Cyclically Adjusted Government Budget Balances

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INTRODUCTION

This article presents international organisations’ methods for calculating cyclically adjusted government budget balances, prompted by a recent change of the method used by the European Commission. No method is perfect, and often the underlying assumptions can justifiably be criticised. It is therefore important to consider several measures when assessing public finances.

The general government budget is influenced by the current business cycle. In periods of relatively high growth and declining unemployment, government revenues increase with the higher level of economic activity, and government expenditure on unemployment benefits falls. All other things being equal, a boom will therefore, via these automatic stabilisers, contribute to a higher government surplus (or a lower deficit), even if fiscal policy otherwise remains unchanged throughout the cycle.

The actual government budget balance is thus an insufficient measure of the economic policy stance. There is therefore an interest in measuring the budget balance adjusted for cyclical influences. Such a measure would be an indicator for the structural part of the fiscal policy and give a better impression of the soundness of public finances. As an extreme point, changes in the structural (cyclically adjusted) balance should solely reflect discretionary changes in the fiscal policy, e.g. tax reductions.

International institutions, including the European Commission, the OECD, the IMF and the ECB, have developed techniques for measuring the cyclically adjusted budget balance, CAB. The European Commission

1 The ECB’s estimates of the cyclically adjusted budget balances are not published, but the method is described in Bouthevillain et al., Cyclically adjusted budget balances: an alternative approach, ECB Working Paper No. 77, 2001.
and the ECB apply CAB in e.g. assessing whether EU member states' public finances meet the requirements of the Stability and Growth Pact to be "close to balance or in surplus in the medium term".¹

The method used to calculate CAB may have a great impact on the results. For instance, the European Commission has calculated CAB for Denmark in 2000 at 1.3 per cent of GDP, while the corresponding figures from the OECD and the IMF are 0.7 and 1.8 per cent of GDP, respectively, and the ECB’s method gives the result of 2.5 per cent of GDP.² This variation is attributable to purely technical aspects of the methods used.

After a brief outline of the two main approaches, the European Commission’s methods are described: the "old" method based on HP filtering, and the "new" method based on a NAIRU³ estimate and a production function. The European Commission’s new method is close to those of the OECD and the IMF. Subsequently the ECB’s method is reviewed. This method differs significantly from the European Commission’s in that it is not based on a measure for the output gap, i.e. actual GDP less potential GDP. Finally, the methods are compared, including a synthesis of the OECD’s and the ECB’s methods which might otherwise easily be seen as incompatible.

**CAB – OVERVIEW OF APPROACHES**

In principle CAB is fairly simple to calculate. The actual budget balance (B) less the cyclical component of the budget balance (CC) leaves the cyclically adjusted or structural balance, CAB:

\[
\text{CAB} = \text{B} - \text{CC}.
\]

Finding the cyclical component of the budget requires a measure of how far the economy is from its potential level. There are two main approaches to calculating CAB: an aggregated and a disaggregated method.

In the aggregated method, the cyclical component of the budget is assumed to be a constant fraction of the output gap. This constant expresses a total elasticity of the budget with respect to the output gap and is determined on the basis of estimated elasticities for some sub-items of the budget with respect to the output gap. For instance, the

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² Sources: The European Commission, the OECD, the IMF and own calculations. The actual government budget balance for Denmark in 2000 was 2.5 per cent of GDP.
³ Non-Accelerating Inflation Rate of Unemployment.
OECD calculates CAB for Denmark as the actual budget balance less $0.75 \times$ the output gap. This aggregated method is used by the OECD, the IMF and the European Commission.

The ECB has opted for a disaggregated method whereby a number of cyclically dependent budget items are treated separately. These items are each dependent on a budget determining base. For instance, one item is indirect taxes, and the corresponding base is private consumption. The cyclical component of this budget item is calculated as the private consumption gap multiplied by an elasticity, which reflects the sensitivity of indirect taxes to private consumption. In other words, a consumption gap must be calculated. The total cyclical budget component is the sum of the cyclical components of the items of the budget. This method thus takes into account that growth driven by e.g. exports and investments has a less significant impact on the government budget than growth driven by e.g. private consumption. In other words, the method emphasises that the composition of growth over the cycle is vital in determining CAB. The two approaches are illustrated in Chart 1.

The ECB does not calculate an output gap, and the other institutions avoid direct calculation of the base gaps. These are implicitly assumed to be fixed in relation to the output gap.

