Cyclical outputs and structural budget balances

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Abstract
Structural budget balances are intertwined with cyclical outputs and lie at the heart of most fiscal surveillance assessments. Failure to comply with adequate goals is largely feared as a step forward towards a foretold unstable environment. We show that alternative cyclical indicators, including those suggested by pivotal international institutions, provide an evaluation of the Portuguese case that has both converging features and important discrepancies. Discrepancies are particularly striking when the evalutation is focused on structural balance levels—with an average amplitude across estimates of 1.5 percentage points over 1999-2018—, whereas similarities are clearer when based on the changes in structural balances—with an average amplitude dropping to 0.3 percentage points. We also highlight significant revisions in the European Commission estimates and find that comparisons with selected benchmarks lead to model-dependent assessments. (JEL: E32, E62, H62)

1. Introduction

Macroeconomic time series are often seen as the result of a long-run trend temporarily disturbed by short-run cycles. Government budget balances are no exception. If assisted by an informed distinction between permanent and temporary influences, policymakers can more easily set adequate spending levels and tax rates to cope, for instance, with medium-term sustainability concerns. Structural balances emerge herein as a natural policy variable, by aiming to gauge the underlying fiscal position.

Structural budget balances are unsurprisingly at the heart of most fiscal surveillance assessments. Failure to comply with the desirable goals is feared as a step towards tighter scrutiny, carrying along losses in discretionary power and higher market pressures. Structural balances are, however, also at the heart of an intense debate. Their estimates result from removing the cyclical component from headline balances, and therefore should remain unchanged if automatic stabilizers explain all movements in the latter. Soaring headline deficits in crisis times, as tax revenues recede and government

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transfers increase (*e.g.* unemployment benefits), can be safely ignored if the structural balance remains at adequate levels. Likewise, cyclical surpluses in expansion periods are not necessarily interpreted as fiscal tightening and consolidation. In short, cyclical outputs and structural balances depend on the filtering processes that identify trends and cycles in observed variables. How much do structural balances change if one uses alternative cyclical indicators? To what extent is the comparison with selected benchmarks affected? These are key questions that we wish to discuss in this article.

Both the levels and changes in structural balances provide information content, among other monitoring data, that policymakers use to infer whether a particular country offers a sound fiscal position. The debate over such practice has both political and academic dimensions: a wrong assessment of the true fiscal position of a particular country can give rise to misplaced policy options; an unreliable cyclical estimate—emphasized, for instance, by Orphanides and van Norden (2002)—poses a challenge that the empirical literature wishes to overcome.

The cyclical component can be subject to several estimation procedures, including univariate and multivariate filters, possibly linked to Phillips curves with wage or price developments. Our goal herein is to focus solely on the marginal impact of cyclical indicators on the budget balance. To achieve this objective we assess the outcome of five different indicators, namely those proposed by the European Commission (EC), International Monetary Fund (IMF), and Organisation for Economic Co-operation and Development (OECD), and also those suggested by Braz, Campos, and Sazedj (2019), used in the context of the European System of Central Banks (ESCB) projection exercises—henceforth the "BCS model"—, and Duarte, Maria, and Sazedj (2020)—henceforth the "*U* model". By using a unique GDP time series over 1999-2019, we can easily recover all implicit potential output estimates.[1] We focus exclusively on the Portuguese case.

We ensure that the only variable driving our results is the output gap—the cyclical indicator. Given that the structural balance corresponds to the published headline budget figures excluding temporary measures and the cyclical component, we rely on a unique time series classified *a priori* as capturing all temporary revenues and expenditures, in line with the ESCB definition. The formula used to estimate structural balances is kept unchanged throughout all experiments.

Finally, we retrieve historical vintages of EC databases to address concerns over the uncertainty of potential output estimates when the information set expands. Herein we are focused on extracting the real-time business cycle contribution to both the level and changes of headline balances, as end-of-period biases can be particularly problematic. For example, unexpected crises can bring about downward revisions of historical levels in the pre-crisis period, when the economy was growing, as a result of the filtering process that decomposes observed data into trends and cycles.[2]

[1] We make no distinction between potential, trend or low-frequency component of output.

[2] A comparison between the cases of Portugal, Germany, France, Italy, Spain, and Greece can be found in Christofzik *et al.* (2018). See Tooze (2019) or Darvas (2019) for a recent critique of the filtering process.

