



ECONOMIC POLICY COMMITTEE

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REPORT ON POTENTIAL OUTPUT AND THE OUTPUT GAP

1. Introduction

The concepts of potential output and the "output gap", i.e. the difference between actual and potential output, have played an increasing role in assessing the stance of macroeconomic policies. Potential output and output gap estimates are in particular largely used in EU macroeconomic surveillance procedures. These indicators have also acquired an "operational" status in the Stability and Growth Pact (SGP), as they provide an essential input for calculating indicators of structural (i.e. cyclically adjusted) fiscal balance, which are used in turn for assessing the progress made by countries towards achieving the goal of medium-term fiscal balance.

Although they represent clear concepts, potential output and the output gap are unobservable in practice. They cannot be easily embedded in robust and unquestionable quantitative indicators. Estimates of potential output and the output gap are known to be particularly uncertain, as different approaches provide estimates, which may differ significantly from each other. This dispersion is problematic when leading to divergent macroeconomic diagnosis and policy recommendations.

Against this background, the Economic Policy Committee (EPC) entrusted an ad-hoc working group of experts, chaired by Mr. Jean Philippe Cotis, to review the estimation methods used by the European Commission (EC) and other national and international institutions, with a view to strengthen the understanding and broaden the consensus on the EC estimates that are used in the surveillance procedures.

The group was composed of experts from the EPC and EU Member States, the EC and the ECB, as well as international organizations such as the IMF and the OECD (Annex 1). The group met on several occasions from June 1999 to October 2001¹. With a view to provide an active contribution and reflect progress and conclusions by the group in its own methodologies, the EC prepared background papers and materials for each of these meetings. The extensive coverage and high quality of this background work proved actually to be a key input for the reflections of the group.

¹ The group met first on June 7-8 and September 14-15, 1999, and later on January 11, September 25 and October 9, 2001.

This document summarizes the discussions and conclusions of the group. Section 2 discusses the concept of potential output and the output gap, highlighting the specific requirements of EU surveillance procedures. Section 3 reviews the respective advantages and drawbacks of the different estimation methods. Section 4 presents the new production function approach developed by the EC. Section 5 reviews some of the analytical and practical issues raised by structural fiscal balance indicators. Finally, Section 6 offers the conclusions and recommendations of the group.

2. Concepts and objectives

On analytical grounds, the group made a clear distinction between two different concepts of output that are generally used by national and international institutions:

- The first and genuine concept defines "potential output" as "the level of output that is consistent with stable inflation". The estimation methods that are associated with this concept have economic foundations, like the production function approach or semi-structural models of the Phillips curve.
- In contrast, a second concept refers to measures of the "trend" component of output. It relates only remotely to economic theory and is based on pure statistical techniques aimed at extracting the trend and cyclical component of output, such as the Hodrick-Prescott (HP) filter.

Estimates of potential or trend output and the output gap give important insights on the short and medium-run outlook of the economy, and on the stance of macroeconomic policies²:

- Estimates of potential output provide a synthetic measure of the aggregate supply capacity of the economy. Output gap estimates thus identify the cyclical position of the economy, which can give an early indication of underlying inflationary pressures. Potential output also help to assess the scope for non-inflationary growth, providing a key reference to prepare or assess medium-term projections.
- Potential output and output gap estimates also help to assess macroeconomic policies. In the EU, output gaps are used to measure structural fiscal balances and therefore to assess the medium-term fiscal objectives of Member countries within the SGP. Moreover, output gap estimates can contribute, to some extent, to identifying and assessing patterns of monetary policy rules over time. Finally, the analytical framework associated with potential output appears suitable to assess the macroeconomic consequences of structural reforms.

As shown by a questionnaire that was circulated by the group at an early stage, national and international institutions involved in macroeconomic analysis and policy recommendations use potential estimates to a sizable, albeit varying, degree. A majority of national institutions and international organizations, such as the IMF, the OECD and the EC make ample use of these estimates, relying in general more on the genuine concept of "potential output". In contrast, some other national institutions make a more modest use of these estimates, relying, for various reasons, more on the concept of "trend output"; this is particularly the case for

² As usually done and to keep exposition simple, this report uses "potential" in reference to both concepts of "potential" and "trend" output when comments to both of when the distinction is not clearly relevant.

countries where the scope and reliability of the statistical base is limited. In view of the uncertainty surrounding any estimate of potential output and the output gap, a number of institutions, including the EC, have recourse to different approaches to assess the dispersion of the results.

