1997	1996	1997
Last date	To date	To date	To date	To date	To date	To date	To date	To date	NA	To date	NA	To date	To date	To date	To date

The availability of the ESI.SERV indicator for EU15

Table 4

	BG	CY	CZ	EE	HU	LT	LV	MT	PL	RO	SI	SK	HR
First date	2002	2002	2002	2002	2002	2002	2002	2007	2003	2002	2002	2002	2008
Last date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date

The availability of the ESI.SERV indicator for EU13

Table 5

	AT	BE	DE	DK	EL	ES	FI	FR	IE	IT	LU	NL	PT	SE	UK
First date	1996	1989	1985	1985	1985	1989	1985	1985	NA	1985	1985	1985	1989	1990	1985
Last date	To date	To date	To date	To date	To date	To date	To date	To date	NA	To date	To date	To date	To date	To date	To date

The availability of the ESI.BUIL indicator for EU15

Table 6

	BG	CY	CZ	EE	HU	LT	LV	MT	PL	RO	SI	SK	HR
First date	1994	2002	1995	1994	1996	1994	1993	2008	1998	1993	2002	1993	2008
Last date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date	To date

The availability of the ESI.BUIL indicator for EU13

Table 7

	AT	BE	DE	DK	EL	ES	FI	FR	IE	IT	LU	NL	PT	SE	UK
First date	1996	1985	1985	1987	1985	1987	1996	1985	1985	1985	1985	1985	1987	1996	1985
Last date	To date	To date	To date	To date	To date	To date	To date	To date	2008	To date	To date	To date	To date	To date	To date

The sample periods for the combined CUBS indicator; EU15

Table 8

	BG	CY	CZ	EE	HU	LT	LV	MT	PL	RO	SI	SK	HR
First date	NA	2008	1995	1995	1996	2002	2002	2003	2003	NA	1995	2002	NA
Last date	NA	To date	To date	To date	To date	To date	To date	To date	To date	NA	To date	To date	NA

The sample periods for the combined CUBS indicator; EU13

Annex 4 : An overview of the debate on the individual components of T+10

1. NAWRU : On 16 November 2012, the EPC endorsed the framework that is used to produce the T+10 NAWRU forecast. This framework incorporates economic rationale into the T+10 NAWRU forecast, relying on a set of economic indicators to guide the forecast beyond T+5. By incorporating economic information, in line with the EPC's mandate, this method provides a useful forecasting framework in many respects. It allows the method to reflect changes in the structure of the labour market over time (e.g. to reflect the structural reforms undertaken by Member States). It also allows for a decomposition of the NAWRU into structural factors (structural unemployment rate) and medium term cycles. This in turn allows for a prediction between T+6 and T+10 which reverts the NAWRU back towards the structural unemployment rate. In this way, it helps policy makers to better understand the outcome of the overall forecast and to link it to the wider monitoring framework which is based on a similar approach of relying on economic indicators (e.g. the scoreboard)[33].

In practice, four economic indicators have been selected to guide the T+10 NAWRU forecast: the labour tax wedge, the generosity of unemployment benefits, the support provided by active labour market policies (ALMP) and the power of unions (proxied by the level of union density). Those indicators are deemed to be the most important, as indicated by a survey of the literature and confirmed by the econometric analysis presented in the OGWG (i.e. good fit and robustness of the results across various estimation techniques).

To reflect the discussions in the OGWG, a number of pragmatic elements have been added to the framework. The convergence path towards the T+10 NAWRU (i.e. the forecast between T+5 and T+10) is kept very simple. A simple convergence rule towards the T+10 NAWRU is applied. Also, a so-called prudent rule was devised to address cases where the T+10 NAWRU forecast is deemed to be surrounded by a relatively high degree of uncertainty for a particular country.

The details of the method that is used for the NAWRU forecast beyond the T+5 horizon are as follows:

- The **T+10 NAWRU** is the fit (in period T) of a (panel) regression that features the four labour market economic indicators discussed and a set of macroeconomic control variables. The effect of the macroeconomic variables is removed from the fit.

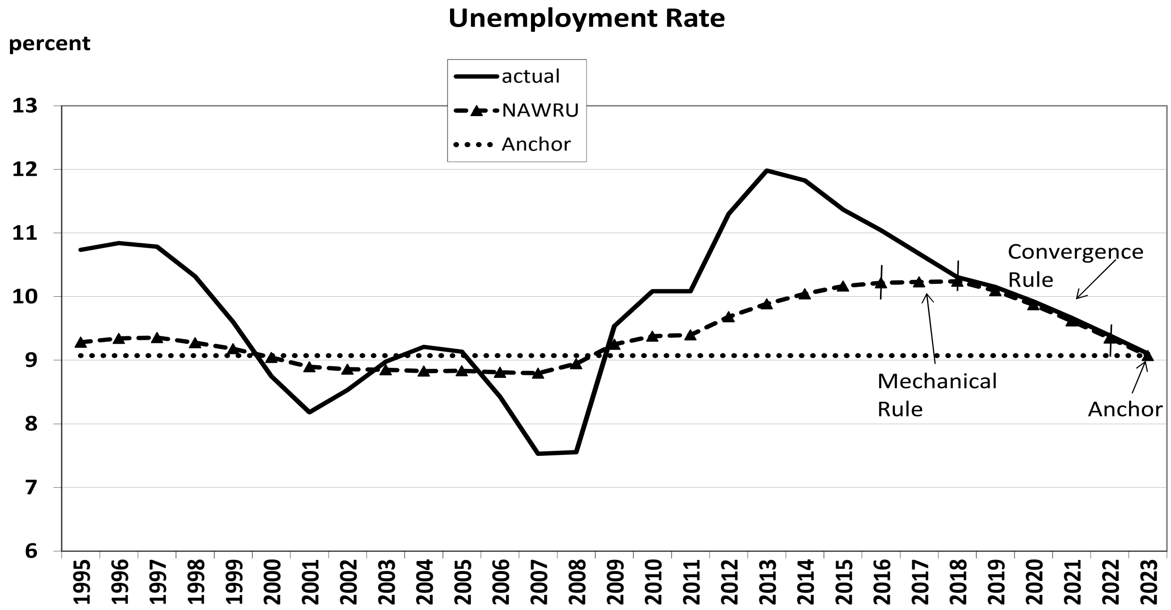
- For some countries the **prudent rule** is applied. This rule entails using the average of the fit and the NAWRU, rather than the fit.

- In terms of the **convergence path** towards the T+10 NAWRU, the following rule is used:
  - up to T+2, NAWRUs, as estimated in the context of EC forecast rounds, are used
  - in T+3, the so called mechanical rule is used
  - from T+4 to T+5, the NAWRU is kept constant (extended "mechanical rule")
  - from T+6 to T+10, the NAWRU converges linearly towards the estimated T+10 NAWRU ("anchor"). The convergence is however capped to be within -1.0 and 0.2.

[33] The structurally determined NAWRU's also provide a very useful check on the plausibility of the Kalman Filter estimated NAWRU's.

In addition, the convergence path is smoothed to avoid a "kink" in the profile between T+5 and T+6 ("convergence rule").

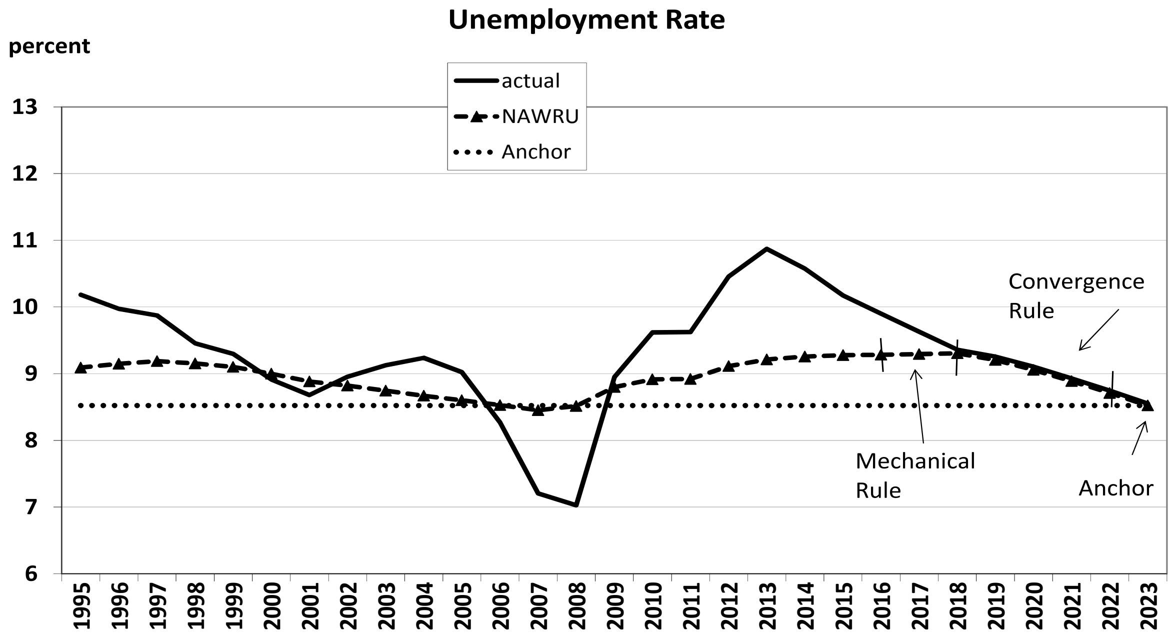
Graph 1: Unemployment rate, the NAWRU and the anchor for the euro area (EA18)



Note: The NAWRU series displays the GDP weighted average NAWRU series of euro area (EA18) countries. For new member states the series were not available from the mid 1990s onwards. They were extended using values computed based on a Hodrick Prescott filter using the harmonized unemployment rate.

Source: DG ECFIN calculations based on Eurostat data.

Graph 2: Unemployment rate, the NAWRU and the anchor for the EU 28 area



Note: The NAWRU series displays the GDP weighted average NAWRU series of EU 28 countries. For new member states the series were not available from the mid 1990s onwards. They were extended using values computed based on a Hodrick Prescott filter using the harmonized unemployment rate.

Source: DG ECFIN calculations based on Eurostat data.

2. TFP : The overall objective was to try to incorporate information on the structural determinants of TFP as well as setting out meaningful TFP convergence rules. In this regard, several broad approaches for producing the T+10 Total Factor Productivity (TFP) projections were considered by the OGWG. The first approach assumed, as with the NAWRU projections described above, that trend TFP in the EU's Member States could be anchored with policy and structural variables that were identified in the literature as relevant for productivity growth. The Commission considered a wide range of possible factors, including product market regulation indicators; education variables; measures of trade openness and trade liberalization; labour market indicators; and many more. A thorough panel analysis indicated that out of these variables, only certain measures of educational attainment and of trade liberalization are correlated with TFP trends in the EU's Member States. Additionally, it was found that the age structure of the population as well as its evolution over time may be relevant for TFP trend growth in the EU. Unfortunately, these factors did not explain the time and cross-country variation in TFP trend growth rates to an acceptable degree. Problems with the quality of the utilized indicators constituted an additional reason for finally giving up on this approach.

A second approach attempted by the Commission relied on the assumption that productivity in the EU's Member States converges to the so called world technology frontier. US productivity was used as a proxy for the frontier. The subsequent panel analysis showed that, unfortunately, US productivity cannot serve as a long-term anchor for TFP trends in the EU's Member States. This analysis yielded three important, essentially pessimistic, results. Firstly, in most of the EU's Member States, TFP trends do not seem to be converging to the US TFP trend level; moreover, there is relatively little evidence at the overall EU level that TFP trend growth rates converge to those in the US (in other words, EU TFP trends appear to be diverging, rather than converging, from the technology frontier). Secondly, these pessimistic developments are relatively recent; in particular, in many Member States, productivity may have been converging to its US level until 1995. There appears to have been a break in the series around this date. Finally, the performance of individual EU Member States is very heterogeneous, with a group of EU countries characterized by much more robust TFP trend growth rates, compared with the EU as a whole. For other countries, however, the TFP trend growth rate has been around zero for an extended period of time. Given these heterogeneous patterns, the clear message from this analysis is that US TFP trends cannot be used for anchoring productivity levels in the EU's Member States.

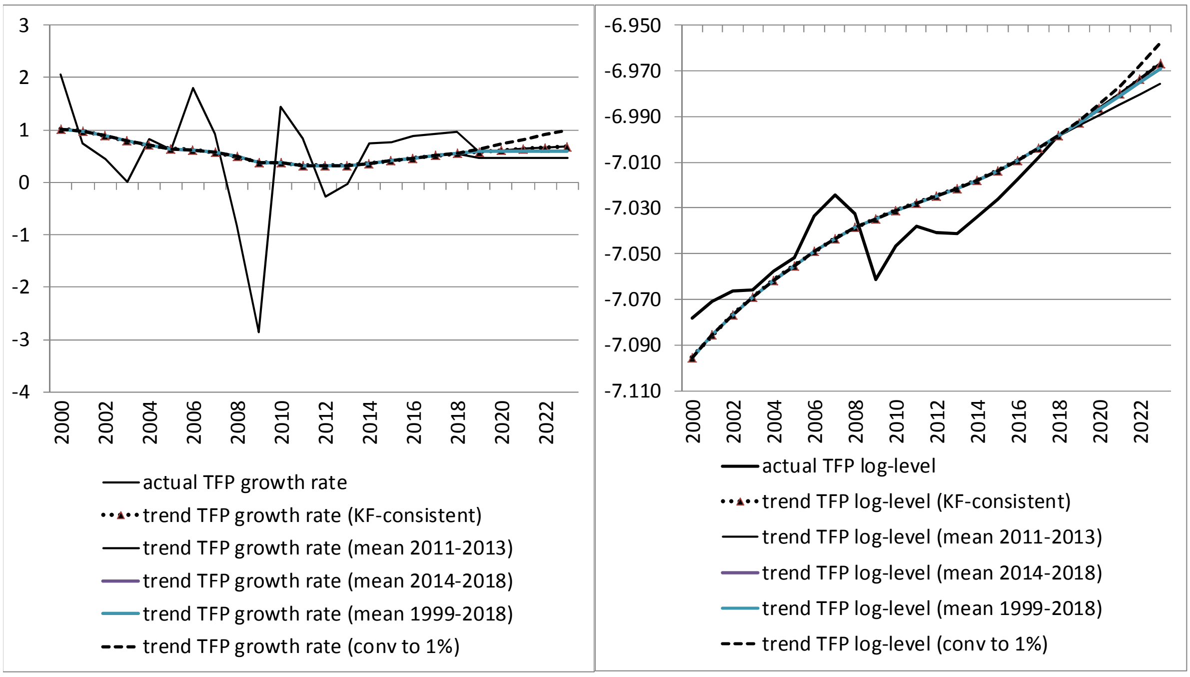
The final approach, and the one underpinning the T+10 projections, relies on the bivariate Kalman Filter (KF) method that is currently used for producing trend TFP projections up to T+5. This method allows for the production of internally consistent projections at any time horizon and hence offers the additional benefit of parsimony (one method would be used for the T+5 and T+10 TFP trend projections).

In operational terms, the T+10 TFP trend projections for the different Member States are calculated as follows. For all Member States, the bivariate Kalman Filter (KF) method of calculating trend TFP, which is used for calculating projections up to T+5, is also used for calculating the T+10 KF projections.[34] The most recent calculations are based on the final Spring 2014 forecasts. The following two additional rules are applied. First, for those pre-2004 accession Member States for which the KF method predicts an implausibly high TFP trend growth, the T+6 to T+10 growth rates are capped at the US TFP trend growth rate

[34] Several post-2004 accession countries (namely Bulgaria, Croatia and Romania) are missing the capacity utilization indicator which is used in the bivariate KF estimation. For these countries, for both the T+5 and T+10 projection calculations, a univariate KF method is used.

projection for T+10. As for the Spring 2014 projections, there is no country for which this rule is binding (historically, this rule capped the trend TFP growth rates for Ireland). Second, since the very low TFP trend growth rate calculated with the KF method is in the long run not plausible for Hungary, the Commission assumes that this country's TFP trend growth rate in the period T+6 to T+10 linearly converges to the average growth rate for the remaining post-2004 accession Member States in T+10.

Graph 3 : Euro Area TFP trend projections up to T+10 – KF Consistent versus other alternative projections



With respect to future work on the TFP projection methodology, the Commission is open to the view that the T+10 methodology could be further improved in the OGWG over the coming years. The Commission is more than prepared to explore the feasibility of pursuing several different approaches to the T+10 TFP methodology.

3 Capital Formation : The debate in relation to the assumption to be used for the T+10 capital formation projections was initiated with a discussion on the relative merits of pursuing a structural model of investment or of sticking to the approach implicitly applied for the 2012 European Semester, namely to linearly interpolate to the Ageing Working Group's (AWG) T+10 capital deepening forecasts. For these forecasts, the AWG imposed a "capital rule" which ensured that the K-stock adjusted to the steady state growth path – essentially capital deepening (K-stock per hour worked) grows at the same pace as labour augmenting technical progress. Following a discussion on the relative merits of both approaches, it was agreed that there would be only limited gains from pursuing a structural model of investment versus simply linking to the AWG's "capital rule" since the latter approach effectively amounts to a structural model of investment since it links investment to its fundamental long run drivers, namely labour supply and TFP.

As a result of this initial discussion, at the 10 October 2012 OGWG meeting, the Commission proposed directly linking to the AWG's T+10 capital deepening forecast for all of the EU's Member States. However, whilst this option produced results for the EU as a whole which

were favourable relative to a range of alternatives, this was not the case for many individual countries, most notably a number of the "new" Member States. For example, for many of these countries, an alternative T+10 approach, where future investment projections would be linked to historical past trends as well as to the short term forecasts from country experts, would be more acceptable. One possibility would be to extend the AR driven investment rule, currently used for projecting the investment to potential GDP ratio up to T+5[35], up to T+10. In addition, for the "old" EU15 countries, whilst the capital rule was on average more optimistic compared with an AR driven investment rule, the results for the individual EU15 countries were more heterogeneous. In fact, for 8 of the EU15 countries, there was no real difference in the investment projections between choosing an AR driven investment approach or linearly interpolating to the AWG's capital rule, over a five year transition period. Of the remaining 7 countries, 4 would gain from having the capital rule (namely Greece, Spain, Ireland and Portugal) and 3 would gain from having an investment rule (namely Belgium, Germany and Luxembourg), with the five year transition period tending to produce excessively optimistic, or pessimistic, forecasts for many of these countries.

As a result of the various rounds of discussions, as well as the feedback received from OGWG members on the Spring 2012 simulation exercise, a broad consensus emerged in the OGWG as to the capital formation assumptions to be adopted for the 2013 T+10 exercise, with the Commission's proposal reflecting this consensus. For the "new" EU12 countries, an investment rule approach was the preferred option (univariate AR model up to T+10); for the EU15 countries, linking to the AWG's capital rule appeared to be the best way to proceed, but given the problems with the five year transition period, it was decided to allow the EU15 countries a period of 10 years to converge to the AWG's capital rule. This longer transition period had the advantage of curbing the extreme results produced with the five year transition period.

The Commission stressed that the investment rule assumption for the EU12 countries could be used for the 2013 Semester but that a slow convergence to the AWG's capital rule (with investment being determined by its long run, fundamental, TFP and employment drivers) could be preferable to the current T+10 investment approach which risks being biased by transitional or "bubble" related factors since it effectively extrapolates forward very high investment ratios linked to the structural transition processes in these Member States.

A specific issue for Cyprus emerged from the Autumn 2012 forecasts – namely an unprecedented collapse in investment over the short run forecast horizon. Since a mechanical application of the investment rule would have led to very low investment trends for Cyprus, the EPC agreed to allow Cyprus to converge to the EU15's average investment to GDP ratio in T+10. Similar investment exceptions were also granted for Malta and Germany.

Since the EPC endorsement of the overall T+10 methodology in November 2012, the OGWG has been working on two specific aspects linked to the capital formation issue. The first issue relates to the work carried out on defining the actual convergence speed of the growth of capital towards the growth of potential output, based on the evolution of a number of exogenous variables (hours worked, population of working age, Nawru, depreciation rate and participation rate). It was found that using a constant or zero growth in the exogenous variables, convergence would occur for most member states before T+18. This estimation on the speed of convergence takes into account the 'starting' level of capital and potential output

[35] Up to T+5, the capital stock is derived from the investment to GDP ratio, extrapolated over the medium term using time series techniques.

growth, as well as the evolution of the underlying exogenous variables. Although the method to define this convergence speed was not found to be mature enough to be introduced in the T+10 forecast, it shows the plausibility of using a convergence speed towards the capital rule of 10 years (so by T+15), certainly for the 'old' EU15 countries. For the 'new' EU13 countries, the results also support a transition to a capital rule, but at a slower pace.

The second issue which the OGWG focused on was the possible removal of the investment exceptions granted for Germany, Malta and Cyprus. Similar investment exceptions, as the one given to Cyprus, were also granted for Malta and Germany with investment to potential converging up to the EU15's average investment to GDP ratio in t+10 for Malta whilst for Germany it converges to the Euro Area average excluding Germany. Over the last year the Commission services showed that these exceptions might lead to implausibly high contributions from capital formation in the three countries, with the overestimation of capital growth leading to a widening in the gap between capital and potential output growth. In addition, the research on the convergence speed also supported the conclusion that the exceptions were not warranted. Based on this research, Cyprus agreed to the removal of the exception. Germany and Malta agreed to partially remove their investment exceptions and to allow their investment to GDP ratio to converge to the EA (excl.DE) and EU15 averages respectively over a longer period (namely in ten years instead of the five years agreed to by the EPC in November 2012).

What was finally agreed for investment by the EPC in May 2014 : The capital formation assumptions to be adopted for the T+10 exercise, involves for the "new" EU12 countries, an investment rule approach (univariate AR model up to T+10). For the EU15 countries, the AWG's capital rule is linked to this investment rule with a ten year transition period starting in T+6. Two countries have exceptions to this approach, namely Germany and Malta, for which the investment rule doesn't follow the univariate AR process, but the investment to potential output ratio (IYPOT) converges to the average in the EA12 (for DE) and in the EU15 (for MT) over 10 years after the end of the medium term projections in T+5.

The standard investment rule can be written as[36]:

$$\widehat{IYPOT}_t = \theta_1 IYPOT_{t-1} + \theta_2 IYPOT_{t-2} + \theta_3 IYPOT_{t-3} + \theta_4 IYPOT_{t-4} \qquad (1)$$

Using this estimated IYPOT ratio we are then able to forecast capital (K) and investment (IQ) as follows:

$$IQ_t^{sr} = \frac{\widehat{IYPOT}_t}{100} * \widehat{YPOT}_t \qquad (2)$$

$$K_t = IQ_t + (1-\delta) * K_{t-1} \qquad (3)$$

with δ: depreciation rate, YPOT: potential output (simultaneously estimated using a Cobb Douglas production function), t: time period.

The capital rule can be written as:

[36] Within this note, the following convention is used: X stands for levels, x for log levels, Δx (or dx) for log difference or growth rate.

$$K_t = K_{t-1} * \frac{\widehat{YPOT_t}}{YPOT_{t-1}} \qquad (4)$$

$$IQ_t^{lr} = K_t + (\delta - 1) * K_{t-1} = K_{t-1} * \left(\frac{\widehat{YPOT_t}}{YPOT_{t-1}} + (\delta - 1)\right) \qquad (5)$$

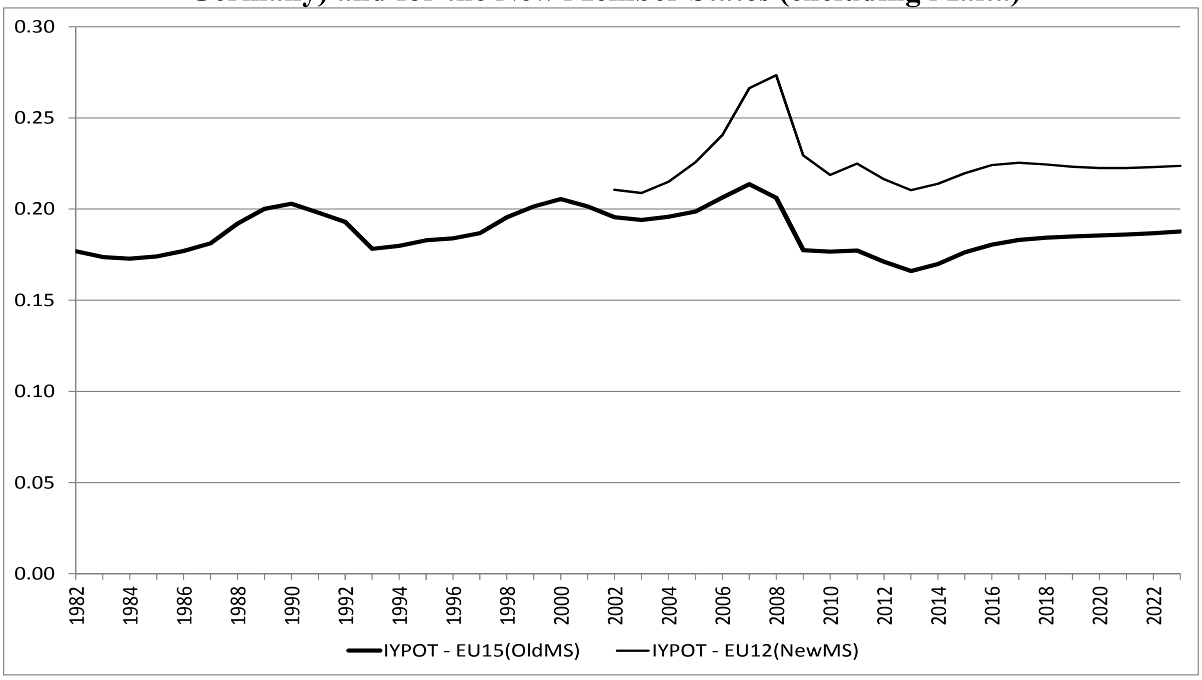
And both rules are combined using a weight (w), which is set exogenously:

$$K_t = w * IQ_t^{sr} + (1 - w) * IQ_t^{lr} + (1 - \delta) * K_{t-1} \qquad (6)$$

with w = 1 before t*+4 and w = 1 – 0.1*((t-t*)-3) for all years after t*+4 with t*: first year of forecast.