Our results show that structural balance levels do seem to extract long-run trends of headline budget balances, with all models featuring common qualitative outcomes. For instance, business cycle contributions are always positive in the beginning of the sample and negative during the financial or sovereign debt crisis of the 2000s. A closer inspection reveals, however, important time-varying differences across models, namely in terms of sign and amplitude. For instance, the U model brings along a larger structural balance over 2007-08 resulting from a close to zero, but negative, business cycle contribution to the headline budget balance, in contrast to the remaining models.[3] The amplitude across databases, measured by the difference between maximum and minimum structural balances, in percentage of potential output estimates, reaches 1.5 percentage points (p.p.) over 1999-2018. The recent past is an example of how such differences translate into opposite assessments regarding deviations from selected benchmarks.

In contrast with the previous assessment, results based on the changes in the structural balance are relatively similar across models. The impact of cyclical output has largely the same sign, or is close to nil, and amplitudes bring along no systematic conflict—an outcome suggesting that policymakers would have similar information sets no matter their preferred output gap series. The amplitude across databases stands at 0.3 p.p. over 1999-2018. The benefits of changing the focus to changes, from levels, has already been highlighted in the literature (Task Force of the Monetary Policy Committee of the European System of Central Banks 2012; Buti *et al.* 2019; Duarte *et al.* 2020). This proximity should not be taken, erroneously, by identical matches, as the small differences can be enough to cast doubts on the validity of fiscal assessments based on point-specific benchmarks.

Finally, an inspection of the historical vintages of the EC database confirms the difficulties of assessing the business cycle contribution in real time. Previous conclusions still hold: results are irregular when evaluated on the levels, and less so on the changes. As the information set expands, our results show smaller revisions in potential growth than output gaps, as the latter are associated with current and past level shifts in potential output. Nevertheless, we report important revisions in growth rates at the end of the sample, particularly for 2018, possibly linked to backward effects of the pandemic crisis, *i.e.* by considering a sample that already includes data from 2020. This has consequences on our ex-post assessment when we compare the results with benchmark objectives.

The article is organized as follows. We start by clarifying the computational method and the role of both structural balance levels and changes in the European fiscal surveillance framework, before proceeding to estimate alternative contributions of cyclical outputs to the headline budget balance, obtained by considering different trend-cycle decompositions. The subsequent section reports our inspection of the historical vintages of the EC estimates, and the last section presents some concluding remarks.

[3] Blanchard and Portugal (2017) also suggest a negative output gap over 2007-08.

2. Institutional and operational environments

The main objective of fiscal surveillance is to ensure sound public finances. Assessing the fiscal policy stance underlying a sequence of government budgets requires a separation between the outcome of discretionary or permanent policy actions, which take the form of fiscal consolidation or expansion processes, and the outcome of other factors, such as special one-off impacts or cyclical developments. For this purpose, fiscal experts and international institutions, namely the IMF, OECD or the EC, rely extensively on structural balances.[4]

2.1. Fiscal surveillance framework

The EU fiscal surveillance framework, which is the one institutionally relevant for Portugal, is classified as a rules-based process (European Commission 2014, 2020), featuring nevertheless a constrained discretion approach that some authors consider adequate, in general, to deal with the unavoidable uncertainty surrounding cyclical output and structural balances (Buti *et al.* 2019; Roeger *et al.* 2019; Hristov *et al.* 2017). Other authors and institutions suggest that the current system is too complex, with many exceptions, that it suffers from credibility losses and transparency issues (Bundesbank 2017; European Fiscal Board 2019; Kamps and Leiner-Killinger 2019), or is in need of new rules, some of them still relying on potential output indicators (Carnot 2014; Andrle *et al.* 2015; Feld *et al.* 2018; Christofzik *et al.* 2018; Gaspar 2020).

We will not address this debate and do not intend to go into a deep assessment over the current state of affairs, nor dwell into the functioning of the Stability and Growth Pact (SGP). Instead, we wish to focus solely on the role of structural balances – levels and changes – in the current framework.

The current set of European rules has been evolving since its inception. The simple benchmark of 3% of Gross Domestic Product (GDP) for the headline deficit proved insufficient to create adequate incentives, in particular for improving the soundness of public finances during favourable economic conditions, and to avoid the implementation of temporary measures just to comply with the benchmark. In this context, the SGP was amended for the first time in 2005, introducing the concept of "structural balances" explicitly.