In view of the experience of national and international institutions, background work by the EC and the requirements of EU surveillance procedures, members of the group agreed on a set of desirable properties for potential output and output gap estimates. The group concluded, in particular, that:

- it would be desirable to develop a common estimation method based on reasonable economic foundations and providing estimates that could be used (uniformly) for most analytical and surveillance purposes ;
- for operational efficiency and adequate surveillance, the method should be reasonably simple, fully transparent and easily replicable; it should also rely on a similar set of assumptions for different Member countries although national specific features should be taken into account when interpreting the estimates ;
- the method should also firmly guard against any bias that would increase the risk of pro-cyclical macroeconomic policies ; in this respect, potential output growth estimates should not display pronounced pro-cyclical features, particularly for the current juncture, as this would lead to a false improvement in the structural fiscal balance during upswings and, conversely, to a false deterioration during downswings ;

3. Assessing the different estimation methods

Members of the group assessed the respective advantages and drawbacks of purely statistical detrending methods, such as the HP filter, and economic methods, such as the production function approach or semi-structural approaches that have been developed more recently.

Members of the group unanimously stressed the uncertainty surrounding any estimates of the level of potential output and the output gap. Measures of potential output growth, and associated changes in the output gap, appear however much less uncertain as estimates from conventional methods generally show no sizable differences.

a. Statistical detrending techniques

The discussion on statistical detrending techniques focused on the HP filter although most conclusions could be extended to other similar techniques. The HP filter identifies trend output by minimizing a criterion combining the deviations from actual output and the fluctuations of the trend. The respective weights given to the two components of the criteria depend on an exogenous detrending parameter (usually referred to as λ), which sets the degree of smoothness of the trend.

While reviewing the main features of the HP filter, members of the group noted that it is a pure mechanical smoothing procedure, whose statistical foundations are simple and transparent. It does not require any judgmental assumptions nor reliance on any particular

economic theory, and estimates from the HP filter can be easily and quickly replicated. These are the main reasons why the EC has relied on the HP filter for estimating trend output and the output gap in order to assess structural fiscal balances within the SGP. Members of the group acknowledged that these properties were worthwhile in the context of formal EU surveillance procedures since there is little scope for countries to disagree with the details of the calculations.

On the negative side, members of the group however noted that trend output and output gap estimates from the HP filter depend on an ad-hoc set of statistical assumptions subject to significant shortcomings, altering thus the assessment of the economic outlook and policy recommendations in various cases. Potential output and output gap estimates from the HP filter depend in particular on the detrending parameter λ which determines the degree of smoothness of the trend (i.e. the amount of cyclicity that is removed). This parameter is generally chosen somewhat arbitrarily, even though the EC sets it to 100 (for annual data), a value popularized by the academic literature on real business cycles.

Output gap estimates from the HP filter are also known to be affected by end-sample biases, as the estimates of trend output tend to rely excessively on the latest developments in actual output. This end-sample bias stems from the symmetric property of the HP filter, which requires that output gaps sum to zero over the estimation period, even though the latter rarely covers an exact number of business cycles. Estimates of trend output can thus be unduly biased toward or further from actual output, particularly when recent developments are dominated by demand shocks.

This end-sample bias can be partially remedied by using medium-term growth projections, as is done by the EC. The resulting estimates are however dependant on the accuracy of these projections. Given the uncertainty surrounding such projections and their natural tendency to revert quickly to what is perceived indeed as trend growth, there is however a risk that end-point biases remain substantial. . As recent or prospective demand shocks can be mistaken for supply shocks, this end-sample bias can prove problematic for policy recommendations: short-lived cyclical upswings may lead in particular to a false improvement in potential growth, and therefore, in the structural fiscal balance, providing countries with an additional incentive to implement a pro-cyclical loose fiscal policy during “good times”. In addition, estimates of potential output growth and the output gap from the HP filter can be significantly revised for the recent past or the present juncture, when the assessment of the short or medium-term growth outlook is modified.

More generally, members of the group agreed that the lack of economic foundations is a serious limitation to the HP filter. Given its pure statistical nature, the HP filter cannot underpin a comprehensive economic assessment of the outlook, nor is it a satisfactory instrument to frame economic policy discussions or explain policy decisions to the public. In particular, the HP filter appears unable to track structural changes in the economy on a timely basis. Recourse to the HP filter also does not allow identification of the respective contributions of the different determinants of potential output growth (capital accumulation, labor supply, technical progress...). Therefore it does not help to highlight the economic constraints and the role of policies in enhancing potential output growth, nor does it help to identify the macroeconomic benefits of structural reforms.