**AGGREGATED METHOD**

With the aggregated method of the OECD, the IMF and the European Commission, the problem lies in estimating the output gap. The latter is
actual GDP less potential GDP, and as the potential GDP cannot be observed, it must be estimated. So far the European Commission has done this by using the Hodrick-Prescott (HP) filter, which is a fairly simple statistical exercise that does not apply any other information than the GDP time series itself.

The HP filter
The HP filter decomposes a time series into a cyclical component and a trend. Applied to GDP, this HP trend is interpreted as the potential GDP. The smoothness of the trend is controlled by a parameter, \( \lambda \). This parameter is decisive to the properties of the trend (and thus the gap) since the gap's average size increases with \( \lambda \), cf. Box 1. Therefore the choice of \( \lambda \) is often subject to intense discussions.

The advantage of HP filtering is that it involves simple and transparent calculations which are easy to reproduce. This is an advantage when comparing several countries' CABs.

HP filtering also involves a number of problems:

- It is a purely statistical exercise which applies no other information than GDP growth itself. This makes the interpretation of the trend "as potential or structural growth, which is consistent with constant inflation" arbitrary, and it is not possible to see the source of a given development in the gap.

- The HP filter is a specific, symmetric moving average. This means that at the ends of the time series the trend will be determined relatively imprecisely since it will here depend on relatively few observations. This is unfortunate since the last observations are often the most interesting for policy purposes. This end-point problem may be solved by extending the series, initially with official forecasts, and thereafter ad hoc. Today's trend will depend on this extension, and that is a problem if the economy evolves differently than predicted. The underlying assumptions and the projection method may be complex, thus hampering the transparency of the calculations.

- The sum of deviations from the trend is always zero. The trend thus depends on the starting time for the sample, and moreover this is contrary to the view that it is easier for GDP to be below its potential for a longer period than to be above it. On the other hand, it can be argued that when applying the output gap to find the cyclical budget component the zero sum is a desirable property.

- The HP-filtered trend cannot capture structural breaks.

For these reasons the European Commission has switched to another method of finding the potential output, and will in the future rely on an
estimate for NAIRU and a production function. The production-function method is already in use by the OECD and the IMF.

**The production-function method**

The production-function method is an attempt to give the potential output a more explicit economic content. The central assumption is that the potential output is determined by an aggregated production function of the Cobb-Douglas type, i.e. the input factors are assumed to be constant and equal to the factors’ output elasticity. This is a tight, but simple structure. Two input factors are assumed, physical capital and potential employment. In addition, potential output depends on the...
potential level of total factor productivity. The method is illustrated in Chart 2 and elaborated on below.

The production function method makes up for the disadvantages of the pure HP filter method in that
- the potential output is now rooted in a (simple) model for the underlying technology,
- the end-point problem is in principle eliminated, although the HP filter is still used for calculating the input factors, cf. below,
- deviations from the potential need not necessarily add up to zero,
- structural breaks are captured to the extent that they are captured in the measures of the input factors.

The drawback is that the problem becomes far more complex, since more time series must be adjusted for cyclical influences. This calls for more subjective choices, and thereby also more grounds for disagreement. In addition, the relevant time series may not be computed consistently or exist in all countries.

Structural employment is the most tricky element, cf. the Chart. Structural employment is calculated as the structural workforce adjusted...
for the natural unemployment, NAIRU. The structural workforce is determined as the working age population multiplied by the structural participation rate. The latter is determined as the HP-filtered historical participation rate, since it is difficult to find more direct indicators. There is seldom much focus on estimating these elements when calculating CAB.

Estimating the NAIRU is, however, a more complicated matter. The starting point is a theoretical Phillips-curve model for the labour market. The IMF and the European Commission estimate the model, and thus NAIRU, by means of the Kalman filter. The Kalman filter is an econometric technique which explicitly takes into account that NAIRU is non-observed.

In an OECD context NAIRU\(^1\) is estimated using a slightly more simple, but related technique, and the HP-filtered trend of the estimated NAIRU time series as the input to the calculation of structural employment.