After the inclusion of the set of laws known as the Six-pack, the Fiscal Compact and the Two-pack, other changes were introduced to the framework, including the expenditure benchmark, to reduce the role played by the output gap.[5] Nonetheless, in its current version, the SGP still relies heavily on structural balances, both under its "preventive arm" and the "corrective arm".

[4]The IMF assesses structural balances regularly in the *World Economic Outlook* releases. The OECD publishes their estimates in the *Economic Outlook Issues* and reports in-depth policy analysis in the biennial *Government at a Glance* publication (see, for example, OECD (2019)).

[5]See European Fiscal Board (2019).

Under the preventive arm countries have to meet a Medium Term Objective (MTO), which is set in terms of a structural balance level.[6] If a Member State fails to achieve this goal, the required corrective policy measures are conditional on country-specific factors. As part of the overall assessment, a minimum fiscal adjustment is set in terms of annual change in the structural balance, and is therefore dependent on the change in the output gap.

Under the corrective arm of the SGP, *i.e.* when Member States present excessive deficits, changes in the structural balance also play a key role in setting the pace for fiscal consolidation (European Commission 2019).[7] When Excessive Deficit Procedures (EDP) are triggered, recommendations are addressed to Member States to bring the headline deficit below 3% according to a specific time frame and targets, both in terms of headline deficits and fiscal effort, *i.e.* the change in the structural balance.

2.2. *Operational environment*

The structural balance is an unobserved variable that needs to be estimated. As in the case of many latent variables, for instance potential output, the empirical literature offers no unique or uncontroversial estimation procedure, although most international institutions converged to relatively similar approaches, namely to use expert judgement to identify special one-off impacts on government budget balances, and to use low-frequency estimates of output to extract the business cycle impact.

Herein we will follow the ESCB methodology, where the structural balance at year t, presumably free from revenue and expenditure business cycle dependencies, is given by the formula

$$\frac{\bar{B}_t}{\bar{Y}_t} = \frac{B_t - TM_t}{Y_t} - \varepsilon\,\hat{Y}_t \tag{1}$$

where $\bar{B}_t/\bar{Y}_t$ is the unobserved structural balance, B_t is the headline budget balance, TM_t is the net effect resulting from temporary measures, Y_t is output, $\hat{Y}_t$ is the cyclical indicator, and $\varepsilon > 0$ is a constant semi-elasticity. All variables are expressed in nominal terms, and bars identify low-frequency estimates, which we also indistinguishably take as "potential" levels, *e.g.* $\bar{Y}_t$ is the nominal potential output (computed with the real estimate and the actual GDP deflator). All time series in equation (1) are officially published by national statistical institutes, except real potential output.[8]

[6]An MTO is a country-specific target that takes into account the need to achieve sustainable debt levels, while allowing for the role of automatic stabilizers without breaching the 3% reference value for the headline deficit.

[7]Member-states risk facing the rules of the corrective arm when the headline deficit breaches the 3% reference value or the debt level is above 60% and is not approaching the reference value at a satisfactory pace, where the annual debt reduction target corresponds to one twentieth of the debt in excess of the threshold. The debt criterion is breached when the reduction falls short of this target over three years. The current regulation also contains discretionary leeway to consider the breach exceptional.

[8]See Braz *et al.* (2019) and Mourre *et al.* (2014) for a more detailed description of the ESCB and EC methodologies, respectively. As Mourre *et al.* (2013) recalls, equation (1) is a linear first order approximation

The aggregate approach behind equation (1) establishes that structural balance ratios are defined as a residual: it is the level that remains after the influences of actual temporary measures and the output gap are removed from the headline budget balance ratio B_t/Y_t. Note that TM_t/Y_t is an observed variable expressed in percentage of nominal GDP. Temporary revenues and expenditure congregated in TM_t have one-off impacts at year t and no permanent effects and therefore, by design, no influence on low-frequency budget balance developments. The criteria to define these impacts vary across institutions and herein we use temporary estimates as defined by the ESCB.

The sole unobserved time series in equation (1) is the economy-wide cyclical indicator $\hat{Y}_t$, which we use extensively by considering $\hat{Y}_t \equiv (Y_t - \bar{Y}_t)/\bar{Y}_t$, *i.e.* a variable measuring the deviation of total output from its trend estimate. The presence of this cyclical component is meant to capture the impact of automatic stabilizers—the effect of the business cycle on the headline budget balance.