Using the investment rule for the EU12 (except for MT) and the combined investment-capital rule for the EU15 (except for DE) leads to the following results in the Spring 2014 forecast:

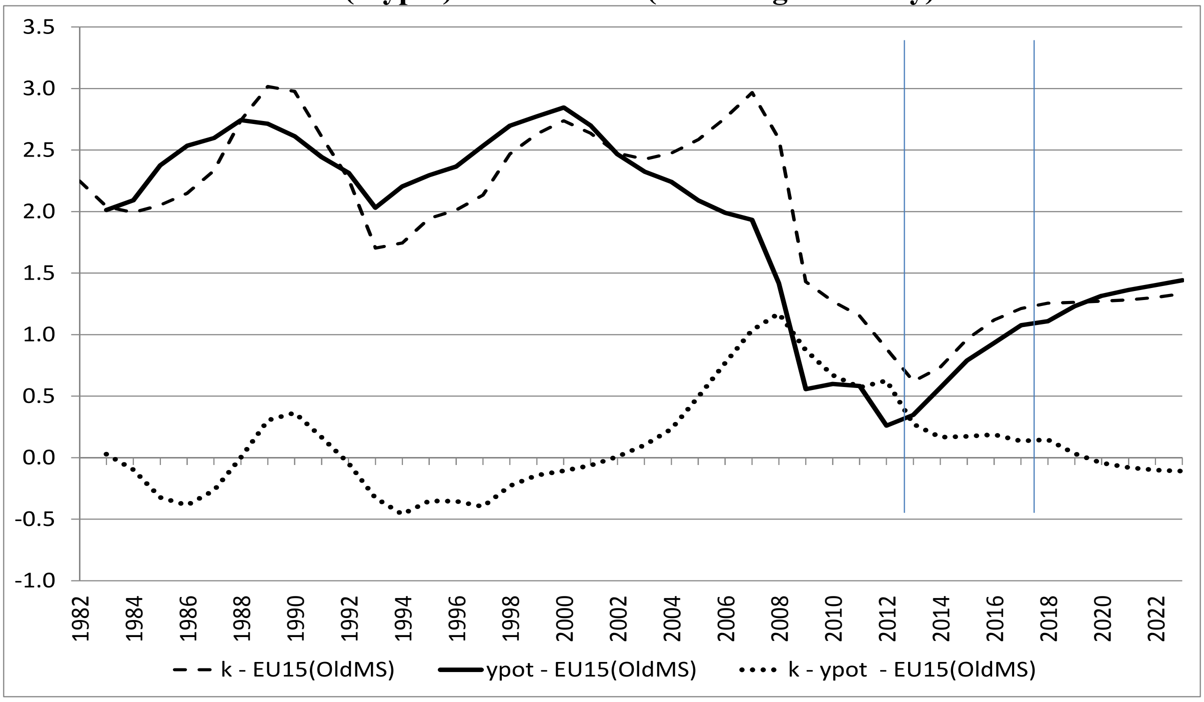
Graph 4 : Investment to potential output ratio (IYPOT) for the EU15 (excluding Germany) and for the New Member States (excluding Malta)



Source : Commission services

The capital rule is based on the idea that over the long run the growth in capital will be equal to the growth in potential output. The convergence speed is set exogenously and is expected to happen within 10 years. The next graph shows the evolution of the growth in potential output and in capital for the EU15 for which the capital rule is used.

Graph 5 : Growth in potential output (ypot), capital (k) and the difference between both (k-ypot) for the EU15 (excluding Germany)



Source:Commission services

4. Trend Participation Rates : With respect to the extension of the trend labour force, the mandate given to the OGWG was to explore the use of the Cohort method for projecting the rate of participation of the labour force[37].

The "Cohort method" breaks down the participation rate of the labour force by age/gender groups (i.e. cohorts) and then mechanically works out the change regarding their attachment to the labour force as they age. Note that (1) the aggregated participation rate is determined entirely by demographics (behavioural changes observed in younger cohorts progressively distil into the entire workforce), and that (2) a key advantage of the method is the possibility to take into account, in a detailed manner, the effects of pension reforms. Despite the well established shortcomings of the Cohort method, namely that a number of determinants are excluded even though they are known to influence future participation trends, the OGWG concluded that the information given by the Cohort method should not be ignored, in particular in relation to forthcoming pension reforms.

The "Cohort Simulation Model" (CSM) is the specific, and very detailed, application of the Cohort method as used and developed by the Ageing Working Group (AWG). The CSM has two main purposes: firstly, for preparing the long-term macroeconomic projections, and secondly for evaluating the impact of national pension reform plans on the labour force. The decision was taken to use the results obtained by the AWG's model as the only pragmatic choice for implementing the Cohort method in the projections up until t+10.

[37] In presenting the projections of the trend labour force into the medium-term, the only determinant discussed is the (trend) rate of participation in the labour force, since population projections are directly taken from EUROPOP, the Eurostat set of demographic projections prepared every 3 years. The cohort method is ideally suited for the T+10 work since one can take on board the mechanical, demographically-induced, changes in participation rates as well as using it to assess the impact of pension reforms.

Another practical issue was the measurement of the participation rate itself, which differs in the methodology used in the OGWG and in the AWG. This has led to the use of relative changes in participation rates, as estimated by the CSM, instead of possibly comparing levels of participation rates in the OGWG and AWG methodologies.

Up until recently, one of the OGWG / AWG differences was in the reference age bracket used for the working age (WA) population. In the OGWG methodology, the reference WA population was the population aged 15-64, whereas the reference WA population had been extended to include 15-74 year olds in the AWG's method. This difference has now been removed with the adoption of a comparable change by the OGWG, i.e. the switching to the 15-74 definition of the WA population in the first forecast exercise of 2013.

In addition to other source and measurement differences between the OGWG and AWG methodologies, the participation rate "starting point" is being revised at each bi-annual estimation and forecast exercise, and therefore only (relative) *changes* in participation rates are comparable to the ones estimated by the AWG in its latest projection exercise. These relative changes, as estimated by the CSM, are used for extending the (rescaled) trend participation rates from t+6 up to t+10 [38].

Concerning the effect of enacted pension reforms that cannot be fully reflected in the projections before t+6, the only relevant circumstances are for pension reforms which would be brought into force in the t+3/t+6 period, that is: too late to be captured by the historical or forecast participation rates and the ensuing estimated trend, but still before the use of the CSM rates of change, which will fully take them into account. For example, in the case of Italy, a simulation was run which adds the effects of the pension reform, as estimated by the CSM, to the statistical extension of the participation rate for the years 2016 and 2017. The results of the simulation for Italy suggested that the effects of the pension reform would be to boost the 2016 potential growth rate by 0.14 of a percentage point and the 2017 potential growth rate by 0.15 of a percentage point.

Regarding the work carried out on participation rates over the last year or so, one key issue stressed in the OGWG's work programme for 2013 was the need to devise a method for smoothing the (sometimes large) breaks in participation rates in the year the Cohort method is introduced. This break is due to the linking of two very different participation rate forecast methodologies in T+6 (i.e. the time series driven OGWG approach, with the more demographics driven Cohort method from the AWG). If the size of the breaks was deemed unacceptable, the Commission proposed to define some technical transition rule between the changes in the participation rate obtained through the OGWG statistical extension, and the corresponding changes obtained from the CSM.

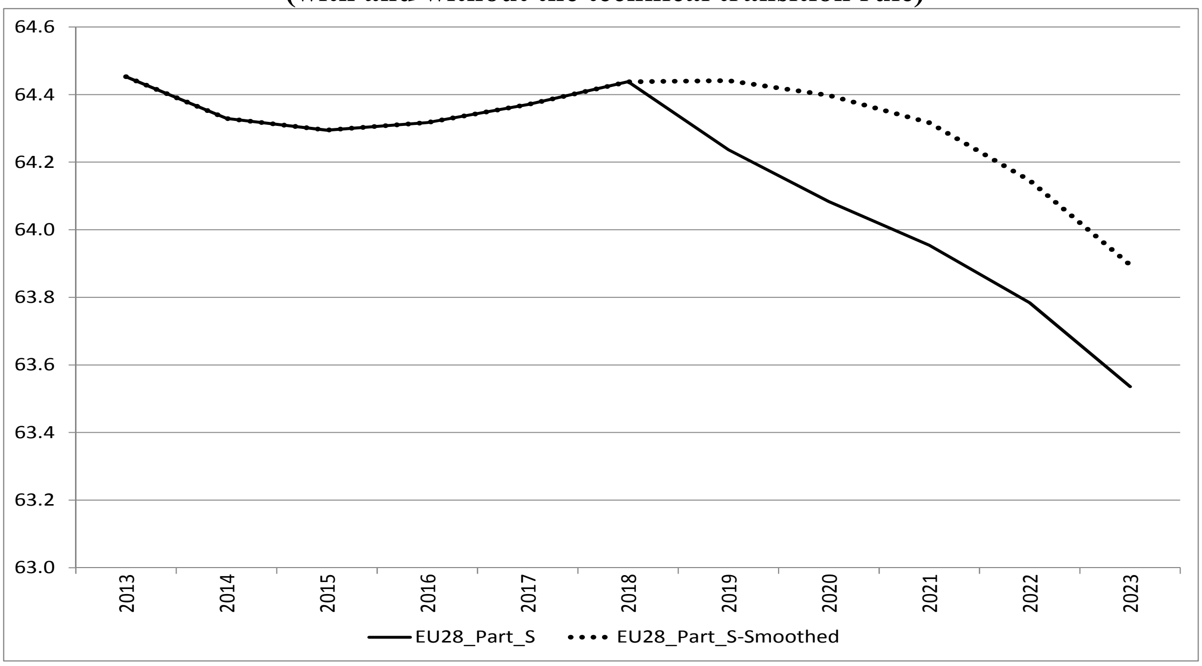
Following a number of discussions in the OGWG, a technical transition rule for smoothing the breaks in participation rates was presented to the group in February 2014. This presentation showed the impact which the introduction of this transition rule would have on the projections for participation rates and potential growth rates. It showed that the proposed rule worked well in that it led to much more credible outcomes for the projected paths of participation rates as well as having positive knock-on benefits for the plausibility of the potential output path for the overall T+10 period. A large majority of countries either gained or were not affected by the proposed transition rule. Following a relatively short discussion,

[38] The t+6 introductory date was linked to the general principle of trying to keep the "t+5" OGWG forecast exercise unchanged.

the Chairman concluded that the OGWG could agree in principle to use the suggested transition rule for the T+10 exercise.

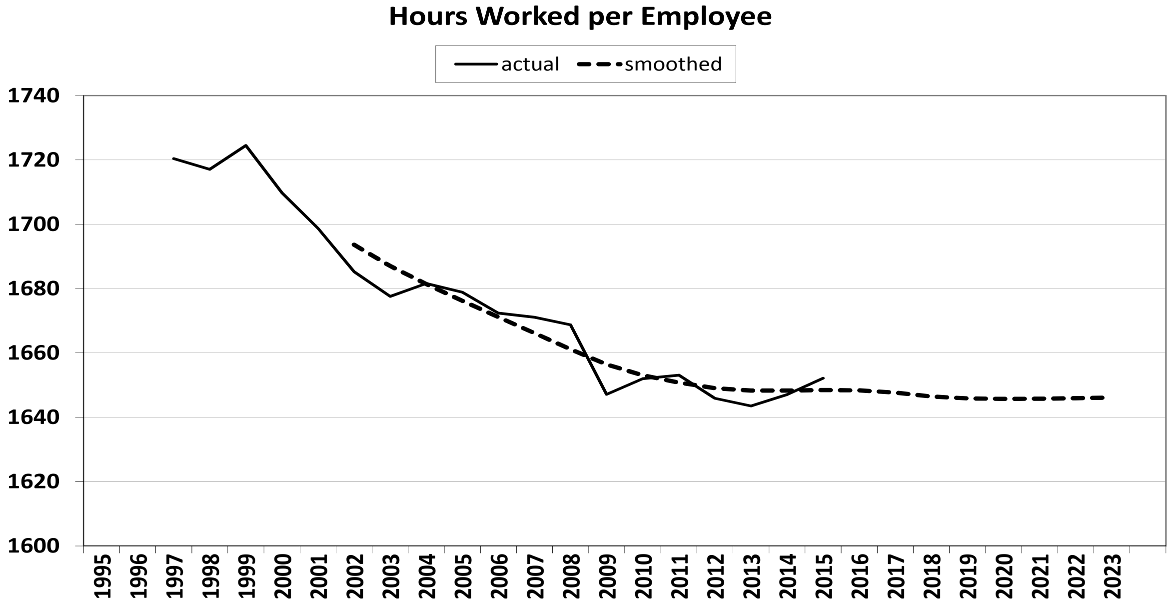
Based on this initial February 2014 agreement, there was an additional discussion at the 7 May OGWG meeting in response to the request from some Member States to check to see whether the agreed "transition rule" would still be necessary with the introduction of the new set of population projections from Eurostat and the updated Cohort Simulation Model (CSM) results. The overall conclusion of this discussion was that the new data inputs did not change the conclusion reached at the February meeting since the participation rate breaks were not "data driven" but were "methodology driven" (i.e. they are driven by the linking of two very different participation rate forecast methodologies in T+6). Following a short discussion, during which time both the ECB and the OECD strongly supported the introduction of the transition rule, the Chairman concluded that the OGWG could endorse the introduction of this transition rule in the T+10 methodology as a pragmatic way of smoothing the link between the OGWG and AWG methodologies.

Graph 6 : EU28 Participation rate projection up to T+10
(with and without the technical transition rule)



5. Hours Worked: The current method assumes broad stabilisation in average hours worked after t+5. The details of the method applied are that, for each country, the estimated trend in average hours worked is damped by taking, each year, half of the change of the preceding year, starting in t+6. The resulting projections for the t+6/t+10 period are comparable to the projections from the AWG which, by keeping hours worked fixed by age/gender group and by taking into account only the changes in the labour force breakdown. This results in practically constant overall average hours worked. The adopted method does not extend the estimated short to medium-term trend up to t+10 in the absence of further analysis and its damped trend feature eases in some way the t+5/t+6 transition issue.

Graph 7 : EU28 T+10 projection for Annual Hours Worked per Employee



Annex 5 : T+10 NAWRU methodology: Detailed description of input data for the NAWRU anchor

The current NAWRU anchor is calculated on the basis of 8 variables for the time series 1985-2012[39]: the NAWRU, total factor productivity (TFP), the real interest rate (R), employment in construction (CONS), active labour market policy (ALMP), union density (UD), the unemployment benefit replacement rate (RR) and the tax wedge (TW). These variables are constructed on the basis of a series of input variables retrieved from different sources. Table 1 below provides an overview of the series, their construction, variables needed for their construction, the data sources for these variables and the data availability.

Table 1: Variables used for the NAWRU anchor calculation and their construction details

Series	Construction	Variable codes	Data sources	Availability
NAWRU	-	ZNAWRU	AMECO statistical annex	1985-2012
TFP	-	ZVGDF	AMECO statistical annex	1985-2012
R	Long-term nominal interest rate (ILN) – 5 year backward moving average of GDP inflation (PVGD) Remark: we need to replace the series R by 0s for Luxembourg (LU) as LU has argued that due to the size of the banking sector the series is unreliable (see note from LU August 2012).	ILN	AMECO statistical annex	1985-2012
		PVGD	AMECO statistical annex	1985-2012
CONS	Employment in the construction sector (NET4)/total employment (NETN)	NET4	AMECO statistical annex	1985-2012
		NETN	AMECO statistical annex	1985-2012 but not available for all countries
ALMP	(ALMP expenditure[40]/ unemployed)/(GDP/population) = ALMP expenditure (ALMP_ex)*population (NPTD)/unemployed (NUTN)	ALMP_expenditure	Eurostat database, variable tps00076; categories 1-7 (sum of categories 2-7 and 1); percent of GDP pc_gdp	1997-2012
		NPTD	AMECO statistical annex	1985-2012
		NUTN	AMECO statistical annex	1985-2012
UD	-	UD	OECD database http://stats.oecd.org/Index.aspx?DataSetCode=UN_DEN and	1985-2012 but not available for all countries
TW	-	TW	Eurostat database, variable earn_nt_taxwedge	1996-2012
RR	Weighted average for short-term and long-term unemployment: w1*RR_after_13months+ (1w1)* [(RR_after_60months-RR_after_13months*0.2)/0.8] where w1=	RR[42]_13_months and RR_60_months for 2 income situations and 3 different family situations[43]. Averages over	Joint OECD/ECFIN database: http://ec.europa.eu/economy_finance/db_indicators/tax_benefits_indicators/index_en.htm Download data for 1EC, 2EC67, S; 67, 100; 13months, 60months from the joint OECD-EC tax and benefit database and save as rr.xls. Then weight the 13m average and	2001-2012

[39] The variables are updated once a year in autumn. In autumn 2014, the data will be updated until 2013.

[40] The ALMP variable includes the following sub-items:10: PES and administration (11: Placement and related services, 12: Benefit administration);20: Training (21: Institutional training, 22: Workplace training, 23: Integrated training, 24: Special support for apprenticeship); 30: Job rotation and job sharing; 40: Employment incentives (41: Recruitment incentives, 42: Employment maintenance incentives);50: Supported employment and rehabilitation (51: Supported employment, 52: Rehabilitation);60: Direct job creation;70: Start-up incentives (In the case of Italy, sub-item 10 could not be included).

	$$\theta = \sum_{i=0}^{11} \alpha(1-\alpha)^i$$ and α is the unemployment exit rate (or job finding rate)[41] Remark: we need to replace part of the series RR by 0s for Italy (as this was agreed in the OGWG). Essentially we need to replace the values which turn out to be negative after the back-splicing.	the 6 situations are taken for both RR_13months and RR_60months.	weight the 60m average by weights calculated based on OECD exit rates. For countries for which we do not have the weight we use the cross-country average (BG, CY, CZ, EE, EL, HU, LT, LU, LV, MT, PL, RO, SI, SK).	

Unavailable Data - Splicing : From the table it becomes apparent that some available series are not sufficient to cover the period from 1985 to 2012. Table 2 shows the additional data sources used for each variable where necessary. To connect the series from the different sources we use a splicing technique. Note that each underlying series is spliced separately. We never splice a constructed series.

Table 2: Data sources used for splicing the series

Series	**Variable codes**	**Data sources**
CONS	NET4	No splicing is needed.
	NETN	AMECO statistical annex and OECD data. We need to splice for CY, ES and EL, IE, PT, SE, UK.
ALMP	ALMP_expenditure	OECD database: http://stats.oecd.org/Index.aspx?DatasetCode=LMPEXP Remark: We use the indicator "110", which refers to the categories 1-7. For Italy we need to replace the indicator by the "112" indicator, which includes categories 2-7. Remark: We miss historical data for BG,CY, CZ, EE, HU, LT, MT, PL, RO, SI, SK, LU, EL. For those countries we need to take means across available time periods (excluding 2012).
	NPTD	No splicing is needed.
	NUTN	No splicing is needed
UD	UD	ICTWSS: Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (http://www.uva-aias.net/207) We need to splice for HU, SK, PL. We need to use Visser data for BG, CY, LT, LV, MT, RO as these data are not available from the OECD.
TW	TW	Bassanini-Duval database; "Employment Patterns in OECD countries: Reassessing the role of policies and institutions" http://www.oecd.org/dataoecd/47/61/36888714.pdf A21.xls; use variable labourtax
RR	RR_13_months RR_60_months	Remark: first we splice the two series "months 13" and "months 60" separately and then we calculate the weighted average. -Bassanini-Duval database: "Employment Patterns in OECD countries: Reassessing the role of policies and institutions"http://www.oecd.org/dataoecd/47/61/36888714.pdf -A21.xls; use variable rr1 for the 13 months average; A22.xls; use variable arr for the 60 months average. -University of Leiden database: "Unemployment replacement rates database" http://www.law.leidenuniv.nl/org/fisceco/economie/hervormingsz/datasetreplacementrates.html

[42] RR includes unemployment benefit (UB), housing benefit (HB) and salary adjustment (SA).

[43] Recipients used to earn 100% or 67% of average wage income. Recipient has no children and is either single, married with a partner that has no income or with a partner that has an income.

[41] Probability to exit unemployment (monthly probabilities)

	AT	BE	DE	DK	ES	FI	FR	IE	IT	NL	PT	SE	UK
2005 to 2007*	15.2	8.6	7.5	23.0	20.3	18.8	11.9	8.2	8.0	11.1	7.1	21.0	17.3

Source: OECD (Economic Outlook).
Note: Average probabilities of exiting unemployment within a month. * Ireland 2006-2007.

Annex 6 : T+10 results – potential growth & output gap tables & graphs for Euro Zone, EU28, EU15, EU13 & the US (+ GDP per capita growth rate and levels decomposition)

EU-15 (Old MS)	Output Gaps (% of Potential Output)		Actual Output Growth (annual % change)	Potential Growth (annual % change)		Contributions to Potential Growth*					Determinants of Labour Potential and Capital Accumulation			
	HP Filter	PF method		Ypot per capita (PopWA 15-74)	PF Potential Growth	Total Labour (Hours) Contribution	*Labour (persons) Contribution*	*Changes in Hours (per Empl) Contribution*	Capital Accumulation Contribution	TFP Contribution	Growth of Working Age Population (annual % change)	Trend Participation Rate (% of Working Age Population)	NAWRU (% of Labour Force)	Investment Ratio (% of Potential Output)
1965														
1966	-0.5	-0.9	3.8	4.7	4.4	-0.7	*(0.1)*	*(-0.8)*	1.4	3.7	0.6	60.3	2.1	20.9
1967	-1.8	-1.8	3.3	4.6	4.2	-0.8	*(0.0)*	*(-0.9)*	1.4	3.7	0.5	60.1	2.2	20.8
1968	-1.2	-0.8	5.2	4.6	4.2	-0.9	*(0.0)*	*(-0.9)*	1.4	3.6	0.5	59.9	2.3	21.2
1969	0.4	0.9	6.2	4.5	4.3	-0.7	*(0.2)*	*(-0.9)*	1.5	3.6	0.6	59.8	2.4	21.7
1970	0.9	1.6	4.9	4.3	4.2	-0.7	*(0.2)*	*(-0.9)*	1.5	3.4	0.5	59.8	2.5	22.0
1971	0.2	0.9	3.4	4.2	4.1	-0.6	*(0.2)*	*(-0.9)*	1.5	3.3	0.6	59.8	2.7	22.0
1972	0.9	1.5	4.6	3.9	4.0	-0.5	*(0.3)*	*(-0.8)*	1.5	3.1	0.7	59.7	3.0	22.1
1973	3.3	3.6	6.2	3.7	4.0	-0.4	*(0.3)*	*(-0.7)*	1.5	2.9	0.7	59.7	3.2	22.5
1974	2.3	2.4	2.4	3.4	3.6	-0.4	*(0.3)*	*(-0.6)*	1.4	2.6	0.7	59.7	3.4	21.3
1975	-1.4	-1.3	-0.6	3.1	3.0	-0.5	*(0.1)*	*(-0.6)*	1.1	2.4	0.6	59.7	3.9	19.8
1976	0.1	0.2	4.5	2.9	2.9	-0.4	*(0.2)*	*(-0.5)*	1.1	2.2	0.7	59.7	4.2	19.7
1977	0.2	0.3	2.8	2.7	2.7	-0.4	*(0.2)*	*(-0.5)*	1.1	2.1	0.7	59.7	4.6	19.5
1978	0.8	0.8	3.1	2.5	2.6	-0.3	*(0.2)*	*(-0.5)*	1.0	1.9	0.7	59.7	5.0	19.3
1979	2.1	1.9	3.6	2.3	2.5	-0.3	*(0.3)*	*(-0.5)*	1.0	1.8	0.8	59.7	5.5	19.5
1980	1.2	0.9	1.4	2.2	2.4	-0.2	*(0.3)*	*(-0.5)*	1.0	1.6	0.8	59.8	5.9	19.4
1981	-0.7	-0.7	0.2	2.1	1.8	-0.3	*(0.2)*	*(-0.5)*	0.8	1.2	0.7	59.8	6.4	18.3
1982	-1.8	-1.4	1.0	2.1	1.7	-0.3	*(0.1)*	*(-0.4)*	0.7	1.3	0.6	59.9	6.8	17.7
1983	-2.1	-1.6	1.8	2.1	2.0	-0.1	*(0.3)*	*(-0.4)*	0.7	1.4	0.5	60.0	7.1	17.4
1984	-1.8	-1.1	2.5	2.2	2.1	-0.1	*(0.2)*	*(-0.3)*	0.7	1.5	0.5	60.1	7.5	17.3
1985	-1.6	-0.9	2.5	2.3	2.3	0.1	*(0.4)*	*(-0.3)*	0.7	1.5	0.5	60.4	7.7	17.4
1986	-1.3	-0.6	2.8	2.4	2.5	0.3	*(0.5)*	*(-0.2)*	0.7	1.5	0.5	60.7	8.0	17.7
1987	-1.0	-0.4	2.8	2.5	2.5	0.3	*(0.5)*	*(-0.2)*	0.8	1.5	0.5	61.1	8.2	18.1
1988	0.7	1.1	4.2	2.5	2.7	0.3	*(0.6)*	*(-0.2)*	0.9	1.5	0.4	61.4	8.4	19.2
1989	1.8	2.0	3.7	2.5	2.7	0.3	*(0.6)*	*(-0.3)*	1.0	1.5	0.5	61.7	8.5	20.0
1990	2.3	2.3	3.0	2.5	2.7	0.2	*(0.5)*	*(-0.3)*	1.0	1.5	0.6	61.9	8.5	20.3
1991	1.8	1.6	1.9	1.9	2.6	0.1	*(0.4)*	*(-0.3)*	0.9	1.6	0.7	61.9	8.6	19.8
1992	0.7	0.4	1.3	1.7	2.5	0.1	*(0.4)*	*(-0.3)*	0.9	1.6	0.8	61.8	8.7	19.3
1993	-1.7	-1.7	-0.1	1.4	2.2	0.0	*(0.2)*	*(-0.3)*	0.7	1.5	0.7	61.7	8.8	17.8
1994	-1.1	-1.0	2.9	1.6	2.2	0.1	*(0.3)*	*(-0.2)*	0.7	1.4	0.5	61.7	8.8	18.0
1995	-0.9	-0.6	2.6	1.8	2.2	0.1	*(0.3)*	*(-0.2)*	0.7	1.3	0.3	61.7	8.8	18.3
1996	-1.5	-0.8	1.9	1.9	2.2	0.2	*(0.4)*	*(-0.2)*	0.7	1.3	0.2	61.9	8.8	18.4
1997	-1.0	-0.2	2.9	2.1	2.3	0.3	*(0.5)*	*(-0.2)*	0.7	1.2	0.2	62.2	8.7	18.7
1998	-0.6	0.3	3.0	2.2	2.4	0.4	*(0.6)*	*(-0.2)*	0.8	1.2	0.2	62.6	8.6	19.6
1999	-0.1	0.8	3.0	2.2	2.5	0.4	*(0.7)*	*(-0.3)*	0.9	1.2	0.3	63.0	8.5	20.1
2000	1.4	2.1	3.9	2.2	2.6	0.5	*(0.8)*	*(-0.3)*	0.9	1.2	0.4	63.4	8.3	20.5
2001	1.1	1.6	2.0	2.0	2.4	0.5	*(0.8)*	*(-0.3)*	0.8	1.1	0.4	63.8	8.2	20.1
2002	0.2	0.6	1.2	1.7	2.2	0.4	*(0.7)*	*(-0.3)*	0.8	1.1	0.5	64.2	8.1	19.6
2003	-0.5	-0.2	1.3	1.5	2.1	0.4	*(0.7)*	*(-0.3)*	0.7	1.0	0.6	64.5	8.1	19.4
2004	0.1	0.2	2.4	1.4	2.0	0.4	*(0.7)*	*(-0.2)*	0.7	0.8	0.6	64.8	8.1	19.6
2005	0.5	0.3	2.0	1.3	1.9	0.4	*(0.6)*	*(-0.2)*	0.8	0.7	0.5	65.0	8.1	19.9
2006	2.2	1.6	3.2	1.4	1.9	0.3	*(0.6)*	*(-0.2)*	0.8	0.7	0.5	65.3	8.1	20.6
2007	4.1	2.8	3.0	1.3	1.8	0.3	*(0.5)*	*(-0.2)*	0.9	0.6	*0.5*	65.5	8.1	21.4
2008	3.1	1.5	0.1	0.9	1.4	0.2	*(0.4)*	*(-0.2)*	0.8	0.4	*0.5*	65.7	8.3	20.6
2009	-2.4	-3.8	-4.6	0.3	0.6	-0.1	*(0.1)*	*(-0.2)*	0.4	0.3	*0.3*	65.8	8.6	17.7
2010	-1.1	-2.5	2.0	0.5	0.7	0.0	*(0.1)*	*(-0.1)*	0.4	0.3	*0.2*	65.9	8.7	17.7
2011	-0.3	-1.7	1.5	0.6	0.7	0.1	*(0.2)*	*(-0.1)*	0.4	0.3	*0.2*	66.0	8.7	17.7
2012	-1.4	-2.6	-0.4	0.4	0.5	-0.1	*(-0.0)*	*(-0.1)*	0.3	0.3	*0.1*	66.2	8.9	17.1
2013	-2.1	-3.2	0.0	0.4	0.6	0.0	*(0.1)*	*(-0.0)*	0.2	0.3	*0.2*	66.2	9.1	16.6
2014	-1.4	-2.4	1.6	0.6	0.8	0.1	*(0.1)*	*(0.0)*	0.3	0.4	*0.2*	66.3	9.2	17.0
2015	-0.5	-1.5	1.9	0.7	1.0	0.2	*(0.2)*	*(0.0)*	0.4	0.4	*0.2*	66.4	9.3	17.6
2016	0.0	-1.0	1.5	0.9	1.0	0.1	*(0.1)*	*(0.0)*	0.4	0.5	*0.1*	66.4	9.4	18.1
2017	0.5	-0.5	1.6	0.9	1.1	0.2	*(0.2)*	*(-0.0)*	0.4	0.5	*0.1*	66.5	9.4	18.3
2018	1.0	0.0	1.6	1.0	1.1	0.1	*(0.2)*	*(-0.0)*	0.4	0.5	*0.1*	66.6	9.4	18.4
2019	0.8	0.0	1.2	1.1	1.2	0.2	*(0.2)*	*(-0.0)*	0.5	0.5	*0.1*	66.7	9.3	18.5
2020	0.8	0.0	1.3	1.2	1.3	0.3	*(0.3)*	*(0.0)*	0.5	0.5	*0.1*	66.8	9.1	18.5
2021	0.8	0.0	1.3	1.2	1.3	0.3	*(0.3)*	*(0.0)*	0.5	0.6	*0.1*	66.8	8.9	18.5
2022	0.8	0.0	1.3	1.3	1.3	0.3	*(0.2)*	*(0.0)*	0.5	0.6	*0.0*	66.9	8.7	18.6
2023	0.8	0.0	1.3	1.3	1.3	0.3	*(0.2)*	*(0.0)*	0.5	0.6	*0.0*	67.0	8.4	18.7