In the context of EU surveillance, members of the group noted that the end-point bias raised by the HP filter could have serious consequences. Trend output growth measures that are

made by the EC for the assessment of stability programs of Member countries depend in particular on short-term growth projections by the EC and on medium-term growth projections by Member countries themselves. Output gap and structural fiscal balance estimates for the recent past and the present juncture can therefore be sizably revised when the EC modifies its assessment of the short-term outlook. In addition, the assumptions for medium-term growth provided by Member countries can influence and bias the underlying potential growth used to evaluate structural balances in the SGP programs. Changes in the assessment of the short-term economic outlook and in medium-term national growth perspectives tend thus to affect estimated potential growth and structural balances for the recent past as well as the future years.

b. Economic approaches

Discussions on economic approaches focused on the traditional production function approach and semi-structural econometric approaches to measuring potential output or the structural unemployment rate that have been developed in recent years. As a common feature, and in contrast with pure statistical detrending techniques, these methods tend to define potential output and the structural component of unemployment as the level of these variables consistent with stable inflation.

Production function approach

The traditional production function approach is intended to provide a comprehensive and consistent economic framework for measuring potential output and the output gap. In its simplest form the production function approach relies on a simple two-factor Cobb-Douglas production function, with capital, labor and the exogenous technical progress measured by total factor productivity (TFP) growth. Potential output, i.e. the level of output consistent with stable inflation, is then estimated by assessing the average non-inflationary degree of utilization of factor inputs. For labor input, this particular degree of utilization encompasses the traditional concept of NAIRU (Non Accelerating Inflation Rate of Unemployment) together with measures of the trend labor force.

Given its economic foundations, the production function approach can provide a broad and consistent assessment of the economic outlook as well as of macroeconomic and structural policies. It highlights how the various factor inputs and technical progress contribute to potential growth. This approach is undoubtedly more appropriate than pure detrending techniques to deal with well identified structural changes in the economy (e.g. aging population and “new economy” developments) as well as the impact of labor market reforms. It can also help to prepare or assess medium-term, and possibly long-term, growth projections. By essence, the production function obviously requires a reasonable amount of economic expertise. Members of the group stressed in particular that in order to meet the genuine definition of potential output, the NAIRU estimates should be explicitly derived from a model of the price or wage formation process, and not from any simple smoothing procedures.

On the negative side, some members of the group expressed concern that potential output and output gap estimates from the production function approach would prove more vulnerable to disagreement from Member states within EU surveillance procedures, as they would reflect questionable assumptions and judgements. Some members also stressed that the production

function approach requires a set of macroeconomic statistics that might not be robust nor available in every country : this is particularly true for data on the capital stock as well as for Germany, whose statistical base has been affected by the unification. While acknowledging these risks, other members however thought that the production function approach provides instead a useful opportunity to discuss these implicit economic assumptions and judgements, which usually requires in itself a broadening and deepening of the economic analysis. Most members of the group also agreed that a production function approach should rely on a similar set of assumptions across countries and prove simple and transparent enough to qualify for EU surveillance procedures, such as the SGP.

Semi-structural approaches

Semi-structural approaches to potential output and the NAIRU have been developed in recent years. These methods are "mixed" methods that rely on both structural econometric foundations, such as equations for the Phillips curve, and recent econometric techniques, such as models with unobservable components (UC). As a special positive feature, such methods generally allow assessment of the uncertainty surrounding potential output and NAIRU estimates.

Members of the group however noted that these approaches can be somewhat technical and the results can be fairly sensitive to the econometric specification that is adopted. Implementing properly these techniques thus requires a fair amount of econometric expertise. In particular, UC models deliver reasonable NAIRU estimates only within well specified augmented Phillips curve, with additional exogenous variables reflecting well identified supply shocks, such as relative oil and import prices or other specific country shocks. Most members of the group thought that such methods, if contained to a simple econometric framework, could help to refine the EC estimates of the NAIRU, providing thus an important ingredient for usual production function approaches.

In contrast, members of the group shared the view that estimation methods based on structural vector-autoregressive (V.A.R.) models, such as the Blanchard and Quah approach, do not provide in general satisfactory estimates of potential output and the output gap. Although intellectually appealing, the assumptions used for identifying the underlying economic disturbances—supply and demand shocks—are too simplistic and the results often prove largely counterintuitive.

c. Conclusions

While acknowledging that the existing methodology based on the HP filter had helped to strengthen EU surveillance in the past, the group felt that a simple production function approach would provide a more comprehensive and adequate framework for assessing the economic outlook and policies of Member countries. This view was broadly shared by the EPC, as indicated by the interim report that the Chairman of the EPC sent to the President of the EFC in November 1999. The group also invited the EC to put a special emphasis on refining its NAIRU estimates, a key ingredient in the production function approach. While such estimates would ideally be derived from labor market theories, such as those specifying the wage and price formation process, most members of the group felt that reasonable estimates could also be derived from simple models of the Phillips curve, with a moderate amount of human resource and expertise.