Although the HP filter is terminated in the European Commission’s and the IMF’s calculation of NAIRU, use of the alternative technique requires other ad-hoc assumptions to be made. The Kalman filter thus requires specification of how the NAIRU develops over time (typically a random walk or another autoregressive process is assumed), as well as a limitation of its variation. In addition, the European Commission sets the conditions that the development in total factor productivity may not be declining and that the output gaps must add up to zero. Like the HP filter’s \(\lambda\), the combination of these specifications and conditions determines NAIRU’s properties, and thereby the output gap. The HP filter’s end-point problem is thereby supplanted by the problem of specifying NAIRU in a satisfactory way. It could be argued that this is easier to pinpoint, since the problem is rooted in an economic structure, although assumptions are still inevitable.

**Total factor productivity and the contribution of physical capital**

In addition to a NAIRU estimate, the level of capital (C) and the potential total factor productivity (TFP) must be determined in order to calculate the potential output and the output gap.

The capital level (K) is taken from the statistical agencies’ statements, and is not cyclically adjusted. On the basis of this figure, as well as actual employment (L) and actual output (Y), a Solow residual, SR, is calculated:

\[
SR = \frac{Y}{L} K^{1-\alpha} = TFP.
\]

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\(^1\) Only wage inflation is included in the OECD’s model, so that the OECD refers to structural unemployment as NAWRU, Non-Accelerating Wage Rate of Unemployment.
The Solow residual, or actual TFP, is an expression of the part of GDP which cannot be explained directly by the actual labour and capital.¹

TFP is assumed to consist of a cyclical and a structural component. The European Commission calculates the structural component of TFP as the Solow residual’s HP-filtered trend. There we have the HP filter again.

Once structural TFP (TFP\textsuperscript{POT}) and structural employment (L\textsuperscript{POT}) have been determined, potential output (Y\textsuperscript{POT}) is calculated as

\[ Y\textsuperscript{POT} = TFP\textsuperscript{POT} \cdot (L\textsuperscript{POT})^\alpha K^{1-\alpha}. \]

The output gap (G) is now calculated as \((Y/Y\textsuperscript{POT}) - 1\). The structural budget balance is thus

\[ \text{CAB} = B - a \times G, \]

where \(a\) is the estimated budget elasticity with respect to the output gap.

**THE ECB’S DISAGGREGATED METHOD**

The ECB’s disaggregated method does not operate with the output gap. Instead, five budget items are identified: four revenue items and one expenditure item, all of which are assumed to be cyclically sensitive. The items and their determinant bases are shown in Table 1.

The principle is that the composition of the cycle is of great importance to the cyclical budget component. For instance, an upturn driven by exports and investments will have a less favourable effect on the government budget than an upturn driven by private consumption. The methods of the European Commission and the OECD do not take account of the composition effect.

The cyclical budget component is calculated by HP-filtering the bases to find the "base gaps", defined as the bases’ deviation from their HP trend. Via estimated elasticities of the budget items with respect to the bases the cyclical budget component, and thereby CAB, can be calculated. The use of the HP filter exposes the method to its weaknesses, cf. the above. In addition, the base variables are dependent on structural relations, so that their potential levels should ideally be derived from theoretical models, such as the production-function method and NAIRU

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¹ The literature includes extreme views on the Solow residual. Real Business Cycle theorists will regard TFP as purely exogenous shocks to the technology. Keynesian economists include the capital utilisation ratio in the Solow residual and give TFP less weight as a source of cyclical fluctuations.
for potential GDP. However, that would require a much larger apparatus.

COMPARISON OF THE METHODS

The production function method results in an interesting expression of potential output and thereby the structural balance. However, the HP filter is still used on implementing the production-function method, since it is applied to the participation rate and the Solow residual. This means that the end-point problem still exists, although it influences the final result less than is the case with an output gap based solely on the HP filter.

A drawback in connection with the production-function method is that it requires several subjective assessments. It is up to the econometrician to estimate a NAIRU using a relatively complex method which may not be equally transparent to everyone. If one does not like the estimate for the structural balance, the assumptions may always be attacked – often justifiably.

This should be contrasted to the advantages of offering politicians and others a more detailed picture of the economy. Changes in the output gap can be interpreted directly in relation to politically important issues such as the labour market, wage formation and inflation. This is less obvious with the pure HP-filter method.