EU-13 (NewMS)	Output Gaps (% of Potential Output)		Actual Output Growth (annual % change)	Potential Growth (annual % change)		Contributions to Potential Growth*					Determinants of Labour Potential and Capital Accumulation			
	HP Filter	PF method		Ypot per capita (PopWA 15-74)	PF Potential Growth	Total Labour (Hours) Contribution	*Labour (persons) Contribution*	*Changes in Hours (per Empl) Contribution*	Capital Accumulation Contribution	TFP Contribution	Growth of Working Age Population (annual % change)	Trend Participation Rate (% of Working Age Population)	NAWRU (% of Labour Force)	Investment Ratio (% of Potential Output)
1995														
1996	0.9	0.6	3.9	2.6	3.0	-0.2	*(-0.5)*	*(-0.2)*	0.8	2.4	0.4	63.5	10.3	20.5
1997	0.4	0.5	3.1	2.9	3.2	-0.2	*(-0.5)*	*(-0.2)*	1.0	2.4	0.3	62.9	10.7	21.5
1998	-0.2	0.1	3.1	3.3	3.6	-0.2	*(-0.5)*	*(-0.2)*	1.1	2.7	0.3	62.5	10.9	22.6
1999	-1.1	-0.7	2.8	3.5	3.6	-0.3	*(-0.6)*	*(-0.3)*	1.1	2.8	0.1	62.0	11.2	22.2
2000	-0.9	-0.6	4.0	3.8	3.8	-0.3	*(-0.5)*	*(-0.3)*	1.1	3.0	0.1	61.6	11.3	22.2
2001	-1.8	-1.3	3.0	3.9	3.7	-0.3	*(-0.6)*	*(-0.3)*	1.0	3.0	-0.2	61.1	11.3	21.5
2002	-2.6	-1.8	3.1	3.9	3.6	-0.3	*(-0.6)*	*(-0.3)*	0.9	3.1	-0.2	60.7	11.3	21.1
2003	-2.3	-1.3	4.3	3.7	3.8	-0.3	*(-0.1)*	*(-0.3)*	0.9	3.2	0.1	60.3	11.0	20.9
2004	-0.8	0.2	5.6	3.9	4.0	-0.2	*(0.0)*	*(-0.2)*	1.0	3.2	0.1	60.1	10.7	21.5
2005	0.2	0.9	4.8	4.1	4.1	-0.2	*(0.2)*	*(-0.2)*	1.3	3.1	0.0	60.0	10.3	22.6
2006	2.9	3.1	6.5	4.3	4.1	-0.2	*(0.3)*	*(-0.2)*	1.5	2.8	-0.1	60.0	9.9	24.1
2007	5.5	4.8	6.0	4.7	4.3	-0.2	*(0.2)*	*(-0.2)*	2.0	2.5	*-0.3*	60.1	9.5	26.6
2008	6.5	5.0	4.1	4.4	4.0	-0.2	*(0.2)*	*(-0.2)*	2.1	2.1	*-0.4*	60.3	9.3	27.3
2009	-0.1	-1.1	-3.7	2.5	2.3	-0.2	*(-0.1)*	*(-0.2)*	1.3	1.2	*-0.2*	60.6	9.5	22.9
2010	-0.4	-1.0	2.3	2.4	2.2	-0.1	*(-0.0)*	*(-0.1)*	1.1	1.3	*-0.2*	60.8	9.7	21.9
2011	0.5	-0.2	3.2	2.6	2.3	-0.1	*(0.1)*	*(-0.1)*	1.2	1.2	*-0.2*	61.0	9.6	22.5
2012	-1.0	-1.3	0.8	2.2	1.9	-0.1	*(0.0)*	*(-0.1)*	1.0	0.9	*-0.3*	61.2	9.6	21.6
2013	-1.9	-2.0	1.2	2.2	1.9	0.0	*(0.1)*	*(-0.0)*	0.9	1.1	*-0.3*	61.4	9.5	21.0
2014	-1.6	-1.7	2.5	2.4	2.2	0.0	*(0.2)*	*(0.0)*	0.9	1.2	*-0.2*	61.5	9.2	21.4
2015	-0.9	-1.2	2.9	2.6	2.4	0.0	*(0.2)*	*(0.0)*	1.0	1.3	*-0.2*	61.6	8.9	22.0
2016	-0.4	-0.8	2.7	2.6	2.3	0.0	*(-0.0)*	*(0.0)*	1.1	1.2	*-0.3*	61.7	8.7	22.3
2017	0.0	-0.4	2.6	2.5	2.2	0.0	*(-0.2)*	*(-0.0)*	1.0	1.2	*-0.3*	61.7	8.8	22.4
2018	0.4	0.0	2.6	2.5	2.2	0.0	*(-0.2)*	*(-0.0)*	1.0	1.2	*-0.3*	61.7	8.8	22.3
2019	0.4	0.0	2.3	2.6	2.3	0.0	*(-0.2)*	*(-0.0)*	1.0	1.3	*-0.3*	61.7	8.8	22.3
2020	0.4	0.0	2.3	2.6	2.3	0.0	*(-0.2)*	*(0.0)*	1.0	1.3	*-0.3*	61.6	8.7	22.2
2021	0.3	0.0	2.3	2.6	2.3	0.0	*(-0.3)*	*(0.0)*	0.9	1.3	*-0.4*	61.6	8.7	22.2
2022	0.3	0.0	2.3	2.8	2.3	0.0	*(-0.3)*	*(0.0)*	0.9	1.3	*-0.5*	61.5	8.7	22.3
2023	0.3	0.0	2.3	2.8	2.3	0.0	*(-0.4)*	*(0.0)*	0.9	1.3	*-0.5*	61.5	8.7	22.4

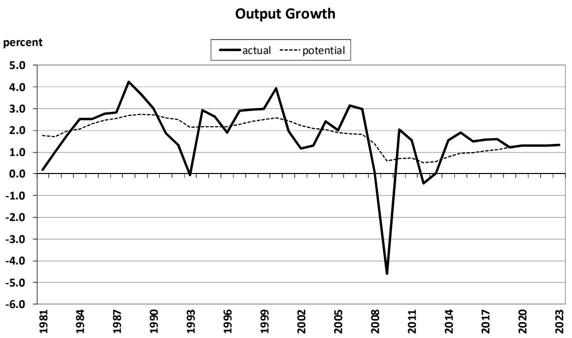
EU 28	Output Gaps (% of Potential Output)		Actual Output Growth (annual % change)	Potential Growth (annual % change)		Contributions to Potential Growth*					Determinants of Labour Potential and Capital Accumulation			
	HP Filter	PF method		HP Trend Growth	PF Potential Growth	Total Labour (Hours) Contribution	*Labour (persons) Contribution*	*Changes in Hours (per Empl) Contribution*	Capital Accumulation Contribution	TFP Contribution	Growth of Working Age Population (annual % change)	Trend Participation Rate (% of Working Age Population)	NAWRU (% of Labour Force)	Investment Ratio (% of Potential Output)
1995														
1996	-1.3	-0.8	2.0	2.5	2.2	0.2	*(0.2)*	*(-0.0)*	0.7	1.3	0.3	63.6	9.1	18.5
1997	-1.0	-0.2	2.9	2.5	2.3	0.2	*(0.3)*	*(-0.0)*	0.8	1.4	0.2	63.1	9.2	18.8
1998	-0.6	0.3	3.0	2.6	2.5	0.3	*(0.4)*	*(-0.1)*	0.8	1.3	0.2	62.6	9.2	19.7
1999	-0.1	0.7	3.0	2.5	2.6	0.3	*(0.4)*	*(-0.1)*	0.9	1.4	0.2	62.1	9.1	20.3
2000	1.3	1.9	3.9	2.5	2.6	0.3	*(0.5)*	*(-0.2)*	0.9	1.4	0.3	61.6	9.0	20.6
2001	1.0	1.5	2.0	2.4	2.5	0.2	*(0.5)*	*(-0.3)*	0.9	1.4	0.3	61.1	8.9	20.2
2002	0.0	0.5	1.3	2.2	2.3	0.2	*(0.5)*	*(-0.3)*	0.8	1.4	0.4	60.7	8.8	19.6
2003	-0.6	-0.2	1.5	2.1	2.2	0.3	*(0.5)*	*(-0.3)*	0.7	1.2	0.5	60.3	8.7	19.5
2004	0.1	0.2	2.6	1.9	2.1	0.3	*(0.6)*	*(-0.2)*	0.8	1.1	0.5	60.0	8.7	19.7
2005	0.5	0.4	2.2	1.8	2.0	0.3	*(0.5)*	*(-0.2)*	0.8	0.9	0.4	59.9	8.6	20.0
2006	2.3	1.7	3.4	1.6	2.0	0.3	*(0.5)*	*(-0.2)*	0.9	0.8	0.4	60.0	8.5	20.9
2007	4.2	2.9	3.2	1.3	2.0	0.3	*(0.5)*	*(-0.2)*	1.0	0.7	0.3	60.1	8.5	21.7
2008	3.4	1.7	0.4	1.1	1.5	0.1	*(0.3)*	*(-0.2)*	0.9	0.5	0.3	60.3	8.5	21.1
2009	-2.2	-3.6	-4.5	0.9	0.7	-0.1	*(0.0)*	*(-0.2)*	0.5	0.4	0.2	60.5	8.8	18.1
2010	-1.1	-2.4	2.0	0.8	0.8	0.0	*(0.1)*	*(-0.1)*	0.4	0.4	0.1	60.8	8.9	18.0
2011	-0.2	-1.6	1.6	0.8	0.8	0.1	*(0.2)*	*(-0.1)*	0.4	0.3	0.1	61.0	8.9	18.1
2012	-1.4	-2.5	-0.4	0.8	0.6	-0.1	*(-0.0)*	*(-0.1)*	0.3	0.3	0.0	61.2	9.1	17.4
2013	-2.1	-3.1	0.1	0.9	0.7	0.0	*(0.1)*	*(-0.0)*	0.3	0.4	0.1	61.4	9.2	16.9
2014	-1.5	-2.4	1.6	0.9	0.9	0.1	*(0.1)*	*(-0.0)*	0.3	0.4	0.1	61.6	9.3	17.3
2015	-0.5	-1.5	2.0	1.0	1.0	0.2	*(0.2)*	*(0.0)*	0.4	0.5	0.1	61.7	9.3	17.9
2016	-0.1	-1.0	1.6	1.1	1.1	0.1	*(0.1)*	*(-0.0)*	0.4	0.6	0.0	61.8	9.3	18.4
2017	0.4	-0.5	1.7	1.2	1.1	0.1	*(0.1)*	*(-0.0)*	0.5	0.6	0.0	61.8	9.3	18.6
2018	0.9	0.0	1.7	1.2	1.2	0.1	*(0.1)*	*(-0.0)*	0.5	0.7	0.0	61.8	9.3	18.7
2019	0.8	0.0	1.3	1.4	1.3	0.1	*(0.2)*	*(-0.0)*	0.5	0.7	0.0	61.8	9.2	18.8
2020	0.8	0.0	1.4	1.4	1.4	0.2	*(0.2)*	*(-0.0)*	0.5	0.7	0.0	61.7	9.1	18.8
2021	0.8	0.0	1.4	1.4	1.4	0.2	*(0.2)*	*(0.0)*	0.5	0.7	0.0	61.7	8.9	18.8
2022	0.8	0.0	1.4	1.4	1.4	0.1	*(0.1)*	*(0.0)*	0.5	0.8	-0.1	61.7	8.7	18.9
2023	0.7	0.0	1.4	1.4	1.4	0.1	*(0.1)*	*(0.0)*	0.5	0.8	-0.1	61.6	8.5	19.0

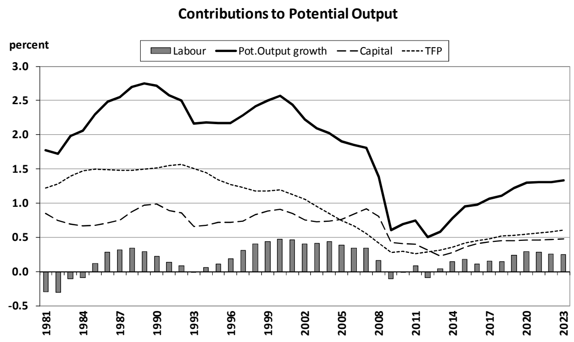
EA-12	Output Gaps (% of Potential Output)		Actual Output Growth (annual % change)	Potential Growth (annual % change)		Contributions to Potential Growth*					Determinants of Labour Potential and Capital Accumulation			
	HP Filter	PF method		Ypot per capita (PopWA 15-74)	PF Potential Growth	Total Labour (Hours) Contribution	*Labour (persons) Contribution*	*Changes in Hours (per Empl) Contribution*	Capital Accumulation Contribution	TFP Contribution	Growth of Working Age Population (annual % change)	Trend Participation Rate (% of Working Age Population)	NAWRU (% of Labour Force)	Investment Ratio (% of Potential Output)
1965														
1966	-0.6	-0.9	4.4	5.2	4.9	-0.7	*(0.2)*	*(-0.9)*	1.5	4.0	0.7	59.3	2.3	22.7
1967	-2.2	-2.0	3.4	5.1	4.7	-0.8	*(0.1)*	*(-0.9)*	1.5	4.0	0.6	59.0	2.4	22.2
1968	-1.7	-1.2	5.5	5.0	4.6	-0.8	*(0.1)*	*(-0.9)*	1.5	4.0	0.5	58.9	2.5	22.6
1969	0.4	1.0	7.2	4.9	4.8	-0.7	*(0.3)*	*(-1.0)*	1.6	3.9	0.7	58.8	2.5	23.3
1970	1.1	1.8	5.6	4.8	4.7	-0.7	*(0.3)*	*(-1.0)*	1.7	3.7	0.6	58.7	2.6	23.6
1971	0.4	1.1	3.8	4.6	4.6	-0.6	*(0.3)*	*(-0.9)*	1.7	3.5	0.6	58.7	2.8	23.6
1972	1.0	1.6	4.9	4.3	4.5	-0.5	*(0.3)*	*(-0.8)*	1.7	3.3	0.8	58.7	3.0	23.8
1973	3.0	3.2	6.1	4.0	4.4	-0.4	*(0.3)*	*(-0.7)*	1.7	3.1	0.8	58.7	3.2	24.1
1974	2.6	2.6	3.3	3.7	4.0	-0.4	*(0.3)*	*(-0.7)*	1.5	2.8	0.8	58.6	3.5	22.8
1975	-1.6	-1.4	-0.8	3.4	3.3	-0.5	*(0.1)*	*(-0.6)*	1.2	2.5	0.7	58.5	3.9	21.1
1976	0.1	0.3	4.9	3.2	3.1	-0.4	*(0.1)*	*(-0.5)*	1.2	2.3	0.7	58.4	4.2	20.8
1977	0.3	0.4	3.1	2.9	3.0	-0.4	*(0.2)*	*(-0.5)*	1.2	2.2	0.7	58.4	4.6	20.7
1978	0.7	0.7	3.2	2.7	2.9	-0.3	*(0.3)*	*(-0.5)*	1.1	2.0	0.8	58.4	5.0	20.5
1979	2.0	1.8	3.8	2.5	2.7	-0.2	*(0.3)*	*(-0.5)*	1.1	1.8	0.9	58.4	5.4	20.7
1980	1.7	1.2	2.1	2.3	2.7	-0.1	*(0.4)*	*(-0.5)*	1.1	1.6	0.9	58.4	5.8	20.7
1981	0.1	-0.1	0.5	2.2	1.8	-0.2	*(0.2)*	*(-0.5)*	1.0	1.1	0.8	58.5	6.3	19.7
1982	-1.4	-1.2	0.7	2.1	1.8	-0.3	*(0.1)*	*(-0.5)*	0.8	1.3	0.7	58.5	6.8	18.8
1983	-2.1	-1.6	1.4	2.1	1.9	-0.2	*(0.3)*	*(-0.4)*	0.8	1.3	0.6	58.6	7.0	18.4
1984	-1.9	-1.2	2.4	2.2	1.9	-0.2	*(0.2)*	*(-0.4)*	0.7	1.4	0.5	58.7	7.4	18.0
1985	-1.9	-1.0	2.3	2.3	2.1	0.0	*(0.3)*	*(-0.4)*	0.7	1.5	0.5	58.9	7.7	18.1
1986	-1.8	-0.9	2.5	2.4	2.4	0.1	*(0.5)*	*(-0.3)*	0.7	1.5	0.5	59.2	7.9	18.4
1987	-1.8	-0.9	2.5	2.5	2.5	0.2	*(0.5)*	*(-0.3)*	0.8	1.5	0.5	59.5	8.3	18.8
1988	-0.1	0.6	4.2	2.5	2.7	0.3	*(0.6)*	*(-0.3)*	0.9	1.5	0.5	59.9	8.4	19.8
1989	1.4	1.8	4.1	2.5	2.8	0.3	*(0.6)*	*(-0.3)*	1.0	1.5	0.6	60.2	8.6	20.6
1990	2.5	2.6	3.6	2.5	2.8	0.3	*(0.6)*	*(-0.3)*	1.0	1.5	0.7	60.4	8.7	21.2
1991	2.7	2.5	2.7	1.9	2.7	0.2	*(0.6)*	*(-0.3)*	1.0	1.5	0.8	60.5	8.8	21.0
1992	1.7	1.3	1.4	1.7	2.6	0.2	*(0.5)*	*(-0.3)*	1.0	1.5	0.9	60.4	8.9	20.5
1993	-1.2	-1.5	-0.7	1.3	2.1	0.1	*(0.3)*	*(-0.3)*	0.7	1.3	0.8	60.4	9.1	18.7
1994	-1.0	-1.1	2.4	1.4	2.0	0.1	*(0.3)*	*(-0.3)*	0.7	1.2	0.6	60.4	9.2	18.8
1995	-0.9	-0.7	2.4	1.6	2.0	0.1	*(0.3)*	*(-0.2)*	0.8	1.1	0.4	60.5	9.2	19.1
1996	-1.6	-1.1	1.5	1.7	1.9	0.2	*(0.4)*	*(-0.2)*	0.7	1.0	0.3	60.7	9.2	19.1
1997	-1.3	-0.5	2.6	1.8	2.0	0.3	*(0.5)*	*(-0.2)*	0.7	1.0	0.2	61.0	9.2	19.3
1998	-0.8	0.1	2.8	1.9	2.1	0.4	*(0.7)*	*(-0.2)*	0.8	0.9	0.2	61.5	9.1	20.0
1999	-0.1	0.8	2.9	2.0	2.3	0.5	*(0.8)*	*(-0.3)*	0.9	0.9	0.2	62.0	9.0	20.8
2000	1.5	2.3	3.8	2.0	2.3	0.5	*(0.8)*	*(-0.3)*	0.9	0.9	0.3	62.5	8.9	21.3
2001	1.4	2.0	2.0	1.8	2.2	0.5	*(0.9)*	*(-0.3)*	0.9	0.9	0.4	62.9	8.8	21.1
2002	0.4	0.9	0.9	1.5	2.0	0.4	*(0.8)*	*(-0.3)*	0.8	0.8	0.5	63.3	8.7	20.4
2003	-0.7	-0.2	0.7	1.3	1.9	0.4	*(0.7)*	*(-0.3)*	0.7	0.7	0.5	63.7	8.7	20.2
2004	-0.2	0.2	2.2	1.3	1.8	0.5	*(0.7)*	*(-0.2)*	0.7	0.6	0.5	64.0	8.7	20.3
2005	0.0	0.1	1.7	1.2	1.7	0.4	*(0.6)*	*(-0.2)*	0.7	0.6	0.5	64.3	8.7	20.6
2006	1.9	1.6	3.2	1.3	1.7	0.3	*(0.6)*	*(-0.2)*	0.8	0.6	0.4	64.6	8.7	21.4
2007	3.7	2.8	2.9	1.3	1.7	0.3	*(0.5)*	*(-0.2)*	0.9	0.5	*0.4*	64.8	8.7	22.1
2008	3.2	1.7	0.3	1.0	1.4	0.1	*(0.4)*	*(-0.2)*	0.8	0.5	*0.4*	65.0	8.9	21.5
2009	-2.1	-3.4	-4.4	0.5	0.6	-0.2	*(0.0)*	*(-0.2)*	0.4	0.4	*0.1*	65.2	9.2	18.6
2010	-0.8	-2.1	2.0	0.7	0.7	-0.1	*(0.1)*	*(-0.2)*	0.4	0.4	*0.0*	65.4	9.3	18.4
2011	0.2	-1.3	1.6	0.8	0.8	0.0	*(0.1)*	*(-0.1)*	0.4	0.4	*0.0*	65.6	9.3	18.6
2012	-1.1	-2.4	-0.7	0.4	0.5	-0.2	*(-0.1)*	*(-0.1)*	0.3	0.4	*0.0*	65.7	9.6	17.7
2013	-2.1	-3.3	-0.4	0.4	0.5	-0.1	*(-0.0)*	*(-0.1)*	0.2	0.4	*0.1*	65.8	9.8	17.1
2014	-1.6	-2.7	1.2	0.6	0.6	0.0	*(0.0)*	*(-0.1)*	0.2	0.4	*0.1*	65.9	10.0	17.4
2015	-0.7	-1.8	1.7	0.7	0.8	0.0	*(0.1)*	*(-0.1)*	0.3	0.5	*0.1*	66.0	10.1	18.0
2016	-0.1	-1.2	1.5	0.8	0.9	0.0	*(0.1)*	*(-0.0)*	0.3	0.5	*0.0*	66.0	10.2	18.5
2017	0.6	-0.6	1.6	0.9	1.0	0.1	*(0.1)*	*(-0.1)*	0.4	0.5	*0.1*	66.1	10.2	18.8
2018	1.2	0.0	1.7	1.0	1.0	0.1	*(0.2)*	*(-0.1)*	0.4	0.5	*0.1*	66.2	10.2	19.0
2019	1.2	0.0	1.2	1.1	1.2	0.2	*(0.2)*	*(-0.0)*	0.4	0.5	*0.1*	66.3	10.0	19.1
2020	1.3	0.0	1.3	1.2	1.3	0.3	*(0.3)*	*(0.0)*	0.4	0.5	*0.1*	66.4	9.8	19.2
2021	1.3	0.0	1.3	1.2	1.3	0.3	*(0.3)*	*(0.0)*	0.4	0.6	*0.1*	66.4	9.5	19.3
2022	1.3	0.0	1.3	1.3	1.3	0.3	*(0.2)*	*(0.0)*	0.5	0.6	*0.0*	66.5	9.3	19.4
2023	1.3	0.0	1.3	1.4	1.3	0.3	*(0.2)*	*(0.0)*	0.5	0.6	*-0.1*	66.5	9.0	19.4