4. The EC production function approach

The EC prepared considerable background materials, following the recommendations of the working group. The EC developed in particular a fully-fledged production function approach. This approach was then refined in view of comments and discussions by the group. In its latest form, this approach relies on the following main features:

- Estimates of the NAIRU are derived from a semi-structural approach, with an UC-model based on a simple wage Phillips curve, including temporary supply shocks (i.e. terms of trade shocks) and allowing for possible "speed-limit" effects associated with changes in the actual unemployment rate. Estimates are based on conventional assumptions regarding the statistical properties of the unobserved NAIRU.
- Estimates of potential output and the output gap are then derived from a simple Cobb-Douglas production function framework. Potential output depends, in particular, on: (i) the capital stock of the business sector; (ii) a measure of potential labor input based on the NAIRU estimate, the working age population and the trend labor force participation rate; and (iii) a measure of trend total factor productivity. For simplicity, measures of the trend participation rate and of trend total factor productivity are therein obtained by applying the HP filter.
- In its approach, the EC has also benefited from its country desks' expertise in order to check the economic reliability of the results. Country desks can help to identify strong economic inadequacies or deficiencies in the statistical data base, as well as refine the common underlying assumptions when needed.

Members of the group welcomed this new approach, which was viewed as striking an appropriate balance between the objective of strengthening the underlying economic analysis and the need to maintain transparency and equal treatment of member countries. While some members noted that the approach should be further refined, the first set of results was considered as reasonable for all countries, offering thus a reliable basis for EU surveillance. The possibility to discuss the underlying common assumptions made for each country was viewed as particularly useful, as it helps to strengthen the economic analysis embedded in the estimates. Most members also welcomed the interaction process with country desks, provided it remained focused on improving the general framework as well as on judging the quality of the data or the balance of risks surrounding the estimates. They also stressed the need to maintain full transparency and equal treatment of countries. Members also agreed that potential output and output gap estimates from the standard HP filter should be retained as a complementary instrument for surveillance work.

Commenting specifically on the results, members of the group noted that the new estimates were generally relatively close to those provided by the HP filter. While this was viewed as comforting, some members of the group noted that this could be partly fortunate, as estimates from the HP filter depended to a large extent on the medium-term growth projections that had been used to mitigate the end-sample bias. Members of the group also noted that the Phillips curve used in the production function approach led to significant differences across countries, regarding the role of supply shocks and to speed-limit effects. While this could prompt

additional analysis, these features were viewed as puzzling, albeit acceptable, by-products of the simple UC model that had been used.

Among areas of desirable methodological improvements, members of the group noted that estimates of the NAIRU could be easily refined by using quarterly data as well as reasonably extended to all EU countries³. In addition, the new potential output growth also displayed some remaining cyclicity for past years, similar to those obtained with the HP filter. In this regard, some members of the group noted that the remaining cyclicity of trend total factor productivity could be reduced by appealing to a smoother trend or by extracting additional information from other cyclical indicators, such as capacity utilization rates in the manufacturing sector⁴. Some members also inquired about the reliability of the data that the EC had used for the capital stock, given that these data are viewed as relatively fragile in some countries and even lack in some others. Some also noted that the various economic data used should, as much as possible, come from national harmonized sources.

The group also reviewed a preliminary set of medium-term estimates for potential output growth and the output gap that the EC had derived from this production function approach. The results were viewed as broadly reasonable, albeit differing somewhat from national estimates for some countries⁵. Members of the group however noted that these estimates could be refined by relying on demographic projections, particularly for the working age population as well as for the participation rate of different age cohorts and gender, in order to account for the aging population and the increased female participation in the labor force. Although such medium-term estimates have to rely on some ad-hoc common assumptions, members of the group also thought that this production function approach helps to highlight the key economic issues for the medium-term outlook.

5. Indicators of structural fiscal balance

Government revenues, and, to a lesser extent, expenditures, are known to be largely dependent on the business cycle. Structural fiscal balance indicators—such as those that have been pioneered by the IMF and the OECD and that are now used in EU surveillance procedures, particularly in the SGP—are thus intended to reflect the underlying government fiscal balance, abstracting from the impact of the business cycle. The structural fiscal balance is thus defined as the fiscal balance that would prevail, if output were at its potential level. These indicators are therefore derived from output gap estimates and a set of output elasticities for the main categories of taxes and cyclically-dependent public expenditures.