The ECB has opted for a $\lambda$ of 30, which was determined by a wish to capture an average cycle length of approximately 8 years. This cycle length is at the lower edge of the Danish experiences, cf. Box 1. With $\lambda$ at 30, the importance of the cycle to the current budget deficits in most

<table>
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<td></td>
<td>Compensation per employee in the private sector</td>
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<tr>
<td>Unemployment-related expenditure</td>
<td>Number of unemployed</td>
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Euro member states is reduced in comparison to a calculation using a higher $\lambda$ value.

**A synthesis of the aggregated and disaggregated methods**

The aggregated method based on the output gap and the disaggregated method based on the base gap and composition effects are easily seen as incompatible. However, it is possible to make a synthesis of the two approaches.\(^1\) The synthesis is illustrated here on the basis of the OECD’s method, but the related methods of the European Commission or the IMF could also have been used.

The cyclical components in the budget for Denmark, using the ECB and the OECD methods, respectively, are shown in Chart 3. The OECD’s aggregated budget sensitivity is based on implicit assumptions as to how the individual base gaps follow the output gap. More specifically, the difference between the cyclical components of the ECB and the OECD ($CC^{ECB}$ and $CC^{OECD}$, respectively) can be divided into a composition effect and an output-gap effect,

$$CC^{ECB} - CC^{OECD} = \text{composition effect} + \text{output-gap effect}.$$ 

The composition effect ($CC^{ECB} - 0.75 \times \text{output gap with HP filter}$) indicates the importance of the ECB’s base gap deviating from the base gap

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\(^1\) For a more detailed review of the synthesis, see the annex to ECB Working Paper No. 77.
which, according to the OECD’s assumptions, results from a HP-calculated output gap. The gap effect, \(0.75 \times (\text{output gap with HP filter} - \text{OECD’s output gap})\), reflects the difference between the two types of output gaps.

With this starting point it is possible to make combinations, e.g. using the OECD’s output gap while also taking composition effects into account. This corresponds to first adjusting the budget balance for e.g. an unusually high level of private consumption as a ratio of GDP, and then adjusting for the OECD’s output gap not being zero.

The gap effect is positive in the early 1990s and takes a negative course up to 2001, when it eventually becomes negative, cf. Chart 4. This reflects that the OECD’s output gap is more negative at the beginning and more positive at the end of the period compared to the corresponding HP-calculated gap, so that the OECD’s method allows greater fluctuation in the output gap than the pure HP-filter method.

The composition effect shifts abruptly from being positive in 1993 to negative in 1994. In 1993, the gaps for the budget-determining bases were less negative than the output gap. In 1994, GDP grew in excess of the trend growth, but unemployment did not fall. This is reflected in a negative composition effect. Declining unemployment in 1998 contributes to a positive composition effect. In 2000, the effect is negative, since growth is driven by investments and exports, while the unemployment and private-consumption gaps are almost closed.
DISCUSSION AND CONCLUSION

The CAB methodologies presented here give a better picture of the state of public finances and changes in the economic policy than the actual government budget balance. However, they should not stand alone, as CAB is a fairly rough measure. In Denmark the Ministry of Finance calculates the effect of the overall fiscal policy on economic activity, the fiscal effect, on the basis of a detailed analysis of fiscal policy measures. Often such direct calculations are easier to interpret than indirect CAB calculations where the discretionary effect is anything which is not cyclical.

An example is the collapse of the taxation of pension yields in 2001 and 2002, which does not reflect a discretionary fiscal policy relaxation. The ECB’s method applies only the five cyclically dependent tax bases in Table 1, in which share prices are not included. The decline in the taxation of pension yields is therefore not included in the cyclical effect, but will diminish CAB and appears as a discretionary relaxation. Another example is the restructuring of the Special Pension Savings Scheme, which as from this year is no longer classified as a tax, but as private savings. The lower government revenue is reflected in CAB and appears as a relaxation, even though the burden on government finances remains unchanged.

As trends cannot be observed, assumptions are unavoidable when identifying CAB. The choice of method depends, inter alia, on how large an apparatus an institution is willing to maintain. For comparison purposes the individual institutions must apply the same framework to the calculations, and a higher level of detail via e.g. extensive use of underlying structural models to determine the potential levels will, all other things being equal, make it more difficult to reach a compromise.

In addition, it is hardly possible to find one method which gives easily interpretable and intuitive results for all countries at any time and in any situation, so that supplementary estimates of the cyclical influence on the budget remains necessary. In principle, it would be desirable for the objective of fiscal policy to concern the structural balance, but this would be difficult to implement in practical international collaboration.