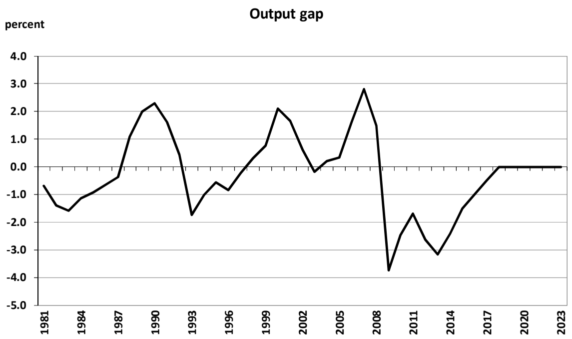
EA-18	Output Gaps (% of Potential Output)		Actual Output Growth (annual % change)	Potential Growth (annual % change)		Contributions to Potential Growth*					Determinants of Labour Potential and Capital Accumulation			
	HP Filter	PF method		Ypot per capita (PopWA 15-74)	PF Potential Growth	Total Labour (Hours) Contribution	*Labour (persons) Contribution*	*Changes in Hours (per Empl) Contribution*	Capital Accumulation Contribution	TFP Contribution	Growth of Working Age Population (annual % change)	Trend Participation Rate (% of Working Age Population)	NAWRU (% of Labour Force)	Investment Ratio (% of Potential Output)
1995														
1996	-1.6	-1.1	1.6	1.7	2.0	0.1	(0.4)	(-0.2)	0.7	1.1	0.3	60.7	9.3	19.1
1997	-1.3	-0.5	2.6	1.8	2.0	0.3	(0.5)	(-0.2)	0.8	1.0	0.2	61.1	9.4	19.3
1998	-0.8	0.1	2.8	2.0	2.2	0.4	(0.6)	(-0.2)	0.8	0.9	0.2	61.5	9.3	20.1
1999	-0.1	0.8	2.9	2.0	2.3	0.4	(0.7)	(-0.3)	0.9	0.9	0.3	62.0	9.2	20.9
2000	1.5	2.2	3.8	2.0	2.4	0.5	(0.8)	(-0.3)	0.9	0.9	0.3	62.4	9.0	21.4
2001	1.4	2.0	2.0	1.8	2.3	0.5	(0.8)	(-0.3)	0.9	0.9	0.4	62.9	8.9	21.1
2002	0.3	0.9	0.9	1.5	2.0	0.4	(0.8)	(-0.3)	0.8	0.8	0.5	63.2	8.9	20.4
2003	-0.7	-0.2	0.8	1.4	1.9	0.4	(0.7)	(-0.3)	0.7	0.7	0.5	63.6	8.9	20.3
2004	-0.2	0.2	2.2	1.3	1.9	0.4	(0.7)	(-0.2)	0.7	0.7	0.5	63.9	8.8	20.4
2005	0.0	0.1	1.7	1.3	1.7	0.4	(0.6)	(-0.2)	0.8	0.6	0.5	64.2	8.8	20.7
2006	1.9	1.6	3.3	1.4	1.8	0.3	(0.6)	(-0.2)	0.8	0.6	0.4	64.5	8.8	21.5
2007	3.8	2.8	3.0	1.3	1.8	0.3	(0.5)	(-0.2)	0.9	0.6	0.4	64.7	8.8	22.2
2008	3.3	1.8	0.4	1.0	1.4	0.1	(0.3)	(-0.2)	0.8	0.5	0.4	64.9	8.9	21.6
2009	-2.1	-3.4	-4.5	0.5	0.6	-0.2	(0.0)	(-0.2)	0.4	0.4	0.1	65.1	9.2	18.7
2010	-0.8	-2.1	2.0	0.7	0.7	-0.1	(0.1)	(-0.2)	0.4	0.4	0.0	65.3	9.4	18.5
2011	0.2	-1.3	1.6	0.8	0.8	0.0	(0.1)	(-0.1)	0.4	0.4	0.0	65.4	9.4	18.6
2012	-1.1	-2.4	-0.6	0.4	0.5	-0.2	(-0.1)	(-0.1)	0.3	0.4	0.0	65.6	9.7	17.8
2013	-2.1	-3.3	-0.4	0.4	0.5	-0.1	(-0.0)	(-0.1)	0.2	0.4	0.1	65.7	9.9	17.2
2014	-1.6	-2.7	1.2	0.6	0.6	0.0	(0.0)	(-0.1)	0.2	0.5	0.1	65.7	10.0	17.5
2015	-0.7	-1.8	1.7	0.7	0.8	0.0	(0.1)	(-0.1)	0.3	0.5	0.1	65.8	10.2	18.1
2016	-0.1	-1.2	1.5	0.9	0.9	0.0	(0.0)	(-0.0)	0.4	0.5	0.0	65.9	10.2	18.5
2017	0.6	-0.6	1.6	0.9	1.0	0.1	(0.1)	(-0.1)	0.4	0.5	0.1	66.0	10.2	18.9
2018	1.2	0.0	1.7	1.0	1.1	0.1	(0.1)	(-0.1)	0.4	0.6	0.1	66.1	10.2	19.1
2019	1.2	0.0	1.2	1.2	1.2	0.2	(0.2)	(-0.0)	0.4	0.6	0.0	66.2	10.1	19.2
2020	1.3	0.0	1.3	1.2	1.3	0.3	(0.3)	(0.0)	0.4	0.6	0.1	66.2	9.9	19.3
2021	1.3	0.0	1.3	1.3	1.3	0.3	(0.3)	(0.0)	0.4	0.6	0.0	66.3	9.6	19.3
2022	1.4	0.0	1.3	1.4	1.3	0.2	(0.2)	(0.0)	0.5	0.6	-0.1	66.3	9.3	19.4
2023	1.4	0.0	1.3	1.4	1.3	0.2	(0.2)	(0.0)	0.5	0.6	-0.1	66.4	9.1	19.5

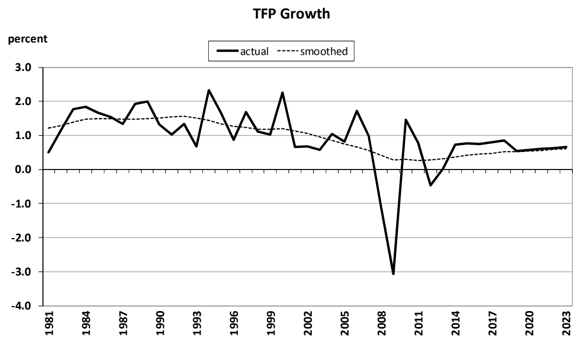
US	Output Gaps (% of Potential Output)		Actual Output Growth (annual % change)	Potential Growth (annual % change)		Contributions to Potential Growth*					Determinants of Labour Potential and Capital Accumulation			
	HP Filter	PF method		HP Trend Growth	PF Potential Growth	Total Labour (Hours) Contribution	*Labour (persons) Contribution*	*Changes in Hours (per Empl) Contribution*	Capital Accumulation Contribution	TFP Contribution	Growth of Working Age Population (annual % change)	Trend Participation Rate (% of Working Age Population)	NAWRU (% of Labour Force)	Investment Ratio (% of Potential Output)
1965														
1966		2.4	6.7		3.6	0.9	*(1.5)*	*(-0.6)*	1.2	1.5	1.6	61.1	4.0	19.4
1967		1.4	2.5		3.5	0.9	*(1.4)*	*(-0.6)*	1.1	1.5	1.6	61.5	4.0	18.6
1968		2.9	4.8		3.3	0.7	*(1.2)*	*(-0.5)*	1.1	1.4	1.6	61.8	4.2	19.0
1969		2.7	3.1		3.2	0.6	*(1.1)*	*(-0.5)*	1.1	1.4	1.6	62.0	4.4	19.1
1970		-0.1	0.2		3.0	0.7	*(1.1)*	*(-0.4)*	1.0	1.4	1.8	62.1	4.7	18.0
1971		0.2	3.3		3.0	0.7	*(1.1)*	*(-0.4)*	0.9	1.3	1.8	62.2	5.0	17.9
1972		2.2	5.2		3.2	0.8	*(1.1)*	*(-0.4)*	1.1	1.3	1.9	62.4	5.3	18.7
1973		4.7	5.6		3.2	0.8	*(1.2)*	*(-0.4)*	1.1	1.2	1.9	62.6	5.7	19.4
1974		1.2	-0.5		2.9	0.8	*(1.2)*	*(-0.4)*	0.9	1.1	1.8	62.8	6.0	18.2
1975		-1.6	-0.2		2.6	0.8	*(1.2)*	*(-0.4)*	0.7	1.1	1.8	63.1	6.4	16.4
1976		0.7	5.4		3.0	1.1	*(1.4)*	*(-0.3)*	0.8	1.0	1.8	63.5	6.6	17.2
1977		2.1	4.6		3.2	1.2	*(1.5)*	*(-0.2)*	1.0	1.0	1.8	64.0	6.9	18.4
1978		4.2	5.6		3.4	1.3	*(1.5)*	*(-0.2)*	1.1	0.9	1.7	64.5	7.1	19.7
1979		4.0	3.2		3.4	1.3	*(1.5)*	*(-0.2)*	1.2	0.9	1.7	65.0	7.2	20.1
1980		1.0	-0.2		2.8	1.0	*(1.1)*	*(-0.2)*	0.9	0.9	1.3	65.4	7.4	18.7
1981		0.4	2.6		3.1	1.0	*(1.0)*	*(-0.1)*	0.9	1.3	1.2	65.7	7.5	18.5
1982		-4.2	-1.9		2.9	0.9	*(0.9)*	*(0.0)*	0.7	1.2	1.1	66.0	7.5	17.0
1983		-2.9	4.6		3.2	1.1	*(1.0)*	*(0.1)*	0.8	1.3	1.0	66.2	7.4	17.7
1984		0.5	7.3		3.7	1.2	*(1.2)*	*(0.1)*	1.0	1.4	1.0	66.7	7.2	19.6
1985		0.9	4.2		3.8	1.3	*(1.3)*	*(-0.0)*	1.1	1.3	1.0	67.2	7.1	20.2
1986		0.7	3.5		3.8	1.4	*(1.5)*	*(-0.1)*	1.1	1.3	1.1	67.9	6.8	20.1
1987		0.6	3.5		3.5	1.2	*(1.5)*	*(-0.2)*	1.0	1.3	0.9	68.7	6.6	19.8
1988		1.4	4.2		3.3	1.1	*(1.3)*	*(-0.2)*	0.9	1.2	0.7	69.3	6.4	19.6
1989		2.0	3.7		3.1	0.9	*(1.1)*	*(-0.1)*	0.9	1.2	0.7	69.9	6.2	19.6
1990		1.1	1.9		2.9	0.9	*(1.0)*	*(-0.1)*	0.8	1.2	0.9	70.2	6.1	19.0
1991		-1.6	-0.1		2.7	0.8	*(0.9)*	*(-0.0)*	0.6	1.1	1.0	70.4	6.0	17.7
1992		-0.9	3.6		2.9	1.0	*(0.9)*	*(0.1)*	0.7	1.2	1.2	70.4	5.9	18.0
1993		-1.2	2.7		3.0	1.1	*(0.8)*	*(0.3)*	0.7	1.2	1.2	70.3	5.7	18.3
1994		-0.4	4.0		3.2	1.2	*(0.8)*	*(0.4)*	0.8	1.2	1.2	70.2	5.5	18.8
1995		-1.1	2.7		3.4	1.3	*(0.8)*	*(0.4)*	0.9	1.3	1.2	70.1	5.3	19.2
1996		-1.0	3.8		3.6	1.2	*(0.9)*	*(0.4)*	1.0	1.4	1.2	70.1	5.1	19.9
1997		-0.3	4.5		3.8	1.2	*(1.0)*	*(0.3)*	1.1	1.5	1.3	70.1	5.0	20.6
1998		0.3	4.4		3.9	1.1	*(1.0)*	*(0.1)*	1.2	1.5	1.3	70.1	4.8	21.6
1999		1.3	4.8		3.7	0.9	*(0.9)*	*(-0.1)*	1.3	1.6	1.2	70.2	4.7	22.6
2000		1.9	4.1		3.5	0.6	*(0.9)*	*(-0.3)*	1.3	1.6	1.2	70.2	4.6	23.2
2001		-0.1	0.9		3.0	0.3	*(0.8)*	*(-0.4)*	1.1	1.5	1.2	70.3	4.6	22.4
2002		-0.8	1.8		2.5	0.1	*(0.6)*	*(-0.5)*	1.0	1.4	1.1	70.3	4.8	21.4
2003		-0.4	2.8		2.4	0.0	*(0.5)*	*(-0.5)*	1.0	1.4	1.0	70.2	4.9	21.8
2004		0.9	3.8		2.5	0.1	*(0.5)*	*(-0.4)*	1.1	1.3	1.2	70.1	5.2	22.5
2005		1.7	3.4		2.5	0.1	*(0.5)*	*(-0.4)*	1.2	1.2	1.2	70.0	5.4	23.2
2006		2.1	2.7		2.3	0.1	*(0.4)*	*(-0.3)*	1.1	1.1	1.2	69.8	5.8	23.1
2007		2.0	1.8		1.9	-0.1	*(0.3)*	*(-0.3)*	1.0	1.0	1.1	69.6	6.2	22.4
2008		0.1	-0.3		1.5	-0.2	*(0.1)*	*(-0.3)*	0.7	0.9	1.1	69.2	6.6	21.0
2009		-3.6	-2.8		1.0	-0.2	*(-0.0)*	*(-0.2)*	0.3	0.9	1.1	68.8	7.0	18.1
2010		-2.3	2.5		1.1	-0.1	*(-0.0)*	*(-0.1)*	0.3	0.9	1.0	68.3	7.2	18.1
2011		-1.8	1.8		1.4	0.1	*(0.0)*	*(0.0)*	0.4	0.9	0.9	67.9	7.4	18.4
2012		-0.8	2.8		1.7	0.3	*(0.2)*	*(0.1)*	0.5	0.9	0.9	67.5	7.4	19.1
2013		-0.8	1.9		1.9	0.5	*(0.3)*	*(0.2)*	0.5	0.9	0.8	67.3	7.3	19.3
2014		-0.3	2.8		2.2	0.7	*(0.5)*	*(0.2)*	0.6	0.9	0.8	67.1	7.2	19.8
2015		0.4	3.2		2.5	0.8	*(0.6)*	*(0.2)*	0.7	1.0	0.8	67.1	7.0	20.8
2016		0.2	2.3		2.5	0.6	*(0.4)*	*(0.2)*	0.8	1.0	0.6	67.0	6.9	21.1
2017		0.1	2.3		2.4	0.6	*(0.4)*	*(0.2)*	0.8	1.0	0.6	67.0	6.9	21.1
2018		0.0	2.3		2.4	0.6	*(0.4)*	*(0.2)*	0.8	1.1	0.6	67.0	6.9	20.8
2019		0.0	2.3		2.3	0.5	*(0.4)*	*(0.1)*	0.7	1.1	0.6	67.0	6.8	20.5
2020		0.0	2.3		2.3	0.5	*(0.4)*	*(0.0)*	0.7	1.1	0.6	67.0	6.8	20.4
2021		0.0	2.3		2.3	0.5	*(0.4)*	*(0.0)*	0.7	1.1	0.6	67.0	6.7	20.3
2022		0.0	2.3		2.3	0.4	*(0.4)*	*(0.0)*	0.7	1.1	0.6	67.0	6.6	20.3
2023		0.0	2.3		2.3	0.4	*(0.4)*	*(0.0)*	0.7	1.1	0.6	67.0	6.6	20.4

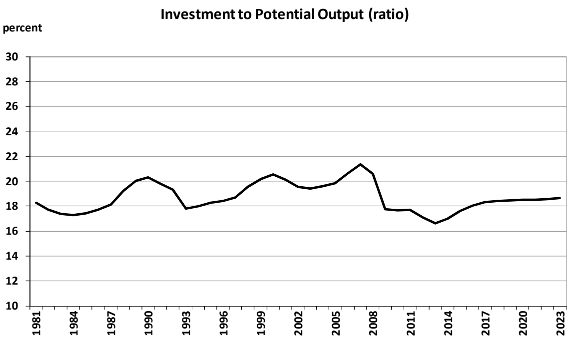
EU15 (Old MS)

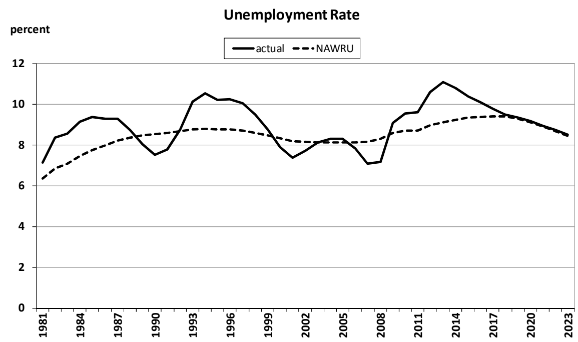

Output Growth
percent
actual
potential

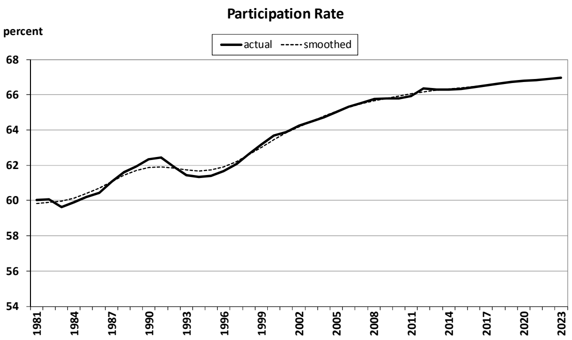

Contributions to Potential Output
percent
Labour
Pot.Output growth
Capital
TFP


Output gap
percent


TFP Growth
percent
actual
smoothed

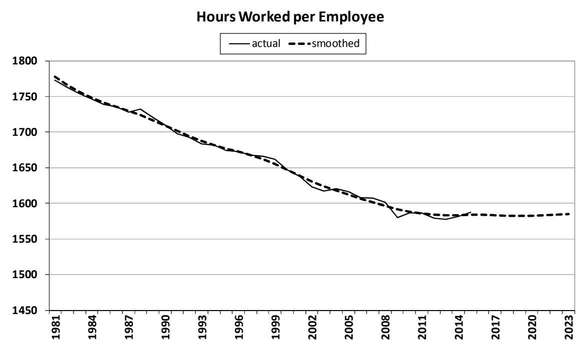

Investment to Potential Output (ratio)
percent


Unemployment Rate
percent
actual
NAWRU

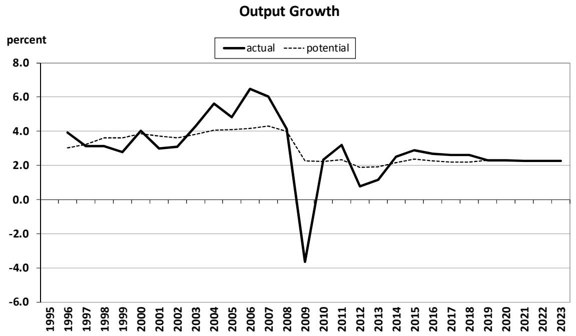

Participation Rate
percent
actual
smoothed

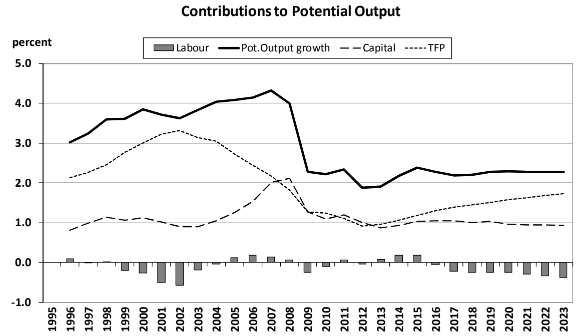

Population of Working Age
percent
growth

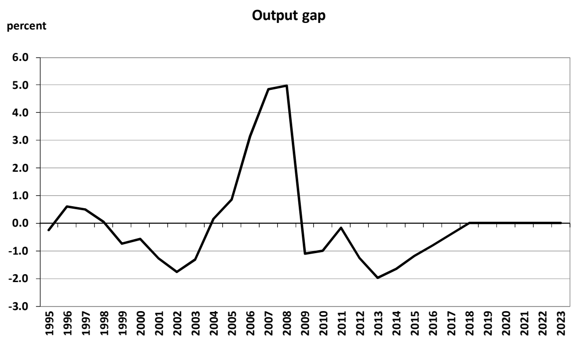

Employment
million
actual
smoothed

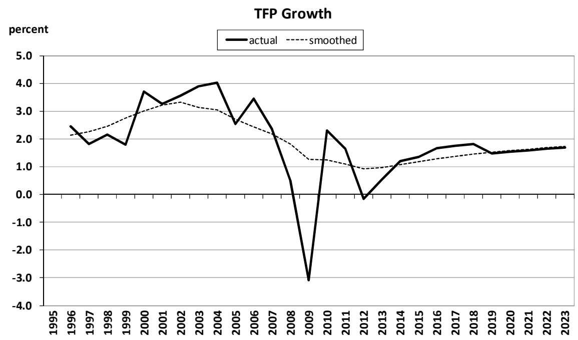

Hours Worked per Employee
actual
smoothed

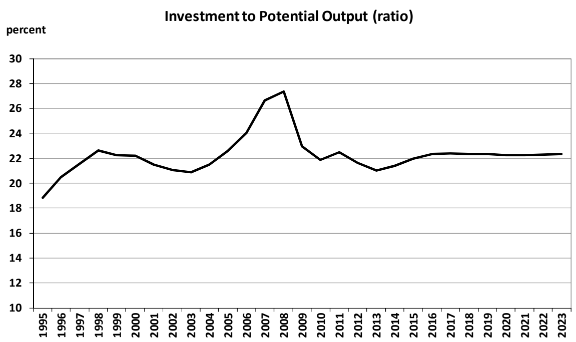
EU13 (NewMS)

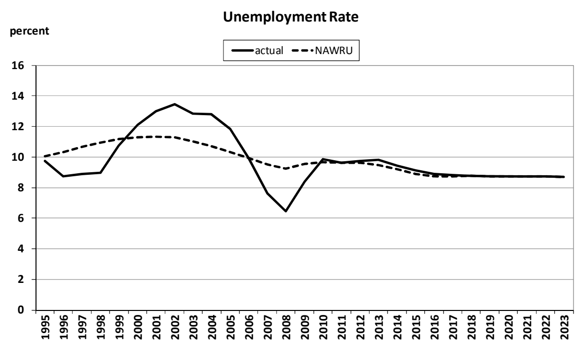

Output Growth
percent
actual
potential

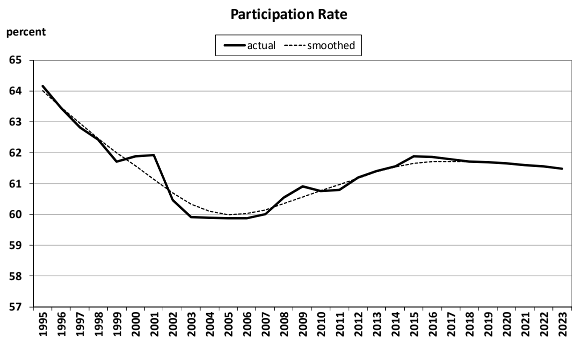

Contributions to Potential Output
percent
Labour
Pot.Output growth
Capital
TFP


Output gap
percent

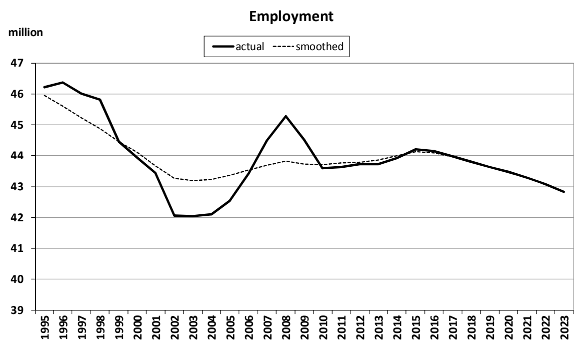

TFP Growth
percent
actual
smoothed

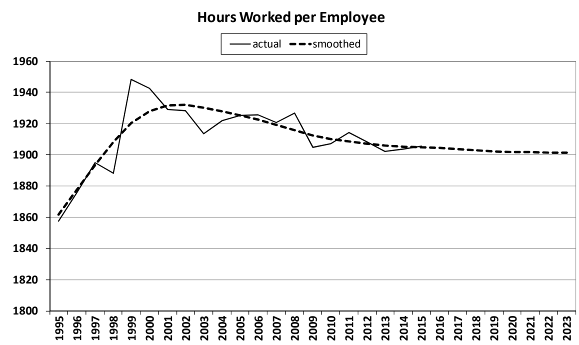

Investment to Potential Output (ratio)
percent


Unemployment Rate
percent
actual
NAWRU


Participation Rate
percent
actual
smoothed

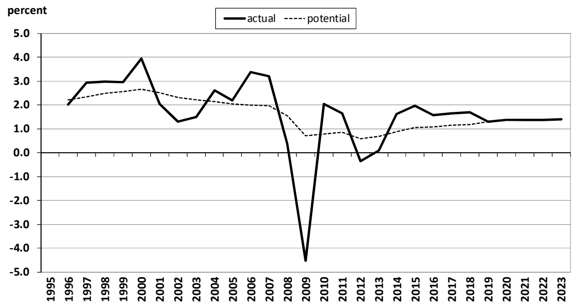

Population of Working Age
percent
growth


Employment
million
actual
smoothed

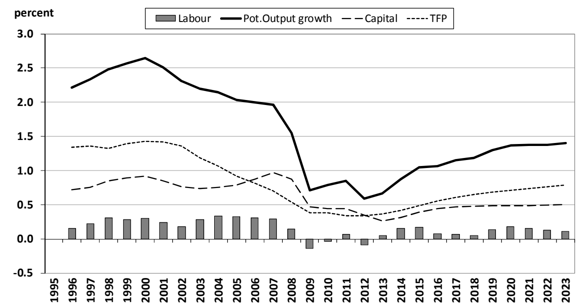

Hours Worked per Employee
actual
smoothed

EU 28

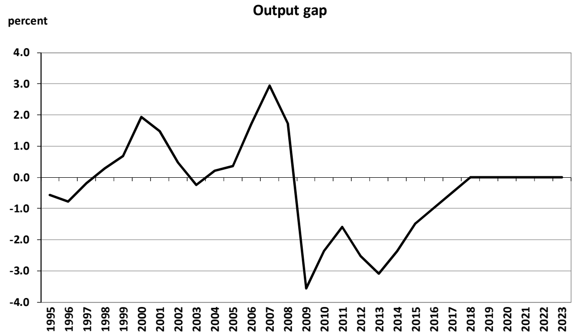
Output Growth



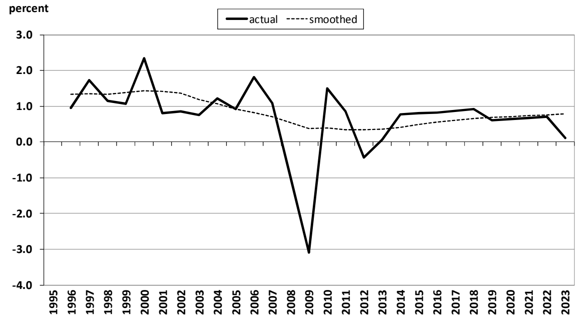
Contributions to Potential Output



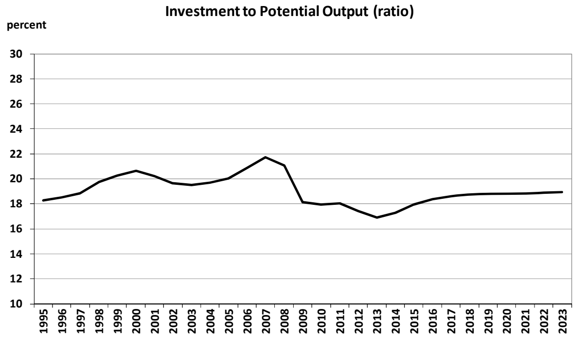
Output gap



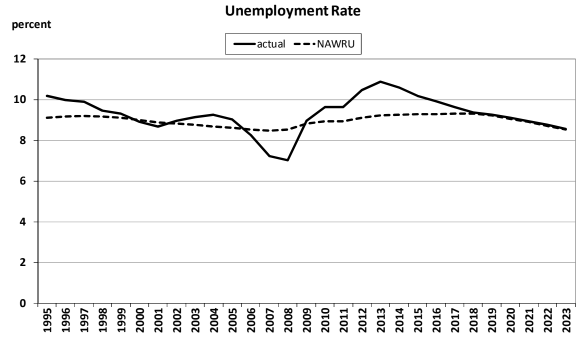
TFP Growth



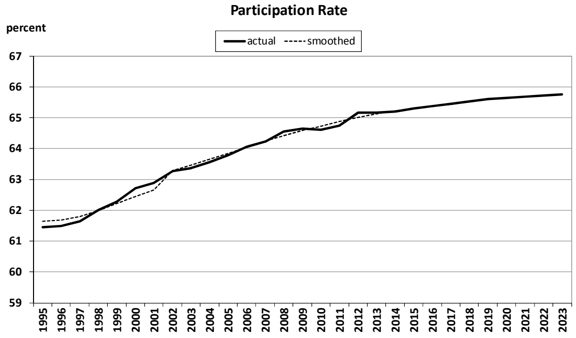
Investment to Potential Output (ratio)