The group stressed that structural fiscal balance indicators are very useful, albeit not perfect, indicators of the fiscal policy stance. They had contributed to strengthening the economic foundations of EU surveillance procedures, including the SGP, to a considerable extent. In practice, measures of the structural fiscal balance mostly depend on measures of the output gap and on the government aggregate tax or expenditure to GDP ratio. Given their reliance on

³ Because of data constraints, the EC had not applied its new approach to Denmark initially.

⁴ Looking further ahead, members of the group welcomed ongoing research work by the EC to capture the role of capital expenditures in enhancing technical progress (through a capital "vintage" production function) and to identify the NAIRU from pure structural models of the wage and price formation process. Preliminary results from these approaches were viewed as promising for long-term structural analysis, but not for fiscal surveillance.

⁵ Differences with national estimates were of more significance for a limited number of countries only.

the output gap, estimates of the structural fiscal balance are rather uncertain, while measures of its changes over time are generally considered to be more robust.

Members of the group felt that annual changes in the structural fiscal balance should be interpreted with caution, since they do not fully reflect discretionary fiscal policy measures nor the precise impact of fiscal policy on aggregate demand. Structural fiscal balance indicators usually reflect other factors, such as changes in inflation or in interest rates, special features of the tax and expenditure system, such as normal time lags in tax collection or specific accounting operations. While changes in the structural primary balance largely abstracts from the impact of changes in inflation and interest rates, they remain subject to the other factors. Short-term changes in the structural fiscal balance also depend on the composition of demand and income to a sizeable extent. Members of the group thus noted that, when assessing the stance of fiscal policy, annual changes in the structural or primary balance could be fruitfully complemented by estimates of new fiscal measures, particularly on the revenue side, as well as by explicitly taking into account the composition of demand and income in the analysis.

6. Conclusions and recommendations

Potential output and the output gap are important concepts for assessing the economic outlook and the stance of macroeconomic policies. These concepts have already helped to strengthen EU macroeconomic and fiscal surveillance procedures to a considerable extent.

The traditional approach used by the EC, based on the HP filter, has served reasonably well in the past. However, the group considers that a simple production function approach would provide a more comprehensive and adequate framework for assessing the economic outlook as well as macroeconomic policies of Member countries for EU surveillance procedures implemented by the EC.

Against this background, most members of the group consider that the new production function approach devised by the EC strikes an appropriate balance between the objective of strengthening the underlying economic analysis and the requirement of maintaining transparent and equal treatment of member countries. The results derived with this approach appear to be close to offering a reliable basis for EU surveillance, as some further methodological changes can help to refine the estimates for the medium term. Although the resulting potential output growth estimates display similar cyclical patterns as those obtained from the HP filter for past years, this approach can help to alleviate the risks of end-point biases and pro-cyclical estimates of potential growth and the structural fiscal balance originating at the present juncture or for the medium-term. The benefits brought by this approach could thus be sizable when the short or medium-term outlook of the economy is particularly changing, as it is the case with the current unexpected slowdown in Europe.

To ensure full transparency and equal treatment among member countries and in order to use this new approach in its formal surveillance procedures, the EC will make available the estimation technique and the underlying data to Member countries and will present on a regular basis to the EPC the estimates, produced by the above mentioned methodology, together with an assessment of the balance of risk surrounding those estimates, to be used as an input to the subsequent multilateral surveillance exercises; any methodological change and

refinement would only be introduced after discussion by a group of experts mandated by the EPC.

Following implementation of the refinements identified in this report, the group would recommend, by a large majority, that the EC adopt this new production function approach for surveillance procedures, while keeping estimates from the standard HP filter approach as an additional reference. This should be done in the course of next year and the EC could thus rely on this new production function approach for assessing the next set of stability programs in 2002. Indeed, most members of the group thought that implementation of these modest refinements would decisively strengthen the robustness and credibility of the results⁶. Several members were even of the view that the current set of estimates, albeit imperfect, could already be used for the immediately forthcoming set of programs and would offer a much better alternative than the HP methodology. Looking ahead, the experience of EC surveillance with this new approach should be assessed a posteriori by the EPC.

In concluding, the group would like to convey its high appreciation of the openness and the strong cooperation efforts provided by the staff of the EC, as witnessed by the extensive and high quality background work that was shared with members of the group.

⁶ A limited number of members felt that this recommendation should still be conditional on the examination and approval of further methodological progress achieved by the EC services.