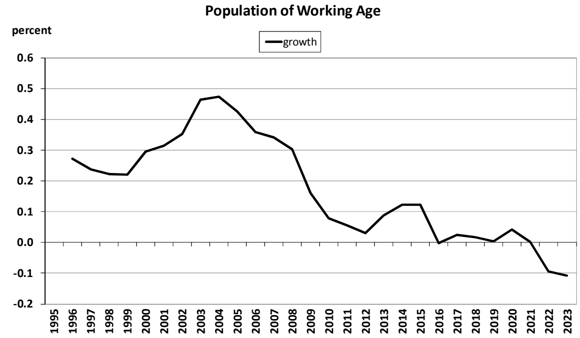
Unemployment Rate



Participation Rate

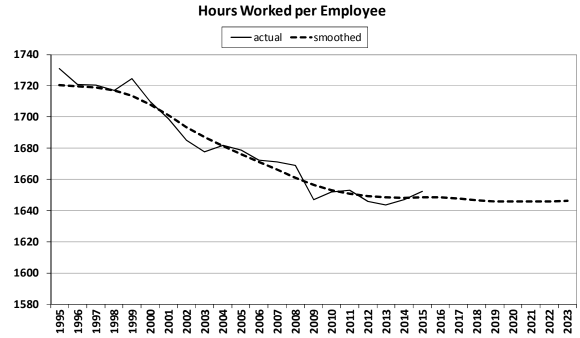


Population of Working Age

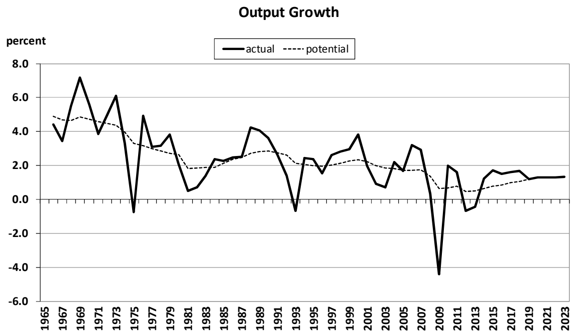


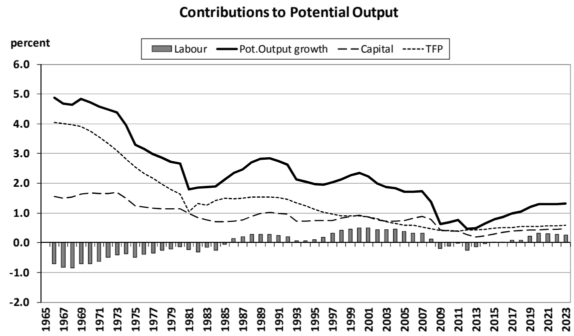
Employment

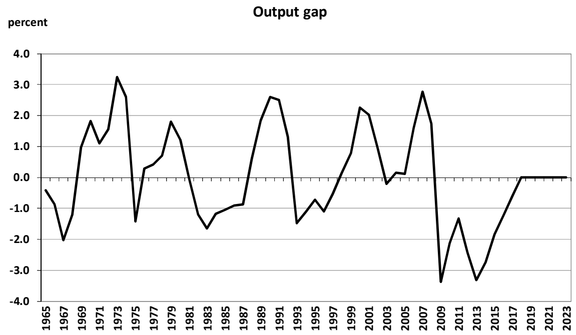
Hours Worked per Employee

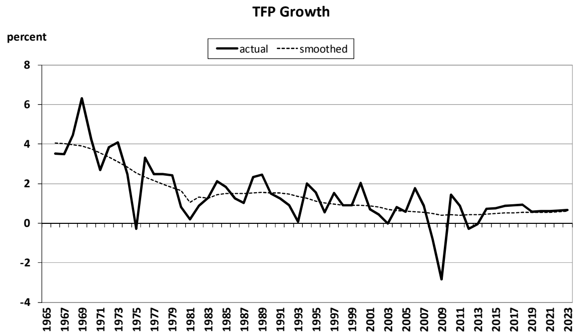


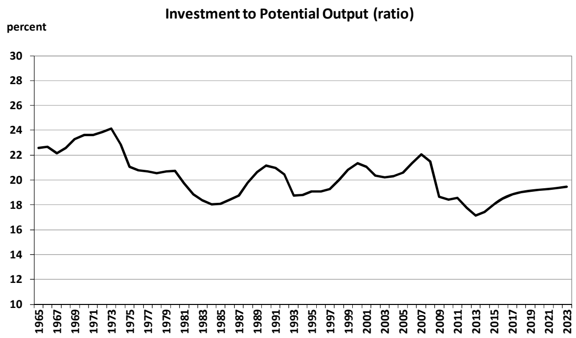
EA12

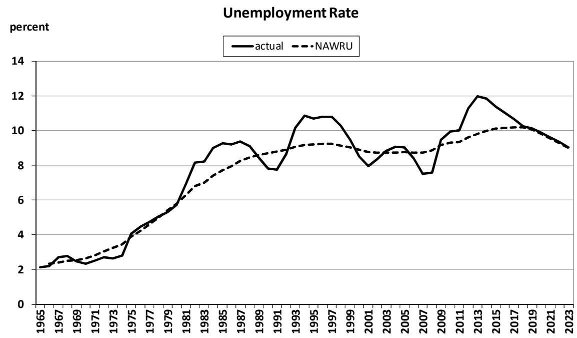

Output Growth
percent
actual
potential

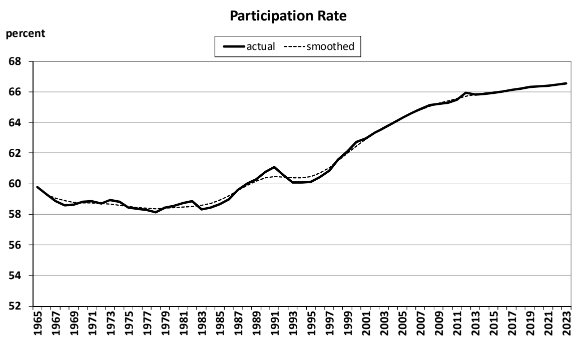

Contributions to Potential Output
percent
Labour
Pot.Output growth
Capital
TFP

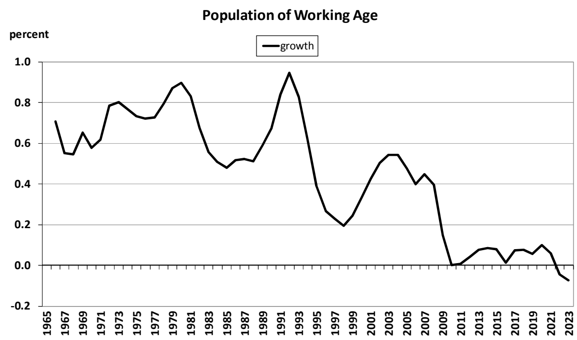

Output gap
percent


TFP Growth
percent
actual
smoothed

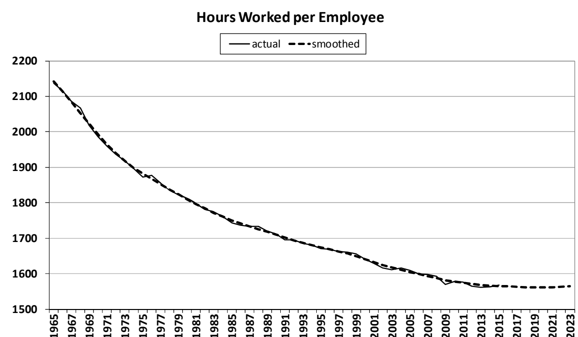

Investment to Potential Output (ratio)
percent


Unemployment Rate
percent
actual
NAWRU

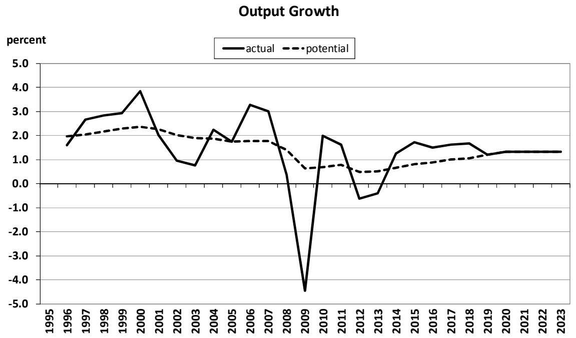

Participation Rate
percent
actual
smoothed

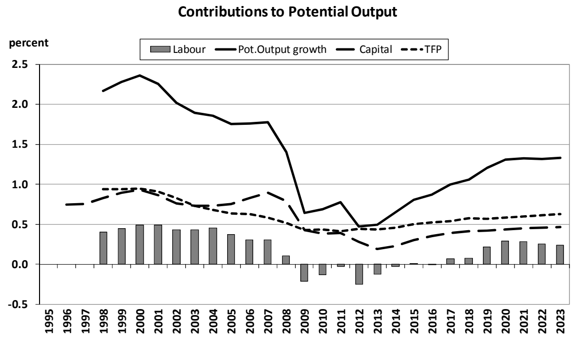

Population of Working Age
percent
growth

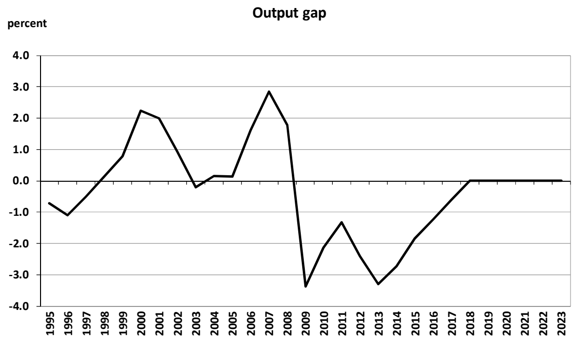

Employment
million
actual
smoothed

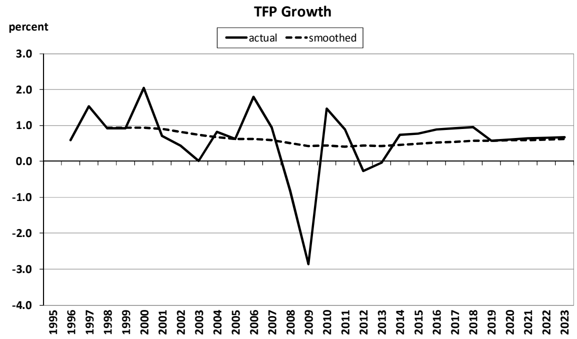

Hours Worked per Employee
actual
smoothed

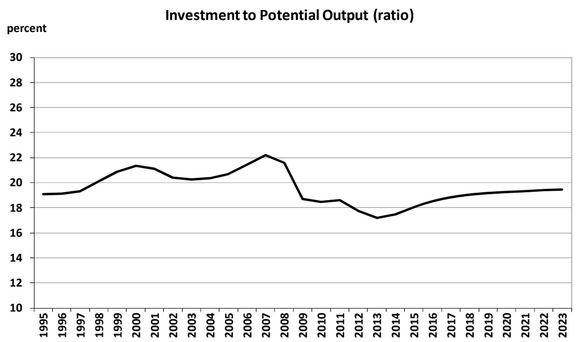
EA18

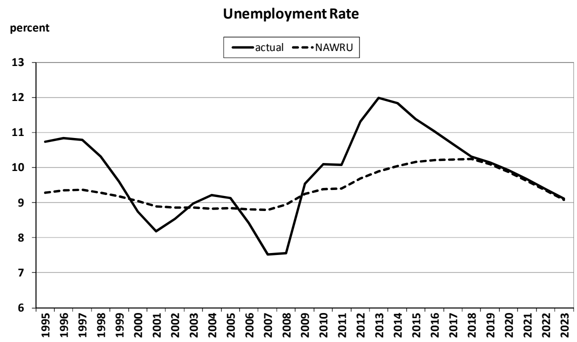

Output Growth
percent
actual
potential

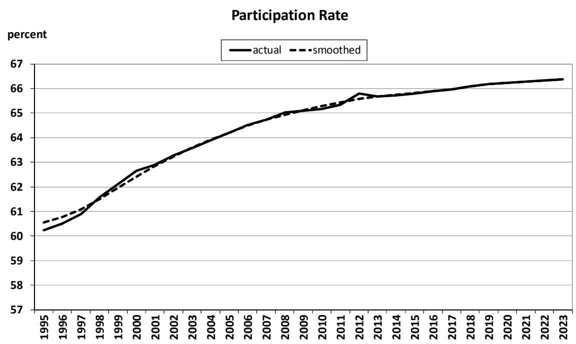

Contributions to Potential Output
percent
Labour
Pot.Output growth
Capital
TFP

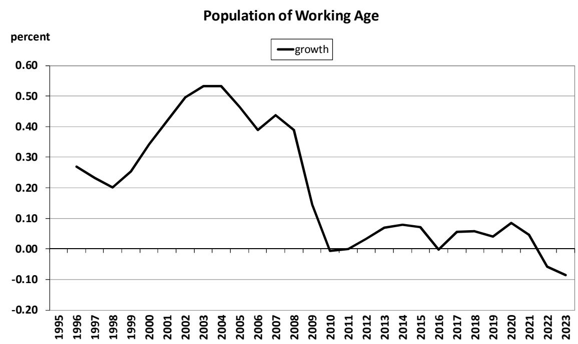

Output gap
percent

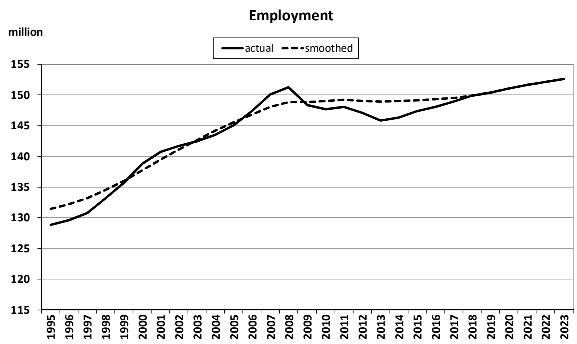

TFP Growth
percent
actual
smoothed

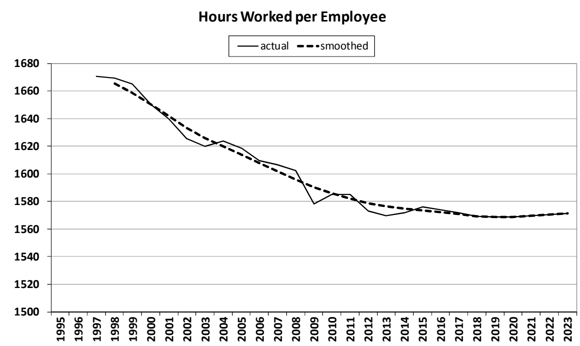

Investment to Potential Output (ratio)
percent


Unemployment Rate
percent
actual
NAWRU


Participation Rate
percent
actual
smoothed

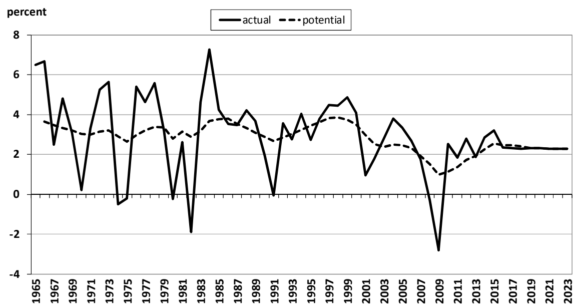

Population of Working Age
percent
growth


Employment
million
actual
smoothed

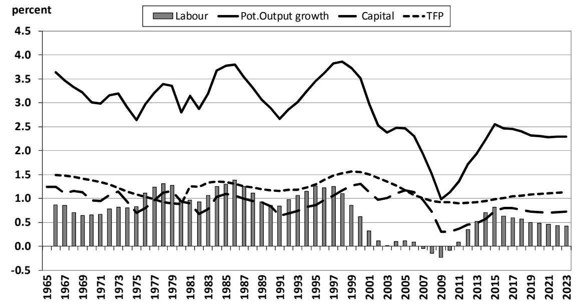

Hours Worked per Employee
actual
smoothed

US

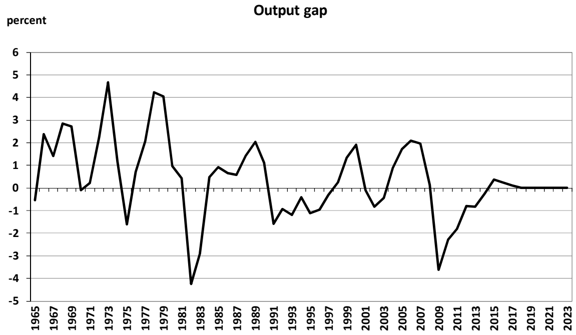
Output Growth



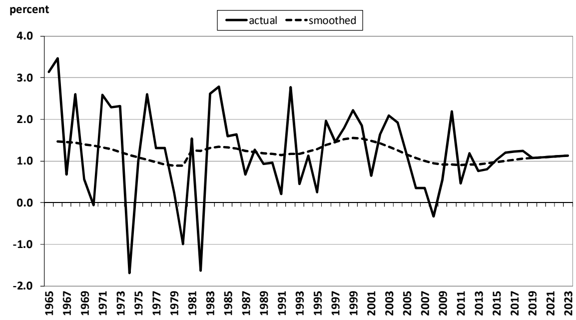
Contributions to Potential Output



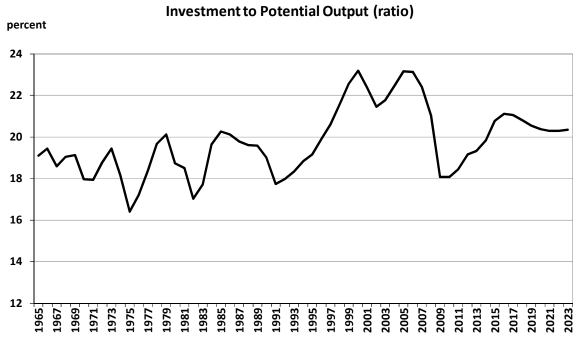
Output gap



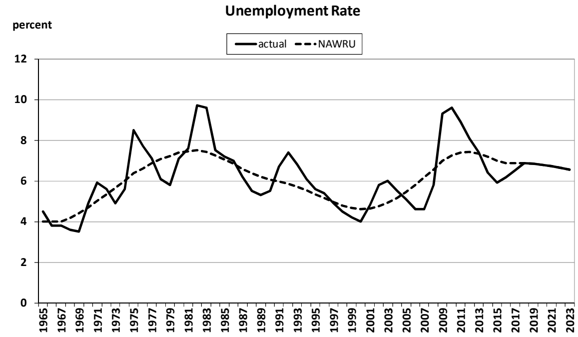
TFP Growth



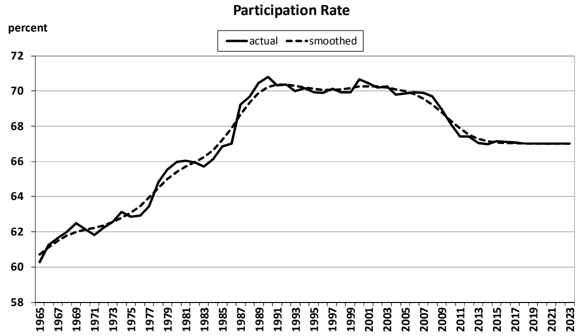
Investment to Potential Output (ratio)



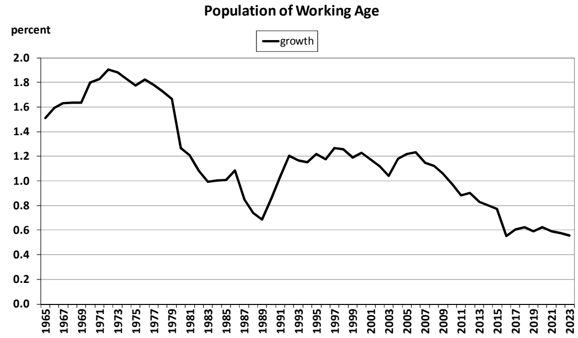
Unemployment Rate



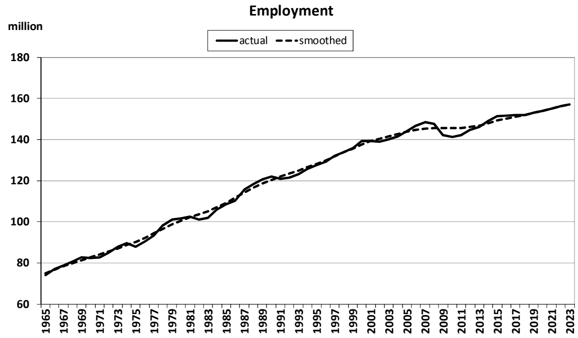
Participation Rate



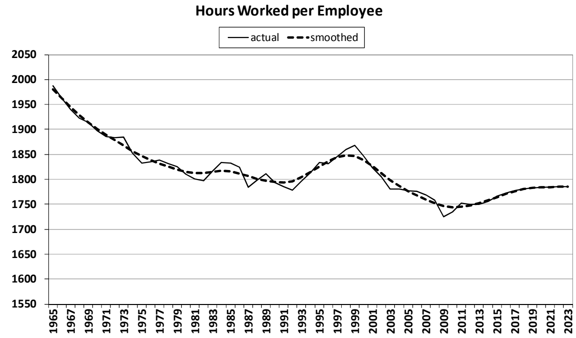
Population of Working Age



Employment



Hours Worked per Employee



EU15	**Potential GDP per capita - Annual Growth Rate (%)**			**Potential GDP per capita - Annual Growth (%)**							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
Version: 2005 Exchange Rates	Potential Growth	Total Population Growth	Per capita Growth	Total (in €)	Total (in € per Hour Worked)	*TFP*	*Capital Intensity (in € per Hour Worked)*	Total (Average Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1965											
1966											
1967	4.2	0.6	3.6	3.6	5.6	*0.3*	*5.3*	-1.9	*-1.3*	*-0.4*	*-0.1*
1968	4.2	0.6	3.6	3.6	5.6	*0.1*	*5.5*	-1.9	*-1.4*	*-0.4*	*-0.1*
1969	4.3	0.7	3.6	3.6	5.5	*0.1*	*5.5*	-1.8	*-1.4*	*-0.3*	*-0.1*
1970	4.2	0.7	3.5	3.5	5.4	*-0.1*	*5.6*	-1.8	*-1.4*	*-0.2*	*-0.2*
1971	4.1	0.8	3.3	3.3	5.2	*-0.2*	*5.3*	-1.7	*-1.3*	*-0.2*	*-0.2*
1972	4.0	0.6	3.4	3.4	4.9	*-0.2*	*5.1*	-1.4	*-1.2*	*-0.3*	*0.1*
1973	4.0	0.6	3.4	3.4	4.6	*-0.4*	*5.0*	-1.2	*-1.1*	*-0.2*	*0.1*
1974	3.6	0.5	3.1	3.1	4.2	*-0.3*	*4.5*	-1.0	*-1.0*	*-0.3*	*0.2*
1975	3.0	0.4	2.7	2.7	3.8	*-0.2*	*4.0*	-1.1	*-0.9*	*-0.4*	*0.3*
1976	2.9	0.3	2.6	2.6	3.5	*-0.3*	*3.8*	-0.9	*-0.8*	*-0.4*	*0.3*
1977	2.7	0.3	2.4	2.4	3.3	*-0.3*	*3.6*	-0.9	*-0.8*	*-0.4*	*0.3*
1978	2.6	0.4	2.3	2.3	3.1	*-0.3*	*3.4*	-0.8	*-0.8*	*-0.4*	*0.4*
1979	2.5	0.4	2.2	2.2	3.0	*-0.4*	*3.4*	-0.8	*-0.8*	*-0.4*	*0.5*
1980	2.4	0.4	2.0	2.0	2.8	*-0.5*	*3.2*	-0.7	*-0.8*	*-0.4*	*0.4*
1981	1.8	0.3	1.4	1.4	2.2	*-0.6*	*2.9*	-0.8	*-0.7*	*-0.5*	*0.4*
1982	1.7	0.2	1.5	1.5	2.2	*-0.4*	*2.6*	-0.7	*-0.7*	*-0.4*	*0.4*
1983	2.0	0.1	1.9	1.9	2.1	*0.0*	*2.1*	-0.3	*-0.6*	*-0.1*	*0.4*
1984	2.1	0.1	1.9	1.9	2.2	*0.1*	*2.0*	-0.2	*-0.5*	*-0.1*	*0.4*
1985	2.3	0.2	2.1	2.1	2.1	*0.4*	*1.7*	0.0	*-0.4*	*0.1*	*0.3*
1986	2.5	0.2	2.3	2.3	2.0	*0.5*	*1.6*	0.2	*-0.3*	*0.3*	*0.3*
1987	2.5	0.2	2.3	2.3	2.1	*0.4*	*1.7*	0.3	*-0.3*	*0.3*	*0.3*
1988	2.7	0.3	2.4	2.4	2.2	*0.2*	*2.0*	0.2	*-0.3*	*0.4*	*0.1*
1989	2.7	0.5	2.3	2.3	2.3	*0.0*	*2.3*	0.0	*-0.4*	*0.3*	*0.0*
1990	2.7	0.7	2.0	2.0	2.4	*-0.1*	*2.5*	-0.3	*-0.4*	*0.2*	*-0.1*
1991	2.6	0.6	2.0	2.0	2.4	*0.0*	*2.3*	-0.4	*-0.5*	*0.0*	*0.1*
1992	2.5	0.5	2.0	2.0	2.4	*0.1*	*2.3*	-0.3	*-0.4*	*-0.2*	*0.3*
1993	2.2	0.4	1.7	1.7	2.2	*0.3*	*1.9*	-0.4	*-0.4*	*-0.3*	*0.3*
1994	2.2	0.3	1.9	1.9	2.1	*0.2*	*1.9*	-0.2	*-0.3*	*-0.1*	*0.2*
1995	2.2	0.3	1.9	1.9	2.0	*0.1*	*1.9*	-0.1	*-0.3*	*0.1*	*0.1*
1996	2.2	0.3	1.9	1.9	1.9	*0.1*	*1.8*	0.0	*-0.3*	*0.3*	*0.0*
1997	2.3	0.3	2.0	2.0	1.8	*0.2*	*1.6*	0.2	*-0.3*	*0.6*	*0.0*
1998	2.4	0.2	2.2	2.2	1.8	*0.0*	*1.8*	0.4	*-0.3*	*0.8*	*0.0*
1999	2.5	0.3	2.2	2.2	1.8	*0.0*	*1.8*	0.4	*-0.4*	*0.8*	*0.0*
2000	2.6	0.4	2.2	2.2	1.8	*0.0*	*1.9*	0.3	*-0.5*	*0.8*	*0.0*
2001	2.4	0.5	2.0	2.0	1.7	*0.0*	*1.7*	0.3	*-0.5*	*0.8*	*0.0*
2002	2.2	0.5	1.7	1.7	1.6	*0.1*	*1.5*	0.1	*-0.5*	*0.6*	*0.0*
2003	2.1	0.6	1.5	1.5	1.5	*0.0*	*1.4*	0.0	*-0.4*	*0.5*	*0.0*
2004	2.0	0.6	1.4	1.4	1.3	*-0.1*	*1.4*	0.1	*-0.4*	*0.5*	*0.0*
2005	1.9	0.6	1.3	1.3	1.3	*-0.3*	*1.6*	0.0	*-0.3*	*0.4*	*-0.1*
2006	1.9	0.5	1.3	1.3	1.3	*-0.6*	*1.9*	0.0	*-0.3*	*0.4*	*-0.1*
2007	1.8	0.6	1.2	1.2	1.3	*-0.8*	*2.1*	-0.1	*-0.3*	*0.3*	*-0.1*
2008	1.4	0.6	0.8	0.8	1.1	*-0.9*	*2.1*	-0.3	*-0.3*	*0.1*	*-0.1*
2009	0.6	0.4	0.2	0.2	0.8	*-0.6*	*1.4*	-0.6	*-0.3*	*-0.1*	*-0.1*
2010	0.7	0.4	0.3	0.3	0.7	*-0.5*	*1.2*	-0.4	*-0.2*	*0.0*	*-0.2*
2011	0.7	0.4	0.4	0.4	0.6	*-0.4*	*1.0*	-0.2	*-0.1*	*0.1*	*-0.2*
2012	0.5	0.5	0.0	0.0	0.6	*-0.4*	*1.0*	-0.6	*-0.1*	*-0.2*	*-0.3*
2013	0.6	0.3	0.3	0.3	0.5	*-0.1*	*0.6*	-0.2	*0.0*	*-0.1*	*-0.1*
2014	0.8	0.4	0.4	0.4	0.6	*0.0*	*0.6*	-0.1	*0.0*	*0.0*	*-0.1*
2015	1.0	0.3	0.6	0.6	0.7	*-0.1*	*0.7*	0.0	*0.0*	*0.0*	*-0.1*
2016	1.0	0.3	0.7	0.7	0.8	*-0.2*	*1.0*	-0.1	*0.0*	*0.1*	*-0.2*
2017	1.1	0.3	0.8	0.8	0.8	*-0.2*	*1.0*	0.0	*0.0*	*0.1*	*-0.1*
2018	1.1	0.2	0.9	0.9	0.9	*-0.2*	*1.1*	0.0	*-0.1*	*0.2*	*-0.1*
2019	1.2	0.2	1.0	1.0	0.8	*-0.1*	*0.9*	0.1	*0.0*	*0.3*	*-0.1*
2020	1.3	0.2	1.1	1.1	0.8	*0.0*	*0.8*	0.2	*0.0*	*0.3*	*-0.1*
2021	1.3	0.2	1.1	1.1	0.9	*0.0*	*0.9*	0.2	*0.0*	*0.3*	*-0.1*
2022	1.3	0.2	1.1	1.1	0.9	*0.0*	*0.9*	0.2	*0.1*	*0.3*	*-0.2*
2023	1.3	0.2	1.1	1.1	0.9	*0.0*	*1.0*	0.2	*0.1*	*0.3*	*-0.2*

	Potential GDP per capita - Annual Growth Rate (%)			**Potential GDP per capita - Annual Growth (%)**							
New MS					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
Version: 2005 Exchange Rates	Potential Growth	Total Population Growth	Per capita Growth	Total (in €)	Total (in € per Hour Worked)	*TFP*	*Capital Intensity (in € per Hour Worked)*	Total (Average Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1991											
1992											
1993											
1994											
1995											
1996											
1997											
1998	3.6	-0.2	3.8								
1999	3.6	-0.2	3.8								
2000	3.8	-0.1	4.0								
2001	3.7	-0.4	4.1								
2002	3.6	-0.9	4.5								
2003	3.8	-0.3	4.1								
2004	4.0	-0.2	4.3	4.3	4.1	*3.1*	1.1	0.2	-0.1	0.0	0.3
2005	4.1	-0.2	4.3	4.3	3.9	*2.7*	1.2	0.4	-0.1	0.3	0.2
2006	4.1	-0.2	4.4	4.4	3.9	*2.5*	1.4	0.5	-0.1	0.5	0.1
2007	4.3	-0.3	4.7	4.7	4.1	*2.2*	1.9	0.6	-0.2	0.7	0.0
2008	4.0	-0.3	4.3	4.3	3.9	*1.9*	2.0	0.4	-0.2	0.6	-0.1
2009	2.3	-0.1	2.4	2.4	2.7	*1.3*	1.4	-0.2	-0.2	0.0	-0.1
2010	2.2	0.1	2.1	2.1	2.4	*1.2*	1.1	-0.3	-0.1	0.2	-0.3
2011	2.3	-0.4	2.8	2.8	2.3	*1.1*	1.1	0.5	-0.1	0.4	0.2
2012	1.9	-0.2	2.0	2.0	1.9	*0.9*	1.0	0.1	-0.1	0.3	-0.2
2013	1.9	-0.2	2.1	2.1	1.8	*1.0*	0.8	0.3	-0.1	0.5	-0.1
2014	2.2	-0.2	2.3	2.3	1.9	*1.1*	0.8	0.4	0.0	0.6	-0.1
2015	2.4	-0.1	2.5	2.5	2.1	*1.2*	0.9	0.4	0.0	0.5	-0.1
2016	2.3	-0.1	2.4	2.4	2.4	*1.3*	1.1	0.1	0.0	0.3	-0.2
2017	2.2	-0.2	2.4	2.4	2.6	*1.4*	1.2	-0.2	0.0	0.0	-0.2
2018	2.2	-0.2	2.4	2.4	2.6	*1.5*	1.1	-0.2	0.0	0.0	-0.2
2019	2.3	-0.2	2.5	2.5	2.7	*1.5*	1.2	-0.2	0.0	0.0	-0.2
2020	2.3	-0.2	2.5	2.5	2.7	*1.6*	1.1	-0.2	0.0	-0.1	-0.1
2021	2.3	-0.2	2.5	2.5	2.7	*1.6*	1.1	-0.2	0.0	-0.1	-0.1
2022	2.3	-0.2	2.5	2.5	2.8	*1.7*	1.1	-0.3	0.0	0.0	-0.2
2023	2.3	-0.3	2.5	2.5	2.9	*1.7*	1.1	-0.3	0.0	-0.1	-0.2

	Potential GDP per capita - Annual Growth Rate (%)			Potential GDP per capita - Annual Growth (%)							
EU28					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
Version: 2005 Exchange Rates	Potential Growth	Total Population Growth	Per capita Growth	Total (in €)	Total (in € per Hour Worked)	*TFP*	*Capital Intensity (in € per Hour Worked)*	Total (Average Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1991											
1992											
1993											
1994											
1995											
1996											
1997											
1998	2.5	0.1	2.3	2.3	2.0	*1.3*	0.7	0.3	-0.1	0.4	0.1
1999	2.6	0.2	2.4	2.4	2.1	*1.4*	0.7	0.2	-0.2	0.4	0.0
2000	2.6	0.3	2.4	2.4	2.2	*1.4*	0.7	0.2	-0.3	0.5	0.0
2001	2.5	0.3	2.2	2.2	2.1	*1.4*	0.7	0.1	-0.4	0.5	0.1
2002	2.3	0.2	2.1	2.1	2.0	*1.4*	0.7	0.0	-0.4	0.4	0.1
2003	2.2	0.4	1.8	1.8	1.8	*1.2*	0.6	0.0	-0.4	0.4	0.1
2004	2.1	0.4	1.7	1.7	1.6	*1.1*	0.6	0.1	-0.3	0.4	0.0
2005	2.0	0.4	1.6	1.6	1.5	*0.9*	0.6	0.1	-0.3	0.4	0.0
2006	2.0	0.4	1.6	1.6	1.5	*0.8*	0.7	0.1	-0.3	0.4	0.0
2007	2.0	0.4	1.5	1.5	1.5	*0.7*	0.8	0.0	-0.3	0.4	-0.1
2008	1.5	0.4	1.2	1.2	1.3	*0.5*	0.8	-0.2	-0.3	0.2	-0.1
2009	0.7	0.3	0.4	0.4	0.9	*0.4*	0.5	-0.5	-0.3	-0.1	-0.1
2010	0.8	0.3	0.5	0.5	0.8	*0.4*	0.5	-0.4	-0.2	0.1	-0.2
2011	0.9	0.2	0.6	0.6	0.7	*0.3*	0.4	-0.1	-0.1	0.2	-0.1
2012	0.6	0.3	0.3	0.3	0.7	*0.3*	0.4	-0.5	-0.1	-0.1	-0.3
2013	0.7	0.2	0.5	0.5	0.6	*0.4*	0.2	-0.1	0.0	0.0	-0.1
2014	0.9	0.3	0.6	0.6	0.6	*0.4*	0.2	0.0	0.0	0.1	-0.1
2015	1.1	0.2	0.8	0.8	0.8	*0.5*	0.3	0.0	0.0	0.1	-0.1
2016	1.1	0.2	0.9	0.9	1.0	*0.6*	0.4	-0.1	0.0	0.1	-0.2
2017	1.1	0.2	1.0	1.0	1.0	*0.6*	0.4	-0.1	0.0	0.1	-0.1
2018	1.2	0.2	1.0	1.0	1.1	*0.7*	0.4	-0.1	-0.1	0.1	-0.1
2019	1.3	0.2	1.1	1.1	1.1	*0.7*	0.4	0.0	0.0	0.2	-0.2
2020	1.4	0.1	1.2	1.2	1.1	*0.7*	0.4	0.1	0.0	0.2	-0.1
2021	1.4	0.1	1.2	1.2	1.1	*0.7*	0.4	0.1	0.0	0.2	-0.1
2022	1.4	0.1	1.2	1.2	1.2	*0.8*	0.4	0.1	0.0	0.3	-0.2
2023	1.4	0.1	1.3	1.3	1.2	*0.8*	0.4	0.1	0.0	0.3	-0.2

EA12	Potential GDP per capita - Annual Growth Rate (%)			Potential GDP per capita - Annual Growth (%)							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
Version: 2005 Exchange Rates	Potential Growth	Total Population Growth	Per capita Growth	Total (in €)	Total (in € per Hour Worked)	*TFP*	*Capital Intensity (in € per Hour Worked)*	Total (Average Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1965											
1966											
1967	4.7	0.6	4.0	4.0	6.0	4.1	1.9	-1.9	-1.4	-0.4	-0.1
1968	4.6	0.6	4.0	4.0	6.0	4.0	2.0	-1.9	-1.5	-0.4	-0.1
1969	4.8	0.7	4.1	4.1	6.0	4.0	2.0	-1.8	-1.5	-0.2	-0.1
1970	4.7	0.7	4.0	4.0	5.9	3.8	2.0	-1.8	-1.5	-0.2	-0.1
1971	4.6	0.8	3.7	3.7	5.6	3.6	2.0	-1.8	-1.4	-0.2	-0.2
1972	4.5	0.7	3.8	3.8	5.3	3.4	1.9	-1.5	-1.3	-0.3	0.1
1973	4.4	0.7	3.7	3.7	5.0	3.1	1.9	-1.3	-1.1	-0.3	0.1
1974	4.0	0.6	3.4	3.4	4.6	2.9	1.7	-1.1	-1.0	-0.3	0.2
1975	3.3	0.5	2.8	2.8	4.1	2.6	1.5	-1.2	-0.9	-0.6	0.3
1976	3.1	0.4	2.7	2.7	3.8	2.4	1.4	-1.0	-0.8	-0.5	0.3
1977	3.0	0.4	2.6	2.6	3.5	2.2	1.4	-1.0	-0.8	-0.5	0.3
1978	2.9	0.4	2.4	2.4	3.3	2.0	1.3	-0.8	-0.8	-0.4	0.4
1979	2.7	0.4	2.3	2.3	3.1	1.8	1.2	-0.7	-0.8	-0.4	0.5
1980	2.7	0.4	2.2	2.2	2.9	1.7	1.2	-0.6	-0.7	-0.3	0.5
1981	1.8	0.4	1.4	1.4	2.2	1.1	1.1	-0.8	-0.7	-0.4	0.4
1982	1.8	0.3	1.6	1.6	2.3	1.3	1.0	-0.8	-0.7	-0.4	0.4
1983	1.9	0.1	1.7	1.7	2.1	1.3	0.8	-0.4	-0.7	-0.1	0.4
1984	1.9	0.1	1.8	1.8	2.3	1.4	0.8	-0.5	-0.6	-0.2	0.4
1985	2.1	0.1	2.0	2.0	2.2	1.5	0.7	-0.2	-0.6	0.0	0.3
1986	2.4	0.2	2.1	2.1	2.1	1.5	0.6	0.0	-0.5	0.2	0.3
1987	2.5	0.2	2.3	2.3	2.1	1.5	0.7	0.1	-0.5	0.3	0.3
1988	2.7	0.4	2.3	2.3	2.3	1.5	0.7	0.1	-0.4	0.4	0.1
1989	2.8	0.5	2.3	2.3	2.4	1.5	0.8	0.0	-0.5	0.3	0.1
1990	2.8	0.7	2.1	2.1	2.4	1.5	0.9	-0.3	-0.5	0.2	-0.1
1991	2.7	0.6	2.1	2.1	2.4	1.5	0.8	-0.2	-0.5	0.0	0.2
1992	2.6	0.5	2.1	2.1	2.3	1.5	0.8	-0.2	-0.4	-0.2	0.4
1993	2.1	0.5	1.7	1.7	2.0	1.3	0.7	-0.4	-0.4	-0.3	0.4
1994	2.0	0.3	1.8	1.8	1.9	1.2	0.7	-0.2	-0.4	-0.1	0.3
1995	2.0	0.3	1.7	1.7	1.8	1.1	0.7	-0.1	-0.4	0.1	0.1
1996	1.9	0.3	1.7	1.7	1.7	1.0	0.6	0.0	-0.3	0.4	0.0
1997	2.0	0.3	1.8	1.8	1.5	1.0	0.6	0.2	-0.3	0.6	0.0
1998	2.1	0.2	1.9	1.9	1.5	0.9	0.6	0.4	-0.4	0.8	0.0
1999	2.3	0.3	2.0	2.0	1.5	0.9	0.6	0.4	-0.4	0.9	0.0
2000	2.3	0.4	1.9	1.9	1.6	0.9	0.6	0.4	-0.5	0.9	-0.1
2001	2.2	0.5	1.8	1.8	1.4	0.9	0.6	0.3	-0.5	0.9	-0.1
2002	2.0	0.6	1.4	1.4	1.3	0.8	0.5	0.1	-0.5	0.7	-0.1
2003	1.9	0.6	1.2	1.2	1.2	0.7	0.5	0.0	-0.4	0.6	-0.1
2004	1.8	0.7	1.2	1.2	1.1	0.6	0.5	0.1	-0.4	0.5	-0.1
2005	1.7	0.6	1.1	1.1	1.1	0.6	0.5	0.0	-0.4	0.5	-0.1
2006	1.7	0.5	1.2	1.2	1.2	0.6	0.6	-0.1	-0.4	0.5	-0.1
2007	1.7	0.6	1.1	1.1	1.2	0.5	0.7	-0.1	-0.4	0.4	-0.1
2008	1.4	0.5	0.8	0.8	1.2	0.5	0.7	-0.4	-0.4	0.1	-0.1
2009	0.6	0.3	0.3	0.3	0.9	0.4	0.5	-0.6	-0.4	-0.1	-0.2
2010	0.7	0.3	0.4	0.4	0.9	0.4	0.4	-0.4	-0.3	0.1	-0.3
2011	0.8	0.3	0.5	0.5	0.8	0.4	0.4	-0.3	-0.2	0.2	-0.3
2012	0.5	0.3	0.2	0.2	0.8	0.4	0.4	-0.6	-0.2	-0.2	-0.2
2013	0.5	0.2	0.3	0.3	0.7	0.4	0.3	-0.4	-0.2	-0.1	-0.1
2014	0.6	0.3	0.4	0.4	0.7	0.4	0.2	-0.3	-0.1	0.0	-0.2
2015	0.8	0.2	0.6	0.6	0.8	0.5	0.3	-0.2	-0.1	0.0	-0.1
2016	0.9	0.2	0.7	0.7	0.9	0.5	0.3	-0.2	-0.1	0.1	-0.2
2017	1.0	0.2	0.8	0.8	0.9	0.5	0.3	0.0	-0.1	0.1	-0.1
2018	1.0	0.1	0.9	0.9	0.9	0.5	0.4	0.0	-0.1	0.2	-0.1
2019	1.2	0.1	1.0	1.0	0.8	0.5	0.3	0.2	0.0	0.3	-0.1
2020	1.3	0.1	1.2	1.2	0.8	0.5	0.3	0.3	0.0	0.4	0.0
2021	1.3	0.1	1.2	1.2	0.8	0.6	0.3	0.3	0.0	0.4	-0.1
2022	1.3	0.1	1.2	1.2	0.9	0.6	0.3	0.3	0.1	0.4	-0.2
2023	1.3	0.1	1.2	1.2	0.9	0.6	0.3	0.3	0.1	0.4	-0.2

US	Potential GDP per capita - Annual Growth Rate (%)			Potential GDP per capita - Annual Growth (%)							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
in $	Potential Growth	Total Population Growth	Per capita Growth	Total (in $)	Total (in $ per Hour Worked)	*TFP*	*Capital Intensity (in $ per Hour Worked)*	Total (Average Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1965											
1966	3.6	1.2	2.4	2.4	2.3	1.5	0.8	0.2	-0.9	0.7	0.4
1967	3.5	1.1	2.3	2.3	2.1	1.5	0.6	0.2	-0.9	0.6	0.5
1968	3.3	1.0	2.3	2.3	2.2	1.5	0.8	0.1	-0.8	0.3	0.6
1969	3.2	1.0	2.2	2.2	2.2	1.4	0.8	0.0	-0.8	0.1	0.6
1970	3.0	1.2	1.8	1.8	2.0	1.4	0.6	-0.1	-0.7	-0.1	0.6
1971	3.0	1.3	1.7	1.7	1.9	1.3	0.6	-0.2	-0.6	-0.2	0.6
1972	3.2	1.1	2.1	2.1	1.9	1.3	0.6	0.1	-0.6	-0.1	0.8
1973	3.2	1.0	2.2	2.2	1.9	1.2	0.7	0.3	-0.6	0.0	0.9
1974	2.9	0.9	2.0	2.0	1.7	1.1	0.5	0.3	-0.6	0.0	0.9
1975	2.6	1.0	1.6	1.6	1.3	1.1	0.2	0.3	-0.5	0.1	0.8
1976	3.0	1.0	2.0	2.0	1.2	1.0	0.2	0.7	-0.4	0.3	0.8
1977	3.2	1.0	2.2	2.2	1.3	1.0	0.3	0.9	-0.4	0.5	0.8
1978	3.4	1.1	2.3	2.3	1.3	0.9	0.4	0.9	-0.3	0.6	0.7
1979	3.4	1.1	2.2	2.2	1.4	0.9	0.5	0.8	-0.3	0.6	0.5
1980	2.8	1.2	1.6	1.6	1.3	0.9	0.4	0.3	-0.2	0.5	0.1
1981	3.1	1.0	2.1	2.1	1.6	1.3	0.4	0.5	-0.1	0.4	0.2
1982	2.9	1.0	1.9	1.9	1.4	1.2	0.2	0.5	0.0	0.3	0.1
1983	3.2	0.9	2.2	2.2	1.5	1.3	0.2	0.7	0.1	0.5	0.1
1984	3.7	0.9	2.8	2.8	1.7	1.4	0.4	1.0	0.1	0.8	0.1
1985	3.8	0.9	2.9	2.9	1.7	1.3	0.4	1.1	0.0	1.0	0.1
1986	3.8	0.9	2.9	2.9	1.6	1.3	0.3	1.2	-0.2	1.3	0.2
1987	3.5	0.9	2.6	2.6	1.6	1.3	0.3	1.0	-0.3	1.4	0.0
1988	3.3	0.9	2.4	2.4	1.6	1.2	0.3	0.8	-0.3	1.2	-0.2
1989	3.1	0.9	2.1	2.1	1.6	1.2	0.4	0.5	-0.2	1.0	-0.3
1990	2.9	1.1	1.7	1.7	1.5	1.2	0.4	0.2	-0.2	0.6	-0.3
1991	2.7	1.3	1.3	1.3	1.3	1.2	0.2	0.0	0.0	0.3	-0.3
1992	2.9	1.3	1.5	1.5	1.3	1.2	0.2	0.2	0.2	0.1	-0.1
1993	3.0	1.3	1.7	1.7	1.3	1.2	0.2	0.3	0.4	0.1	-0.1
1994	3.2	1.2	2.0	2.0	1.4	1.2	0.2	0.6	0.6	0.0	-0.1
1995	3.4	1.2	2.2	2.2	1.5	1.3	0.2	0.7	0.6	0.1	0.0
1996	3.6	1.2	2.4	2.4	1.7	1.4	0.3	0.7	0.6	0.1	0.0
1997	3.8	1.2	2.6	2.6	1.9	1.5	0.4	0.7	0.4	0.2	0.1
1998	3.9	1.2	2.7	2.7	2.1	1.5	0.6	0.5	0.2	0.2	0.1
1999	3.7	1.1	2.5	2.5	2.4	1.6	0.8	0.2	-0.1	0.2	0.0
2000	3.5	1.1	2.4	2.4	2.5	1.6	1.0	-0.1	-0.4	0.2	0.1
2001	3.0	1.0	2.0	2.0	2.5	1.5	1.0	-0.5	-0.7	0.0	0.2
2002	2.5	1.0	1.6	1.6	2.3	1.4	0.9	-0.8	-0.8	-0.1	0.2
2003	2.4	0.9	1.4	1.4	2.4	1.4	1.0	-0.9	-0.8	-0.3	0.1
2004	2.5	0.9	1.6	1.6	2.3	1.3	1.1	-0.8	-0.7	-0.4	0.3
2005	2.5	0.9	1.5	1.5	2.3	1.2	1.1	-0.8	-0.6	-0.5	0.3
2006	2.3	1.0	1.3	1.3	2.2	1.1	1.1	-0.8	-0.5	-0.6	0.3
2007	1.9	1.0	1.0	1.0	2.0	1.0	1.0	-1.0	-0.5	-0.7	0.2
2008	1.5	0.9	0.6	0.6	1.8	0.9	0.8	-1.2	-0.4	-0.9	0.2
2009	1.0	0.9	0.1	0.1	1.3	0.9	0.4	-1.2	-0.3	-1.1	0.2
2010	1.1	0.8	0.3	0.3	1.3	0.9	0.3	-1.0	-0.1	-1.0	0.1
2011	1.4	0.7	0.6	0.6	1.2	0.9	0.3	-0.6	0.1	-0.8	0.2
2012	1.7	0.7	1.0	1.0	1.2	0.9	0.3	-0.2	0.2	-0.5	0.2
2013	1.9	0.7	1.2	1.2	1.1	0.9	0.2	0.1	0.3	-0.3	0.1
2014	2.2	0.7	1.5	1.5	1.1	0.9	0.2	0.4	0.3	0.0	0.1
2015	2.5	0.7	1.8	1.8	1.3	1.0	0.3	0.5	0.4	0.1	0.1
2016	2.5	0.5	2.0	2.0	1.5	1.0	0.5	0.5	0.4	0.1	0.0
2017	2.4	0.5	1.9	1.9	1.5	1.0	0.5	0.4	0.3	0.0	0.1
2018	2.4	0.5	1.9	1.9	1.5	1.1	0.5	0.4	0.3	0.0	0.1
2019	2.3	0.5	1.8	1.8	1.5	1.1	0.5	0.3	0.1	0.0	0.1
2020	2.3	0.5	1.8	1.8	1.5	1.1	0.4	0.3	0.1	0.1	0.1
2021	2.3	0.5	1.8	1.8	1.6	1.1	0.5	0.2	0.0	0.1	0.1
2022	2.3	0.5	1.8	1.8	1.6	1.1	0.5	0.2	0.0	0.1	0.1
2023	2.3	0.5	1.8	1.8	1.6	1.1	0.5	0.1	0.0	0.1	0.1

EU 15	**Potential GDP per capita - Annual Growth Rate (%)**			**Potential GDP per capita - Levels**							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
Version: 2005 PPS	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	TFP	Capital Intensity (in PPS per Hour Worked)	Total (Avg Annual Hours per capita)	Avg Annual Hours per employee	Employment rate	Pop.Working Age as a % of Tot.Population
1965											
1966	4.4	0.8	3.6	10 373	11.70	3.44	3.41	886	2 085	59.0	72.0
1967	4.3	0.6	3.6	10 749	12.36	3.56	3.47	870	2 057	58.8	71.9
1968	4.2	0.6	3.6	11 140	13.06	3.69	3.53	853	2 029	58.5	71.9
1969	4.4	0.7	3.7	11 552	13.78	3.83	3.60	838	2 000	58.4	71.8
1970	4.3	0.7	3.6	11 967	14.54	3.96	3.67	823	1 972	58.2	71.7
1971	4.2	0.8	3.4	12 372	15.29	4.09	3.74	809	1 946	58.1	71.6
1972	4.1	0.6	3.5	12 800	16.05	4.22	3.80	798	1 923	57.9	71.6
1973	4.0	0.6	3.4	13 241	16.80	4.34	3.87	788	1 902	57.8	71.7
1974	3.7	0.5	3.2	13 662	17.52	4.46	3.93	780	1 883	57.6	71.8
1975	3.1	0.4	2.7	14 029	18.19	4.56	3.99	771	1 866	57.4	72.0
1976	2.9	0.3	2.6	14 393	18.83	4.66	4.04	764	1 850	57.2	72.3
1977	2.8	0.3	2.4	14 742	19.47	4.76	4.09	757	1 835	56.9	72.5
1978	2.6	0.4	2.3	15 077	20.07	4.85	4.14	751	1 820	56.7	72.8
1979	2.5	0.4	2.2	15 402	20.67	4.93	4.19	745	1 805	56.5	73.1
1980	2.4	0.4	2.0	15 716	21.25	5.01	4.24	740	1 790	56.3	73.4
1981	1.8	0.3	1.4	15 938	21.72	5.07	4.28	734	1 777	56.0	73.7
1982	1.7	0.2	1.5	16 177	22.19	5.14	4.32	729	1 766	55.8	74.0
1983	2.0	0.1	1.8	16 475	22.67	5.21	4.35	727	1 756	55.7	74.3
1984	2.0	0.1	1.9	16 791	23.16	5.28	4.38	725	1 748	55.6	74.6
1985	2.3	0.2	2.1	17 146	23.64	5.36	4.41	725	1 741	55.7	74.8
1986	2.5	0.2	2.3	17 533	24.12	5.44	4.43	727	1 735	55.8	75.0
1987	2.5	0.2	2.3	17 944	24.62	5.52	4.46	729	1 730	56.0	75.2
1988	2.7	0.3	2.4	18 368	25.15	5.60	4.49	730	1 724	56.3	75.3
1989	2.8	0.5	2.3	18 793	25.74	5.69	4.53	730	1 717	56.5	75.3
1990	2.7	0.7	2.1	19 181	26.35	5.77	4.57	728	1 709	56.6	75.3
1991	2.6	0.6	2.0	19 571	26.98	5.86	4.60	725	1 701	56.6	75.4
1992	2.5	0.5	2.1	19 973	27.63	5.95	4.64	723	1 694	56.5	75.6
1993	2.2	0.4	1.7	20 318	28.23	6.04	4.67	720	1 687	56.3	75.8
1994	2.2	0.3	1.9	20 699	28.82	6.13	4.70	718	1 682	56.2	76.0
1995	2.2	0.3	1.9	21 085	29.39	6.21	4.73	717	1 677	56.3	76.0
1996	2.2	0.3	1.9	21 484	29.94	6.29	4.76	718	1 672	56.4	76.0
1997	2.3	0.3	2.0	21 915	30.47	6.36	4.79	719	1 667	56.8	76.0
1998	2.4	0.2	2.2	22 391	31.01	6.43	4.82	722	1 662	57.2	76.0
1999	2.5	0.3	2.2	22 883	31.57	6.51	4.85	725	1 655	57.7	75.9
2000	2.6	0.4	2.2	23 383	32.15	6.58	4.88	727	1 647	58.1	75.9
2001	2.4	0.5	2.0	23 845	32.70	6.66	4.91	729	1 639	58.6	75.9
2002	2.2	0.5	1.7	24 249	33.22	6.73	4.94	730	1 631	59.0	75.9
2003	2.1	0.6	1.5	24 616	33.71	6.79	4.97	730	1 624	59.3	75.9
2004	2.0	0.6	1.4	24 961	34.16	6.84	4.99	731	1 618	59.5	75.9
2005	1.9	0.6	1.3	25 281	34.60	6.90	5.02	731	1 612	59.8	75.8
2006	1.9	0.5	1.3	25 612	35.06	6.94	5.05	731	1 607	60.0	75.8
2007	1.8	0.6	1.2	25 921	35.51	6.98	5.09	730	1 602	60.2	75.7
2008	1.4	0.6	0.8	26 132	35.92	7.01	5.13	728	1 596	60.2	75.7
2009	0.6	0.4	0.2	26 186	36.19	7.03	5.15	724	1 591	60.1	75.6
2010	0.7	0.4	0.3	26 270	36.45	7.05	5.17	721	1 588	60.2	75.4
2011	0.7	0.4	0.4	26 366	36.66	7.07	5.19	719	1 586	60.2	75.3
2012	0.5	0.5	-0.0	26 365	36.89	7.08	5.21	715	1 584	60.1	75.0
2013	0.5	0.3	0.3	26 432	37.06	7.10	5.22	713	1 583	60.1	75.0
2014	0.7	0.4	0.4	26 532	37.25	7.13	5.23	712	1 583	60.1	74.9
2015	0.9	0.3	0.6	26 688	37.49	7.16	5.24	712	1 584	60.1	74.8
2016	0.9	0.3	0.7	26 867	37.77	7.19	5.26	711	1 584	60.1	74.7
2017	1.0	0.3	0.8	27 078	38.07	7.22	5.27	711	1 583	60.2	74.6
2018	1.1	0.2	0.8	27 303	38.40	7.26	5.29	711	1 582	60.3	74.5
2019	1.2	0.2	1.0	27 567	38.72	7.29	5.31	712	1 582	60.5	74.4
2020	1.3	0.2	1.1	27 859	39.05	7.33	5.32	713	1 583	60.7	74.3
2021	1.3	0.2	1.1	28 160	39.39	7.38	5.34	715	1 583	60.9	74.2
2022	1.3	0.2	1.1	28 465	39.75	7.42	5.36	716	1 584	61.1	74.0
2023	1.3	0.2	1.1	28 783	40.12	7.46	5.38	717	1 585	61.3	73.9

New MS in 2005 PPS	Potential GDP per capita - Annual Growth Rate (%)			Potential GDP per capita - Levels							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1995											
1996	2.9	-0.2	3.1	8204	10.13	*3.4*	3.0	810	1878	56.9	75.7
1997	3.1	-0.2	3.3	8476	10.45	*3.5*	3.0	811	1893	56.3	76.1
1998	3.5	-0.2	3.7	8788	10.81	*3.6*	3.0	813	1908	55.7	76.5
1999	3.6	-0.2	3.7	9116	11.23	*3.7*	3.1	811	1920	55.1	76.7
2000	3.8	-0.1	4.0	9478	11.71	*3.8*	3.1	809	1928	54.6	76.9
2001	3.7	-0.4	4.1	9870	12.24	*3.9*	3.1	806	1932	54.2	77.1
2002	3.6	-0.9	4.5	10317	12.80	*4.0*	3.2	806	1932	53.8	77.5
2003	3.9	-0.3	4.2	10746	13.33	*4.2*	3.2	806	1930	53.6	77.8
2004	4.1	-0.2	4.4	11214	13.89	*4.3*	3.2	807	1928	53.6	78.1
2005	4.2	-0.2	4.4	11710	14.44	*4.4*	3.3	811	1925	53.8	78.3
2006	4.2	-0.2	4.5	12231	15.02	*4.5*	3.3	814	1923	54.1	78.4
2007	4.4	-0.3	4.8	12815	15.65	*4.6*	3.4	819	1919	54.4	78.4
2008	4.1	-0.3	4.4	13380	16.27	*4.7*	3.5	822	1916	54.8	78.3
2009	2.3	-0.1	2.4	13707	16.71	*4.8*	3.5	820	1912	54.8	78.2
2010	2.2	0.1	2.1	13994	17.11	*4.8*	3.6	818	1910	54.9	78.0
2011	2.4	-0.4	2.8	14385	17.50	*4.9*	3.6	822	1909	55.1	78.1
2012	1.9	-0.2	2.1	14687	17.85	*4.9*	3.6	823	1907	55.3	78.0
2013	2.0	-0.2	2.1	15001	18.18	*5.0*	3.7	825	1906	55.5	77.9
2014	2.2	-0.2	2.4	15360	18.54	*5.0*	3.7	829	1905	55.9	77.9
2015	2.4	-0.1	2.6	15754	18.94	*5.1*	3.7	832	1905	56.2	77.8
2016	2.3	-0.1	2.5	16144	19.40	*5.1*	3.8	832	1904	56.3	77.6
2017	2.2	-0.2	2.4	16530	19.90	*5.2*	3.8	831	1904	56.3	77.5
2018	2.2	-0.2	2.4	16927	20.42	*5.3*	3.9	829	1903	56.3	77.4
2019	2.3	-0.2	2.5	17353	20.98	*5.4*	3.9	827	1902	56.3	77.2
2020	2.3	-0.2	2.5	17787	21.55	*5.5*	4.0	826	1902	56.3	77.2
2021	2.3	-0.2	2.5	18231	22.14	*5.5*	4.0	824	1902	56.2	77.1
2022	2.3	-0.2	2.5	18691	22.76	*5.6*	4.0	821	1902	56.2	76.9
2023	2.3	-0.3	2.5	19167	23.41	*5.7*	4.1	819	1901	56.1	76.7

EU28 IN 2005 PPS	Potential GDP per capita - Annual Growth Rate (%)			Potential GDP per capita - Levels							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1995											
1996	2.2	0.2	2.1	18 465	25.06	*5.65*	4.44	737	1 720	56.4	76.0
1997	2.3	0.2	2.2	18 871	25.56	*5.72*	4.47	738	1 719	56.5	76.0
1998	2.5	0.1	2.4	19 320	26.08	*5.80*	4.50	741	1 717	56.7	76.1
1999	2.6	0.2	2.4	19 786	26.64	*5.88*	4.53	743	1 713	57.0	76.1
2000	2.7	0.3	2.4	20 268	27.23	*5.97*	4.56	744	1 708	57.2	76.1
2001	2.6	0.3	2.3	20 736	27.83	*6.05*	4.60	745	1 701	57.5	76.2
2002	2.4	0.2	2.1	21 182	28.42	*6.14*	4.63	745	1 694	57.7	76.3
2003	2.3	0.4	1.9	21 582	28.94	6.22	4.66	746	1 687	57.9	76.3
2004	2.3	0.4	1.8	21 974	29.45	6.29	4.68	746	1 681	58.1	76.4
2005	2.2	0.4	1.7	22 350	29.93	6.35	4.71	747	1 676	58.3	76.4
2006	2.1	0.4	1.7	22 738	30.42	6.41	4.75	747	1 671	58.6	76.3
2007	2.1	0.4	1.7	23 124	30.92	6.46	4.79	748	1 666	58.8	76.3
2008	1.7	0.4	1.3	23 427	31.38	6.50	4.83	747	1 661	59.0	76.2
2009	0.8	0.3	0.5	23 548	31.70	6.53	4.86	743	1 656	58.9	76.1
2010	0.9	0.3	0.5	23 677	31.99	6.55	4.88	740	1 653	58.9	76.0
2011	0.9	0.2	0.7	23 849	32.25	6.58	4.90	740	1 651	59.1	75.9
2012	0.6	0.3	0.3	23 923	32.50	6.60	4.92	736	1 649	59.0	75.6
2013	0.7	0.2	0.5	24 047	32.70	6.63	4.94	735	1 648	59.0	75.6
2014	0.9	0.2	0.7	24 207	32.93	6.66	4.95	735	1 648	59.1	75.5
2015	1.1	0.2	0.9	24 418	33.20	6.69	4.96	735	1 648	59.2	75.4
2016	1.1	0.2	0.9	24 646	33.54	6.73	4.98	735	1 648	59.2	75.3
2017	1.2	0.2	1.0	24 898	33.90	6.77	5.01	734	1 648	59.3	75.2
2018	1.2	0.2	1.1	25 164	34.29	6.82	5.03	734	1 646	59.4	75.0
2019	1.4	0.2	1.2	25 467	34.69	6.87	5.05	734	1 646	59.5	74.9
2020	1.4	0.1	1.3	25 794	35.09	6.92	5.07	735	1 646	59.7	74.9
2021	1.4	0.1	1.3	26 129	35.51	6.97	5.09	736	1 646	59.8	74.8
2022	1.4	0.1	1.3	26 471	35.95	7.03	5.12	736	1 646	60.0	74.6
2023	1.5	0.1	1.3	26 826	36.42	7.09	5.14	737	1 646	60.1	74.4

EA12	**Potential GDP per capita - Annual Growth Rate (%)**			**Potential GDP per capita - Levels**							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
Version: 2005 PPS	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1965											
1966	4.9	0.8	4.0	10 105	11.49	*3.40*	3.38	879	2 113	57.8	72.0
1967	4.7	0.6	4.0	10 513	12.18	*3.54*	3.44	863	2 084	57.6	71.9
1968	4.7	0.6	4.0	10 937	12.92	*3.68*	3.51	847	2 053	57.4	71.8
1969	4.9	0.7	4.1	11 387	13.70	*3.82*	3.58	831	2 023	57.3	71.8
1970	4.7	0.7	4.0	11 840	14.50	*3.97*	3.66	817	1 993	57.2	71.7
1971	4.6	0.8	3.7	12 282	15.31	*4.11*	3.73	802	1 965	57.0	71.5
1972	4.5	0.7	3.8	12 747	16.13	*4.24*	3.80	790	1 941	56.9	71.6
1973	4.4	0.7	3.7	13 221	16.94	*4.37*	3.87	780	1 919	56.7	71.7
1974	4.0	0.6	3.4	13 672	17.72	*4.50*	3.94	772	1 899	56.5	71.9
1975	3.3	0.5	2.8	14 059	18.44	*4.61*	4.00	762	1 882	56.2	72.0
1976	3.2	0.4	2.7	14 445	19.14	*4.72*	4.05	755	1 867	55.9	72.3
1977	3.0	0.4	2.6	14 814	19.82	*4.82*	4.11	748	1 852	55.7	72.5
1978	2.8	0.4	2.4	15 171	20.46	*4.92*	4.16	742	1 838	55.4	72.8
1979	2.7	0.4	2.3	15 520	21.08	*5.00*	4.21	736	1 824	55.2	73.1
1980	2.6	0.4	2.2	15 859	21.68	*5.09*	4.26	731	1 810	55.0	73.4
1981	1.8	0.4	1.4	16 076	22.15	*5.14*	4.31	726	1 797	54.8	73.7
1982	1.6	0.3	1.4	16 294	22.62	*5.20*	4.35	720	1 784	54.5	74.0
1983	2.1	0.1	1.9	16 604	23.14	*5.27*	4.39	717	1 772	54.5	74.3
1984	1.9	0.1	1.8	16 897	23.67	*5.35*	4.43	714	1 761	54.3	74.6
1985	2.1	0.1	2.0	17 232	24.19	*5.42*	4.46	712	1 751	54.3	74.9
1986	2.4	0.2	2.1	17 600	24.70	*5.50*	4.49	712	1 741	54.5	75.1
1987	2.5	0.2	2.3	17 999	25.24	*5.59*	4.52	713	1 733	54.6	75.4
1988	2.7	0.4	2.3	18 421	25.81	*5.67*	4.55	714	1 726	54.8	75.5
1989	2.8	0.5	2.3	18 849	26.42	*5.76*	4.59	713	1 718	55.0	75.5
1990	2.8	0.7	2.1	19 244	27.05	*5.85*	4.63	711	1 710	55.1	75.5
1991	2.8	0.6	2.1	19 655	27.69	*5.93*	4.67	710	1 702	55.1	75.7
1992	2.6	0.5	2.1	20 071	28.33	*6.02*	4.71	708	1 694	55.0	76.0
1993	2.1	0.5	1.7	20 405	28.91	*6.10*	4.74	706	1 687	54.8	76.3
1994	2.0	0.3	1.8	20 763	29.47	*6.17*	4.77	704	1 680	54.8	76.5
1995	2.0	0.3	1.7	21 114	30.01	*6.24*	4.81	704	1 674	54.8	76.6
1996	1.9	0.3	1.7	21 468	30.50	*6.31*	4.84	704	1 669	55.0	76.6
1997	2.0	0.3	1.8	21 847	30.97	*6.37*	4.87	705	1 663	55.4	76.6
1998	2.1	0.2	1.9	22 267	31.43	*6.42*	4.89	709	1 657	55.8	76.6
1999	2.3	0.3	2.0	22 707	31.91	*6.48*	4.93	712	1 649	56.4	76.6
2000	2.4	0.4	2.0	23 151	32.41	*6.54*	4.96	714	1 641	56.9	76.5
2001	2.3	0.5	1.8	23 561	32.89	*6.59*	4.99	716	1 632	57.4	76.5
2002	2.0	0.6	1.4	23 900	33.33	*6.65*	5.01	717	1 624	57.8	76.4
2003	1.9	0.6	1.2	24 198	33.73	*6.69*	5.04	717	1 617	58.1	76.4
2004	1.8	0.7	1.2	24 484	34.11	*6.74*	5.06	718	1 611	58.4	76.3
2005	1.7	0.6	1.1	24 753	34.50	*6.78*	5.09	717	1 605	58.7	76.2
2006	1.7	0.5	1.2	25 048	34.93	*6.82*	5.12	717	1 599	59.0	76.1
2007	1.8	0.6	1.2	25 336	35.37	*6.85*	5.16	716	1 593	59.2	75.9
2008	1.4	0.5	0.8	25 549	35.80	*6.89*	5.20	714	1 587	59.3	75.8
2009	0.6	0.3	0.3	25 624	36.13	*6.91*	5.23	709	1 582	59.2	75.7
2010	0.7	0.3	0.4	25 727	36.44	*6.94*	5.25	706	1 577	59.3	75.5
2011	0.7	0.3	0.5	25 847	36.72	*6.97*	5.27	704	1 574	59.4	75.3
2012	0.4	0.3	0.2	25 890	37.01	*7.00*	5.29	700	1 571	59.3	75.1
2013	0.4	0.2	0.2	25 953	37.25	*7.02*	5.30	697	1 568	59.2	75.0
2014	0.6	0.3	0.3	26 038	37.49	*7.05*	5.31	695	1 566	59.2	74.9
2015	0.7	0.2	0.5	26 173	37.76	*7.09*	5.33	693	1 565	59.2	74.8
2016	0.8	0.2	0.7	26 344	38.07	*7.12*	5.35	692	1 564	59.2	74.7
2017	1.0	0.2	0.8	26 555	38.39	*7.16*	5.36	692	1 563	59.3	74.6
2018	1.0	0.1	0.9	26 785	38.73	*7.19*	5.38	692	1 561	59.4	74.6
2019	1.2	0.1	1.0	27 064	39.05	*7.23*	5.40	693	1 561	59.6	74.5
2020	1.3	0.1	1.2	27 378	39.37	*7.27*	5.41	695	1 561	59.8	74.5
2021	1.3	0.1	1.2	27 703	39.70	*7.31*	5.43	698	1 562	60.0	74.4
2022	1.3	0.1	1.2	28 031	40.05	*7.36*	5.44	700	1 563	60.3	74.3
2023	1.3	0.1	1.2	28 368	40.42	*7.40*	5.46	702	1 564	60.5	74.2

EA18	**Potential GDP per capita - Annual Growth Rate (%)**			**Potential GDP per capita - Levels**								
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)				
Version: 2005 PPS	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1995											
1996	2.0	0.2	1.7	21 010	30	6.21	4.78	707	1 677	55.0	76.6
1997	2.1	0.2	1.8	21 393	30	6.28	4.81	708	1 671	55.3	76.5
1998	2.2	0.2	2.0	21 816	31	6.33	4.84	711	1 665	55.8	76.6
1999	2.3	0.3	2.0	22 258	31	6.39	4.88	714	1 658	56.3	76.5
2000	2.4	0.4	2.0	22 704	32	6.45	4.91	717	1 650	56.8	76.5
2001	2.3	0.4	1.8	23 123	32	6.51	4.94	719	1 642	57.2	76.5
2002	2.1	0.5	1.5	23 471	33	6.57	4.96	720	1 633	57.6	76.5
2003	1.9	0.6	1.3	23 782	33	6.62	4.99	720	1 626	58.0	76.4
2004	1.9	0.6	1.3	24 083	33	6.66	5.02	721	1 620	58.3	76.3
2005	1.8	0.6	1.2	24 371	34	6.71	5.04	720	1 614	58.6	76.2
2006	1.8	0.5	1.3	24 685	34	6.75	5.08	720	1 608	58.8	76.1
2007	1.8	0.6	1.2	24 992	35	6.79	5.12	719	1 602	59.1	76.0
2008	1.5	0.5	0.9	25 221	35	6.83	5.15	717	1 596	59.1	75.9
2009	0.7	0.3	0.3	25 304	36	6.86	5.18	712	1 590	59.1	75.8
2010	0.7	0.3	0.4	25 413	36	6.89	5.21	709	1 586	59.1	75.6
2011	0.8	0.2	0.5	25 543	36	6.92	5.23	707	1 582	59.2	75.4
2012	0.4	0.2	0.2	25 594	36	6.95	5.25	702	1 579	59.1	75.2
2013	0.5	0.2	0.3	25 664	37	6.97	5.26	700	1 576	59.0	75.2
2014	0.6	0.3	0.4	25 755	37	7.01	5.27	697	1 575	59.0	75.0
2015	0.8	0.2	0.6	25 897	37	7.04	5.29	696	1 573	59.0	74.9
2016	0.9	0.2	0.7	26 077	38	7.08	5.30	695	1 572	59.1	74.8
2017	1.0	0.1	0.8	26 295	38	7.11	5.32	694	1 571	59.2	74.7
2018	1.1	0.1	0.9	26 535	38	7.15	5.34	694	1 569	59.3	74.7
2019	1.2	0.1	1.1	26 821	39	7.20	5.36	696	1 569	59.5	74.6
2020	1.3	0.1	1.2	27 143	39	7.24	5.37	698	1 569	59.7	74.6
2021	1.3	0.1	1.2	27 476	39	7.28	5.39	700	1 570	59.9	74.5
2022	1.3	0.1	1.2	27 813	40	7.33	5.41	702	1 570	60.1	74.4
2023	1.4	0.1	1.2	28 159	40	7.38	5.42	704	1 571	60.3	74.2

US	Potential GDP per capita - Annual Growth Rate (%)			Potential GDP per capita - Levels							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
Version: 2005 PPS	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1965											
1966	3.6	1.2	2.4	16 244	21.25	5.15	4.13	764	1 962	58.7	66.4
1967	3.5	1.1	2.3	16 625	21.70	5.23	4.15	766	1 944	59.0	66.7
1968	3.3	1.0	2.3	17 008	22.18	5.30	4.18	767	1 928	59.2	67.2
1969	3.2	1.0	2.2	17 382	22.67	5.38	4.22	767	1 914	59.3	67.6
1970	3.0	1.2	1.8	17 700	23.12	5.45	4.24	766	1 901	59.2	68.0
1971	3.0	1.3	1.7	18 000	23.57	5.52	4.27	764	1 889	59.1	68.4
1972	3.2	1.1	2.1	18 371	24.02	5.59	4.29	765	1 878	59.0	69.0
1973	3.2	1.0	2.2	18 778	24.48	5.66	4.32	767	1 868	59.0	69.6
1974	2.9	0.9	2.0	19 148	24.89	5.73	4.35	769	1 857	59.0	70.2
1975	2.6	1.0	1.6	19 462	25.22	5.79	4.36	772	1 846	59.1	70.8
1976	3.0	1.0	2.0	19 847	25.53	5.85	4.37	777	1 838	59.3	71.4
1977	3.2	1.0	2.2	20 277	25.85	5.91	4.38	784	1 831	59.6	71.9
1978	3.4	1.1	2.3	20 745	26.20	5.96	4.40	792	1 825	59.9	72.4
1979	3.4	1.1	2.2	21 204	26.56	6.01	4.42	798	1 820	60.3	72.8
1980	2.8	1.2	1.6	21 546	26.91	6.07	4.44	801	1 815	60.6	72.8
1981	3.1	1.0	2.1	22 002	27.35	6.14	4.45	805	1 813	60.8	73.0
1982	2.9	1.0	1.9	22 419	27.74	6.22	4.46	808	1 813	61.0	73.1
1983	3.2	0.9	2.2	22 923	28.16	6.30	4.47	814	1 815	61.3	73.1
1984	3.7	0.9	2.8	23 556	28.64	6.39	4.48	822	1 817	61.8	73.2
1985	3.8	0.9	2.9	24 228	29.14	6.47	4.50	831	1 816	62.5	73.3
1986	3.8	0.9	2.9	24 920	29.61	6.56	4.52	842	1 812	63.3	73.4
1987	3.5	0.9	2.6	25 570	30.08	6.64	4.53	850	1 806	64.1	73.4
1988	3.3	0.9	2.4	26 179	30.55	6.72	4.55	857	1 801	64.9	73.3
1989	3.1	0.9	2.1	26 730	31.05	6.80	4.57	861	1 797	65.6	73.1
1990	2.9	1.1	1.7	27 193	31.53	6.88	4.58	863	1 794	66.0	72.9
1991	2.7	1.3	1.3	27 546	31.95	6.96	4.59	862	1 793	66.2	72.7
1992	2.9	1.3	1.5	27 959	32.38	7.04	4.60	864	1 796	66.2	72.6
1993	3.0	1.3	1.7	28 429	32.81	7.12	4.61	866	1 804	66.3	72.5
1994	3.2	1.2	2.0	28 997	33.28	7.21	4.61	871	1 814	66.3	72.4
1995	3.4	1.2	2.2	29 643	33.78	7.31	4.62	878	1 826	66.4	72.4
1996	3.6	1.2	2.4	30 363	34.35	7.41	4.64	884	1 836	66.5	72.4
1997	3.8	1.2	2.6	31 147	34.99	7.52	4.65	890	1 844	66.6	72.5
1998	3.9	1.2	2.7	31 973	35.73	7.63	4.68	895	1 848	66.7	72.5
1999	3.7	1.1	2.5	32 787	36.58	7.75	4.72	896	1 846	66.9	72.6
2000	3.5	1.1	2.4	33 569	37.50	7.87	4.76	895	1 839	67.0	72.7
2001	3.0	1.0	2.0	34 225	38.43	7.99	4.81	891	1 826	67.0	72.8
2002	2.5	1.0	1.6	34 757	39.33	8.10	4.85	884	1 812	66.9	72.9
2003	2.4	0.9	1.4	35 256	40.26	8.21	4.90	876	1 798	66.7	73.0
2004	2.5	0.9	1.6	35 804	41.20	8.32	4.95	869	1 786	66.5	73.2
2005	2.5	0.9	1.5	36 349	42.14	8.41	5.01	863	1 776	66.2	73.4
2006	2.3	1.0	1.3	36 832	43.05	8.50	5.06	856	1 768	65.8	73.6
2007	1.9	1.0	1.0	37 185	43.92	8.59	5.11	847	1 759	65.3	73.7
2008	1.5	0.9	0.6	37 396	44.69	8.67	5.15	837	1 752	64.7	73.9
2009	1.0	0.9	0.1	37 429	45.29	8.75	5.18	826	1 746	64.0	74.0
2010	1.1	0.8	0.3	37 543	45.86	8.83	5.19	819	1 744	63.4	74.1
2011	1.4	0.7	0.6	37 775	46.42	8.91	5.21	814	1 745	62.9	74.2
2012	1.7	0.7	1.0	38 148	46.97	8.99	5.22	812	1 748	62.5	74.3
2013	1.9	0.7	1.2	38 611	47.49	9.07	5.23	813	1 752	62.3	74.4
2014	2.2	0.7	1.5	39 200	48.04	9.16	5.24	816	1 758	62.3	74.5
2015	2.5	0.7	1.8	39 919	48.65	9.25	5.26	821	1 764	62.4	74.5
2016	2.5	0.5	2.0	40 701	49.37	9.34	5.28	824	1 771	62.4	74.6
2017	2.4	0.5	1.9	41 488	50.12	9.44	5.31	828	1 776	62.4	74.7
2018	2.4	0.5	1.9	42 273	50.88	9.54	5.33	831	1 781	62.4	74.8
2019	2.3	0.5	1.8	43 037	51.67	9.64	5.36	833	1 783	62.4	74.8
2020	2.3	0.5	1.8	43 811	52.47	9.75	5.38	835	1 784	62.5	74.9
2021	2.3	0.5	1.8	44 586	53.29	9.85	5.41	837	1 785	62.5	75.0
2022	2.3	0.5	1.8	45 380	54.15	9.97	5.43	838	1 785	62.6	75.0
2023	2.3	0.5	1.8	46 190	55.03	10.08	5.46	839	1 785	62.6	75.1

EU15 *in 2005 PPS*	**Potential GDP per capita - Annual Growth Rate (%)**			**Potential GDP per capita - US=100**							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1965											
1966	4.4	0.8	3.6	63.9	55.1	*66.7*	82.5	115.9	106.2	100.6	108.5
1967	4.3	0.6	3.6	64.7	57.0	*68.2*	83.5	113.5	105.8	99.6	107.8
1968	4.2	0.6	3.6	65.5	58.9	*69.7*	84.5	111.3	105.2	98.9	107.0
1969	4.4	0.7	3.7	66.5	60.8	*71.2*	85.4	109.3	104.5	98.5	106.2
1970	4.3	0.7	3.6	67.6	62.9	*72.7*	86.5	107.5	103.8	98.3	105.4
1971	4.2	0.8	3.4	68.7	64.9	*74.1*	87.6	105.9	103.0	98.3	104.6
1972	4.1	0.6	3.5	69.7	66.8	*75.4*	88.6	104.3	102.4	98.1	103.8
1973	4.0	0.6	3.4	70.5	68.6	*76.7*	89.5	102.8	101.9	97.9	103.0
1974	3.7	0.5	3.2	71.4	70.4	*77.8*	90.5	101.4	101.4	97.7	102.3
1975	3.1	0.4	2.7	72.1	72.1	*78.8*	91.5	100.0	101.1	97.2	101.8
1976	2.9	0.3	2.6	72.5	73.8	*79.7*	92.5	98.3	100.7	96.4	101.3
1977	2.8	0.3	2.4	72.7	75.3	*80.6*	93.4	96.6	100.2	95.6	100.8
1978	2.6	0.4	2.3	72.7	76.6	*81.4*	94.2	94.9	99.7	94.6	100.6
1979	2.5	0.4	2.2	72.6	77.8	*82.0*	94.9	93.3	99.2	93.7	100.5
1980	2.4	0.4	2.0	72.9	79.0	*82.7*	95.5	92.4	98.6	92.9	100.8
1981	1.8	0.3	1.4	72.4	79.4	*82.6*	96.1	91.2	98.0	92.1	101.0
1982	1.7	0.2	1.5	72.2	80.0	*82.6*	96.8	90.2	97.4	91.4	101.3
1983	2.0	0.1	1.8	71.9	80.5	*82.7*	97.4	89.3	96.8	90.8	101.6
1984	2.0	0.1	1.9	71.3	80.8	*82.7*	97.7	88.2	96.2	90.0	101.9
1985	2.3	0.2	2.1	70.8	81.1	*82.8*	97.9	87.2	95.9	89.1	102.0
1986	2.5	0.2	2.3	70.4	81.5	*83.0*	98.2	86.4	95.8	88.3	102.2
1987	2.5	0.2	2.3	70.2	81.8	*83.2*	98.4	85.7	95.8	87.4	102.5
1988	2.7	0.3	2.4	70.2	82.3	*83.4*	98.8	85.2	95.7	86.7	102.7
1989	2.8	0.5	2.3	70.3	82.9	*83.6*	99.1	84.8	95.5	86.1	103.1
1990	2.7	0.7	2.1	70.5	83.6	*83.9*	99.6	84.4	95.3	85.8	103.3
1991	2.6	0.6	2.0	71.0	84.5	*84.2*	100.3	84.1	94.9	85.5	103.7
1992	2.5	0.5	2.1	71.4	85.3	*84.5*	100.9	83.7	94.3	85.2	104.2
1993	2.2	0.4	1.7	71.5	86.0	*84.8*	101.4	83.1	93.5	84.9	104.6
1994	2.2	0.3	1.9	71.4	86.6	*85.0*	101.9	82.4	92.7	84.7	104.9
1995	2.2	0.3	1.9	71.1	87.0	*85.0*	102.4	81.7	91.9	84.8	105.0
1996	2.2	0.3	1.9	70.8	87.2	*84.8*	102.7	81.2	91.1	84.9	104.9
1997	2.3	0.3	2.0	70.4	87.1	*84.6*	102.9	80.8	90.4	85.2	104.8
1998	2.4	0.2	2.2	70.0	86.8	*84.3*	103.0	80.7	89.9	85.7	104.7
1999	2.5	0.3	2.2	69.8	86.3	*84.0*	102.8	80.9	89.6	86.2	104.7
2000	2.6	0.4	2.2	69.7	85.7	*83.6*	102.5	81.3	89.6	86.8	104.5
2001	2.4	0.5	2.0	69.7	85.1	*83.3*	102.1	81.9	89.7	87.5	104.3
2002	2.2	0.5	1.7	69.8	84.5	*83.0*	101.8	82.6	90.0	88.1	104.2
2003	2.1	0.6	1.5	69.8	83.7	*82.7*	101.3	83.4	90.3	88.8	104.0
2004	2.0	0.6	1.4	69.7	82.9	*82.3*	100.7	84.1	90.6	89.5	103.7
2005	1.9	0.6	1.3	69.6	82.1	*82.0*	100.2	84.7	90.8	90.3	103.3
2006	1.9	0.5	1.3	69.5	81.4	*81.6*	99.8	85.4	90.9	91.2	103.0
2007	1.8	0.6	1.2	69.7	80.9	*81.3*	99.5	86.2	91.0	92.2	102.7
2008	1.4	0.6	0.8	69.9	80.4	*80.8*	99.4	86.9	91.1	93.1	102.5
2009	0.6	0.4	0.2	70.0	79.9	*80.3*	99.5	87.5	91.2	94.0	102.2
2010	0.7	0.4	0.3	70.0	79.5	*79.8*	99.5	88.1	91.1	95.0	101.8
2011	0.7	0.4	0.4	69.8	79.0	*79.3*	99.6	88.4	90.9	95.8	101.5
2012	0.5	0.5	0.0	69.1	78.5	*78.8*	99.7	88.0	90.6	96.2	100.9
2013	0.5	0.3	0.3	68.5	78.0	*78.3*	99.7	87.7	90.4	96.4	100.7
2014	0.7	0.4	0.4	67.7	77.5	*77.8*	99.6	87.3	90.1	96.4	100.5
2015	0.9	0.3	0.6	66.9	77.1	*77.4*	99.6	86.8	89.8	96.3	100.3
2016	0.9	0.3	0.7	66.0	76.5	*76.9*	99.5	86.3	89.4	96.4	100.1
2017	1.0	0.3	0.8	65.3	76.0	*76.5*	99.3	85.9	89.1	96.5	99.9
2018	1.1	0.2	0.8	64.6	75.5	*76.1*	99.2	85.6	88.9	96.7	99.6
2019	1.2	0.2	1.0	64.1	74.9	*75.7*	99.1	85.5	88.8	96.9	99.4
2020	1.3	0.2	1.1	63.6	74.4	*75.2*	98.9	85.4	88.7	97.1	99.2
2021	1.3	0.2	1.1	63.2	73.9	*74.8*	98.8	85.5	88.7	97.3	98.9
2022	1.3	0.2	1.1	62.7	73.4	*74.4*	98.6	85.5	88.8	97.6	98.6
2023	1.3	0.2	1.1	62.3	72.9	*74.1*	98.4	85.5	88.8	97.9	98.4

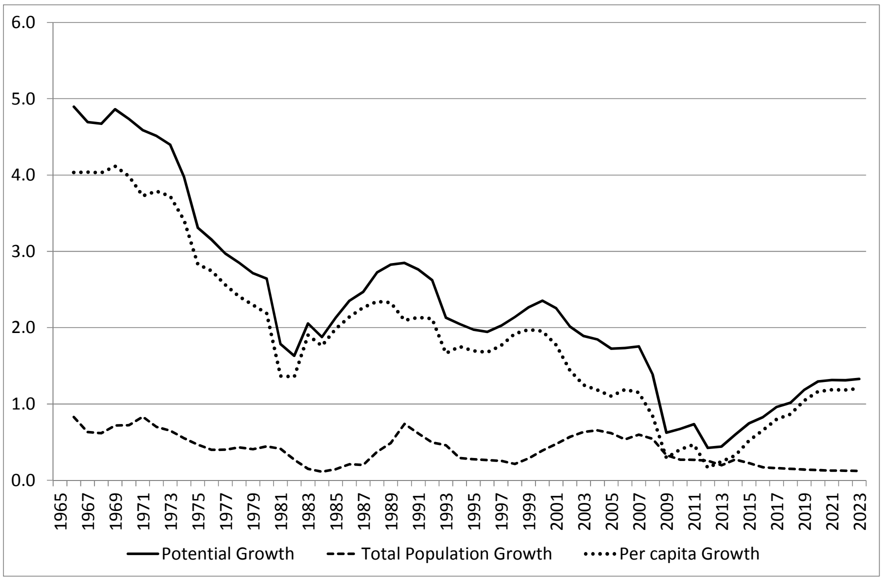
New MS	Potential GDP per capita - Annual Growth Rate (%)			Potential GDP per capita - US=100							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
in 2005 PPS	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1995											
1996	2.9	-0.2	3.1	27.0	29.5	*46.1*	64.1	91.6	102.3	85.7	104.6
1997	3.1	-0.2	3.3	27.2	29.9	*46.4*	64.4	91.1	102.7	84.5	105.0
1998	3.5	-0.2	3.7	27.5	30.3	*46.8*	64.7	90.8	103.2	83.4	105.5
1999	3.6	-0.2	3.7	27.8	30.7	*47.3*	64.9	90.5	104.0	82.4	105.7
2000	3.8	-0.1	4.0	28.2	31.2	*48.0*	65.1	90.4	104.9	81.5	105.8
2001	3.7	-0.4	4.1	28.8	31.9	*48.8*	65.3	90.5	105.8	80.8	105.9
2002	3.6	-0.9	4.5	29.7	32.5	*49.7*	65.5	91.2	106.6	80.4	106.4
2003	3.9	-0.3	4.2	30.5	33.1	*50.6*	65.4	92.0	107.3	80.4	106.6
2004	4.1	-0.2	4.4	31.3	33.7	*51.5*	65.4	92.9	107.9	80.6	106.7
2005	4.2	-0.2	4.4	32.2	34.3	*52.3*	65.5	94.0	108.4	81.3	106.7
2006	4.2	-0.2	4.5	33.2	34.9	*53.1*	65.7	95.2	108.8	82.2	106.5
2007	4.4	-0.3	4.8	34.5	35.6	*53.7*	66.3	96.7	109.1	83.4	106.3
2008	4.1	-0.3	4.4	35.8	36.4	*54.2*	67.2	98.3	109.4	84.7	106.1
2009	2.3	-0.1	2.4	36.6	36.9	*54.4*	67.9	99.2	109.5	85.7	105.8
2010	2.2	0.1	2.1	37.3	37.3	*54.5*	68.4	99.9	109.6	86.6	105.3
2011	2.4	-0.4	2.8	38.1	37.7	*54.6*	69.0	101.0	109.4	87.7	105.3
2012	1.9	-0.2	2.1	38.5	38.0	*54.6*	69.5	101.3	109.1	88.4	105.0
2013	2.0	-0.2	2.1	38.9	38.3	*54.7*	70.0	101.5	108.8	89.1	104.7
2014	2.2	-0.2	2.4	39.2	38.6	*54.8*	70.5	101.5	108.4	89.7	104.5
2015	2.4	-0.1	2.6	39.5	38.9	*54.9*	70.9	101.4	107.9	90.0	104.3
2016	2.3	-0.1	2.5	39.7	39.3	*55.0*	71.4	101.0	107.5	90.2	104.1
2017	2.2	-0.2	2.4	39.8	39.7	*55.2*	71.9	100.4	107.2	90.2	103.8
2018	2.2	-0.2	2.4	40.0	40.1	*55.5*	72.4	99.8	106.9	90.2	103.5
2019	2.3	-0.2	2.5	40.3	40.6	*55.7*	72.9	99.3	106.7	90.1	103.2
2020	2.3	-0.2	2.5	40.6	41.1	*56.0*	73.4	98.9	106.6	90.0	103.0
2021	2.3	-0.2	2.5	40.9	41.5	*56.2*	73.9	98.4	106.6	89.9	102.8
2022	2.3	-0.2	2.5	41.2	42.0	*56.5*	74.3	98.0	106.5	89.8	102.5
2023	2.3	-0.3	2.5	41.5	42.5	*56.9*	74.8	97.5	106.5	89.6	102.2

EA18 *in 2005 PPS*	**Potential GDP per capita - Annual Growth Rate (%)**			**Potential GDP per capita - US=100**							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1995											
1996	2.0	0.3	1.7	69.2	86.6	*83.9*	103.2	79.9	91.3	82.8	105.7
1997	2.1	0.3	1.8	68.7	86.3	*83.5*	103.4	79.5	90.6	83.1	105.6
1998	2.2	0.2	2.0	68.2	85.9	*83.0*	103.5	79.5	90.1	83.6	105.5
1999	2.3	0.3	2.0	67.9	85.2	*82.5*	103.3	79.7	89.8	84.1	105.5
2000	2.4	0.4	2.0	67.6	84.5	*82.0*	103.0	80.1	89.8	84.7	105.3
2001	2.3	0.5	1.8	67.6	83.7	*81.5*	102.7	80.7	89.9	85.4	105.1
2002	2.0	0.6	1.5	67.5	82.9	*81.1*	102.3	81.4	90.1	86.1	104.9
2003	1.9	0.6	1.3	67.5	82.0	*80.6*	101.8	82.2	90.4	86.9	104.7
2004	1.9	0.6	1.2	67.3	81.1	*80.1*	101.2	82.9	90.7	87.7	104.3
2005	1.8	0.6	1.2	67.0	80.3	*79.7*	100.7	83.5	90.9	88.5	103.9
2006	1.8	0.5	1.2	67.0	79.6	*79.4*	100.3	84.2	91.0	89.4	103.5
2007	1.8	0.6	1.2	67.2	79.1	*79.1*	100.0	85.0	91.1	90.5	103.1
2008	1.4	0.5	0.9	67.4	78.8	*78.8*	100.0	85.6	91.1	91.4	102.8
2009	0.7	0.3	0.3	67.6	78.5	*78.4*	100.1	86.2	91.1	92.3	102.5
2010	0.7	0.3	0.4	67.7	78.2	*78.0*	100.2	86.6	90.9	93.3	102.0
2011	0.8	0.3	0.5	67.6	77.9	*77.6*	100.3	86.8	90.7	94.2	101.6
2012	0.4	0.3	0.2	67.1	77.6	*77.3*	100.4	86.5	90.3	94.5	101.2
2013	0.5	0.2	0.3	66.5	77.2	*76.9*	100.5	86.0	90.0	94.7	101.0
2014	0.6	0.3	0.3	65.7	76.9	*76.5*	100.5	85.4	89.6	94.7	100.7
2015	0.8	0.2	0.5	64.9	76.5	*76.1*	100.5	84.8	89.2	94.7	100.5
2016	0.8	0.2	0.7	64.1	76.0	*75.7*	100.4	84.3	88.8	94.7	100.3
2017	1.0	0.2	0.8	63.4	75.6	*75.4*	100.2	83.9	88.4	94.8	100.1
2018	1.0	0.1	0.9	62.8	75.1	*75.0*	100.1	83.6	88.1	95.0	99.9
2019	1.2	0.1	1.1	62.3	74.6	*74.6*	100.0	83.5	88.0	95.2	99.7
2020	1.3	0.1	1.2	62.0	74.1	*74.3*	99.8	83.6	87.9	95.5	99.5
2021	1.3	0.1	1.2	61.6	73.7	*73.9*	99.7	83.7	88.0	95.7	99.4
2022	1.3	0.1	1.2	61.3	73.2	*73.5*	99.5	83.8	88.0	96.0	99.1
2023	1.4	0.1	1.2	61.0	72.7	*73.2*	99.3	83.8	88.0	96.3	98.9

EA12 Version: 2005 PPS	Potential GDP per capita - Annual Growth Rate (%)			Potential GDP per capita - US=100							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1965											
1966	4.9	0.8	4.0	62.2	54.1	*66.0*	81.9	115.1	107.7	98.6	108.4
1967	4.7	0.6	4.0	63.2	56.1	*67.7*	83.0	112.6	107.2	97.6	107.7
1968	4.7	0.6	4.0	64.3	58.2	*69.4*	84.0	110.4	106.5	96.9	107.0
1969	4.9	0.7	4.1	65.5	60.4	*71.1*	85.0	108.4	105.7	96.6	106.2
1970	4.7	0.7	4.0	66.9	62.7	*72.8*	86.2	106.7	104.8	96.5	105.4
1971	4.6	0.8	3.7	68.2	65.0	*74.4*	87.4	105.0	104.0	96.5	104.6
1972	4.5	0.7	3.8	69.4	67.1	*75.9*	88.5	103.3	103.3	96.3	103.8
1973	4.4	0.7	3.7	70.4	69.2	*77.3*	89.6	101.7	102.7	96.1	103.0
1974	4.0	0.6	3.4	71.4	71.2	*78.6*	90.6	100.3	102.3	95.8	102.4
1975	3.3	0.5	2.8	72.2	73.1	*79.7*	91.8	98.8	101.9	95.2	101.8
1976	3.2	0.4	2.7	72.8	75.0	*80.7*	92.9	97.1	101.5	94.4	101.3
1977	3.0	0.4	2.6	73.1	76.6	*81.7*	93.9	95.3	101.1	93.5	100.9
1978	2.8	0.4	2.4	73.1	78.1	*82.5*	94.7	93.7	100.7	92.5	100.6
1979	2.7	0.4	2.3	73.2	79.4	*83.2*	95.4	92.2	100.2	91.6	100.5
1980	2.6	0.4	2.2	73.6	80.6	*83.8*	96.1	91.3	99.7	90.8	100.8
1981	1.8	0.4	1.4	73.1	81.0	*83.6*	96.8	90.2	99.1	90.1	101.0
1982	1.6	0.3	1.4	72.7	81.6	*83.5*	97.6	89.1	98.4	89.4	101.3
1983	2.1	0.1	1.9	72.4	82.2	*83.6*	98.3	88.1	97.6	88.8	101.7
1984	1.9	0.1	1.8	71.7	82.6	*83.7*	98.7	86.8	96.9	87.9	101.9
1985	2.1	0.1	2.0	71.1	83.0	*83.8*	99.1	85.7	96.4	87.0	102.2
1986	2.4	0.2	2.1	70.6	83.4	*83.9*	99.4	84.7	96.1	86.1	102.3
1987	2.5	0.2	2.3	70.4	83.9	*84.1*	99.7	83.9	96.0	85.1	102.7
1988	2.7	0.4	2.3	70.4	84.5	*84.4*	100.1	83.3	95.8	84.4	103.0
1989	2.8	0.5	2.3	70.5	85.1	*84.7*	100.5	82.9	95.6	83.9	103.4
1990	2.8	0.7	2.1	70.8	85.8	*85.0*	101.0	82.5	95.3	83.5	103.6
1991	2.8	0.6	2.1	71.4	86.7	*85.3*	101.7	82.3	94.9	83.3	104.1
1992	2.6	0.5	2.1	71.8	87.5	*85.5*	102.4	82.0	94.3	83.0	104.7
1993	2.1	0.5	1.7	71.8	88.1	*85.6*	102.9	81.5	93.5	82.7	105.3
1994	2.0	0.3	1.8	71.6	88.5	*85.6*	103.4	80.9	92.6	82.6	105.7
1995	2.0	0.3	1.7	71.2	88.8	*85.4*	104.0	80.2	91.7	82.6	105.8
1996	1.9	0.3	1.7	70.7	88.8	*85.1*	104.3	79.6	90.9	82.8	105.8
1997	2.0	0.3	1.8	70.1	88.5	*84.7*	104.5	79.2	90.2	83.2	105.7
1998	2.1	0.2	1.9	69.6	88.0	*84.1*	104.5	79.2	89.6	83.7	105.6
1999	2.3	0.3	2.0	69.3	87.2	*83.6*	104.4	79.4	89.3	84.2	105.5
2000	2.4	0.4	2.0	69.0	86.4	*83.1*	104.1	79.8	89.3	84.9	105.3
2001	2.3	0.5	1.8	68.8	85.6	*82.5*	103.7	80.4	89.4	85.6	105.1
2002	2.0	0.6	1.4	68.8	84.7	*82.0*	103.3	81.1	89.6	86.4	104.8
2003	1.9	0.6	1.2	68.6	83.8	*81.5*	102.8	81.9	89.9	87.1	104.6
2004	1.8	0.7	1.2	68.4	82.8	*81.0*	102.2	82.6	90.2	87.9	104.2
2005	1.7	0.6	1.1	68.1	81.9	*80.5*	101.6	83.2	90.3	88.7	103.8
2006	1.7	0.5	1.2	68.0	81.1	*80.2*	101.2	83.8	90.5	89.7	103.4
2007	1.8	0.6	1.2	68.1	80.5	*79.8*	100.9	84.6	90.6	90.7	103.0
2008	1.4	0.5	0.8	68.3	80.1	*79.4*	100.8	85.3	90.6	91.7	102.7
2009	0.6	0.3	0.3	68.5	79.8	*79.0*	101.0	85.8	90.6	92.6	102.3
2010	0.7	0.3	0.4	68.5	79.4	*78.6*	101.0	86.3	90.5	93.6	101.9
2011	0.7	0.3	0.5	68.4	79.1	*78.2*	101.1	86.5	90.2	94.5	101.5
2012	0.4	0.3	0.2	67.9	78.8	*77.8*	101.2	86.1	89.9	94.8	101.1
2013	0.4	0.2	0.2	67.2	78.4	*77.4*	101.3	85.7	89.5	95.0	100.8
2014	0.6	0.3	0.3	66.4	78.0	*77.0*	101.3	85.1	89.1	95.0	100.6
2015	0.7	0.2	0.5	65.6	77.6	*76.6*	101.3	84.5	88.7	94.9	100.3
2016	0.8	0.2	0.7	64.7	77.1	*76.2*	101.2	83.9	88.3	94.9	100.1
2017	1.0	0.2	0.8	64.0	76.6	*75.8*	101.0	83.6	88.0	95.0	99.9
2018	1.0	0.1	0.9	63.4	76.1	*75.4*	100.9	83.2	87.7	95.2	99.7
2019	1.2	0.1	1.0	62.9	75.6	*75.0*	100.7	83.2	87.5	95.5	99.6
2020	1.3	0.1	1.2	62.5	75.0	*74.6*	100.6	83.3	87.5	95.7	99.4
2021	1.3	0.1	1.2	62.1	74.5	*74.2*	100.4	83.4	87.5	96.0	99.3
2022	1.3	0.1	1.2	61.8	74.0	*73.8*	100.2	83.5	87.6	96.3	99.0
2023	1.3	0.1	1.2	61.4	73.4	*73.4*	100.0	83.6	87.6	96.6	98.8

EA18	**Potential GDP per capita - Annual Growth Rate (%)**			**Potential GDP per capita - US=100**							
					Hourly Labour Productivity (Potential)			Labour Input (Hours) per capita (Potential)			
in 2005 PPS	Potential Growth	Total Population Growth	Per capita Growth	Total	Total (in PPS per Hour Worked)	*TFP*	*Capital Intensity (in PPS per Hour Worked)*	Total (Avg Annual Hours per capita)	*Avg Annual Hours per employee*	*Employment rate*	*Pop.Working Age as a % of Tot.Population*
1995											
1996	2.0	0.3	1.7	69.2	86.6	*83.9*	103.2	79.9	91.3	82.8	105.7
1997	2.1	0.3	1.8	68.7	86.3	*83.5*	103.4	79.5	90.6	83.1	105.6
1998	2.2	0.2	2.0	68.2	85.9	*83.0*	103.5	79.5	90.1	83.6	105.5
1999	2.3	0.3	2.0	67.9	85.2	*82.5*	103.3	79.7	89.8	84.1	105.5
2000	2.4	0.4	2.0	67.6	84.5	*82.0*	103.0	80.1	89.8	84.7	105.3
2001	2.3	0.5	1.8	67.6	83.7	*81.5*	102.7	80.7	89.9	85.4	105.1
2002	2.0	0.6	1.5	67.5	82.9	*81.1*	102.3	81.4	90.1	86.1	104.9
2003	1.9	0.6	1.3	67.5	82.0	*80.6*	101.8	82.2	90.4	86.9	104.7
2004	1.9	0.6	1.2	67.3	81.1	*80.1*	101.2	82.9	90.7	87.7	104.3
2005	1.8	0.6	1.2	67.0	80.3	*79.7*	100.7	83.5	90.9	88.5	103.9
2006	1.8	0.5	1.2	67.0	79.6	*79.4*	100.3	84.2	91.0	89.4	103.5
2007	1.8	0.6	1.2	67.2	79.1	*79.1*	100.0	85.0	91.1	90.5	103.1
2008	1.4	0.5	0.9	67.4	78.8	*78.8*	100.0	85.6	91.1	91.4	102.8
2009	0.7	0.3	0.3	67.6	78.5	*78.4*	100.1	86.2	91.1	92.3	102.5
2010	0.7	0.3	0.4	67.7	78.2	*78.0*	100.2	86.6	90.9	93.3	102.0
2011	0.8	0.3	0.5	67.6	77.9	*77.6*	100.3	86.8	90.7	94.2	101.6
2012	0.4	0.3	0.2	67.1	77.6	*77.3*	100.4	86.5	90.3	94.5	101.2
2013	0.5	0.2	0.3	66.5	77.2	*76.9*	100.5	86.0	90.0	94.7	101.0
2014	0.6	0.3	0.3	65.7	76.9	*76.5*	100.5	85.4	89.6	94.7	100.7
2015	0.8	0.2	0.5	64.9	76.5	*76.1*	100.5	84.8	89.2	94.7	100.5
2016	0.8	0.2	0.7	64.1	76.0	*75.7*	100.4	84.3	88.8	94.7	100.3
2017	1.0	0.2	0.8	63.4	75.6	*75.4*	100.2	83.9	88.4	94.8	100.1
2018	1.0	0.1	0.9	62.8	75.1	*75.0*	100.1	83.6	88.1	95.0	99.9
2019	1.2	0.1	1.1	62.3	74.6	*74.6*	100.0	83.5	88.0	95.2	99.7
2020	1.3	0.1	1.2	62.0	74.1	*74.3*	99.8	83.6	87.9	95.5	99.5
2021	1.3	0.1	1.2	61.6	73.7	*73.9*	99.7	83.7	88.0	95.7	99.4
2022	1.3	0.1	1.2	61.3	73.2	*73.5*	99.5	83.8	88.0	96.0	99.1
2023	1.4	0.1	1.2	61.0	72.7	*73.2*	99.3	83.8	88.0	96.3	98.9

EA12



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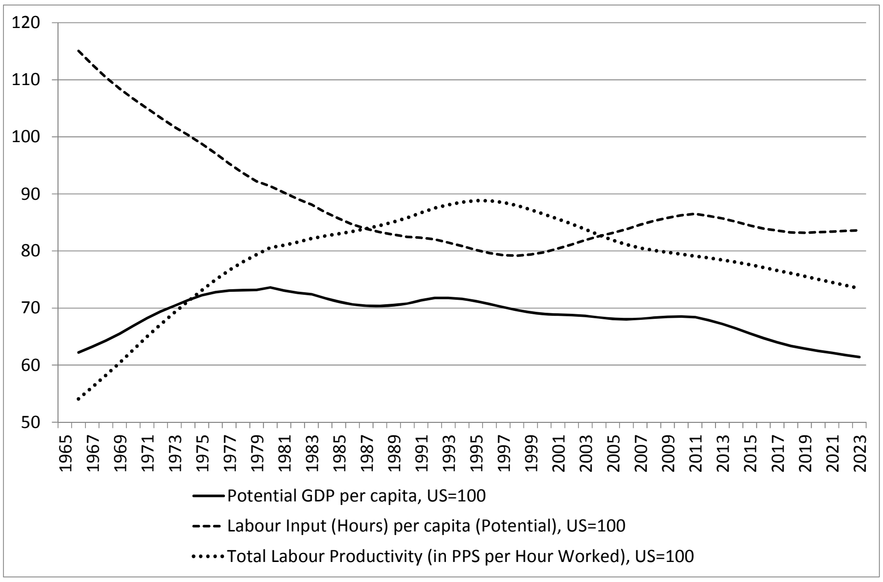
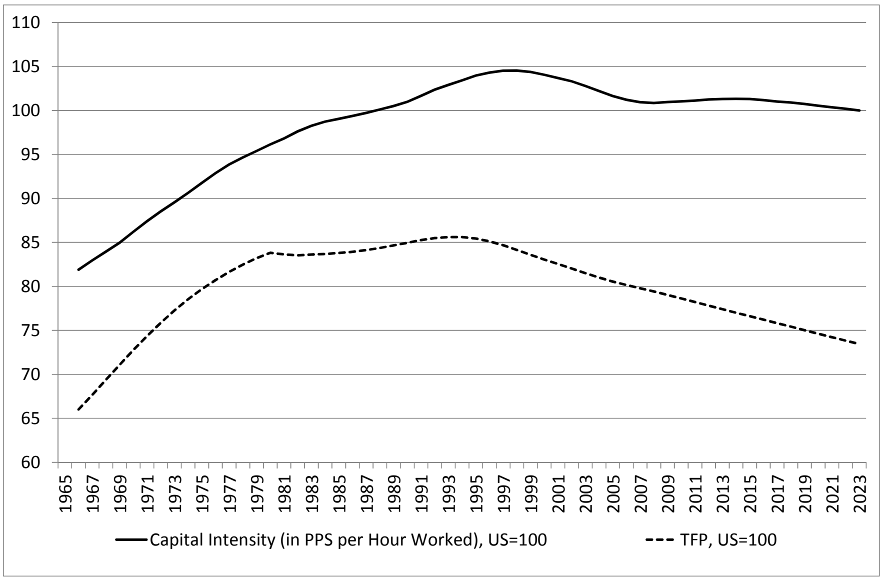
5.0
4.0
3.0
2.0
1.0
0.0
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
Potential Growth
Total Population Growth
Per capita Growth



120
110
100
90
80
70
60
50
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
Potential GDP per capita, US=100
Labour Input (Hours) per capita (Potential), US=100
Total Labour Productivity (in PPS per Hour Worked), US=100



110
105
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1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017 2019 2021 2023
Capital Intensity (in PPS per Hour Worked), US=100
TFP, US=100

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