In the analysis that follows we rely on cyclical indicators produced by the EC, IMF and OECD models, as well as those suggested by Braz, Campos, and Sazedj (2019), used in the context of the ESCB projection exercises (the BCS model), and Duarte, Maria, and Sazedj (2020)—parametrized with posterior median estimates (the U model). All estimates intend to capture the maximum level of output that the economy can produce without jeopardizing price stability, *i.e.* an overall supply measure from which actual output can deviate. Potential output computed by the EC, OECD, BCS and U models are based on Cobb-Douglas production functions with constant returns to scale, featuring two factor inputs—labour and capital—, and a measure of total factor productivity. IMF estimates are computed by country desk experts following no uniform method. For industrialized countries, the estimation usually also relies on a production function, however, public details regarding the method applied to Portugal are not available.[9]

The semi-elasticity of the budget balance to the output gap ε is derived from the difference between revenue and expenditure semi-elasticities, which are weighted averages of the semi-elasticity of each revenue and expenditure component. Each of these former elasticities is obtained by multiplying an elasticity—meant to capture the sensibility of these items to changes in their macroeconomic bases—and the elasticity of the latter relative to the output gap. Herein we take the ESCB estimate and set $\varepsilon = 0.5$.[10]

Solving equation (1) for B_t/Y_t, namely

$$\frac{B_t}{Y_t} = \frac{\bar{B}_t}{\bar{Y}_t} + \frac{TM_t}{Y_t} + \varepsilon \frac{Y_t - \bar{Y}_t}{\bar{Y}_t} \tag{2}$$

allows us to clarify that the contribution of the business cycle for the headline balance in levels is given by $\varepsilon \frac{Y_t - \bar{Y}_t}{\bar{Y}_t}$, and in changes by $\varepsilon \Delta \frac{Y_t - \bar{Y}_t}{\bar{Y}_t}$, where the operator Δ identifies

of a more precise but cumbersome expression measuring the difference between cyclically-adjusted revenues and expenditures.

9. The EC, BCS and U models are briefly presented in Appendix A

10. It should be noted that some approaches, including the ESCB, rely on a second semi-elasticity intended to capture lagged effects on current estimates. We abstract from this complexity as our qualitative results remain unchanged.

a variation between two consecutive time periods. Positive/nil/negative output gaps generate positive/nil/negative contributions to the headline ratio.

3. Cyclical outputs and structural budget balances

After highlighting the importance of structural balances in the European fiscal surveillance framework, we now focus on the Portuguese case. Temporary measures, GDP and the semi-elasticity are identical across all estimates, and thus differences between alternative levels stem solely from business cycle indicators.

Our sample spans the period 1999-2019 whenever the database vintage was produced in 2020. In the case of the OECD, we use a vintage produced during 2019 and therefore the associated sample ends in 2018. Average values using all databases span 1999-2018.[11]

3.1. Impact on the level

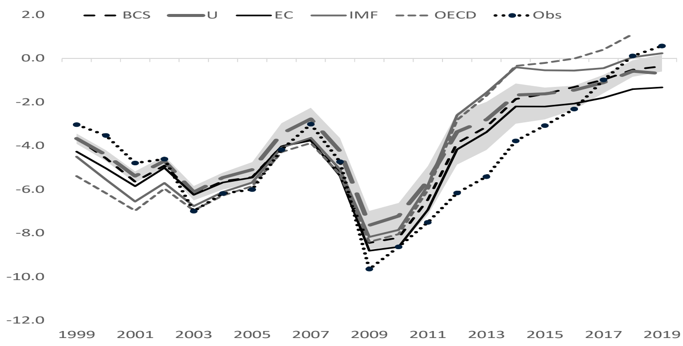
Figure 1a reports structural balances, according to equation (1), superimposed against published headline data excluding temporary measures. Figure 1b isolates the business cycle contribution, as clarified in equation (2). All unobserved times series fulfil to some extent the expected role of long-run trend estimates, around which observed data oscillates. In addition, all models share some identical features, for instance positive contributions in the beginning of the sample, or large negative impacts in the first part of the 2010s. Results also show, nevertheless, striking time-varying differences, not only in terms of sign but also in term of amplitude. For instance, the U model suggests close but below zero output gaps during 2007-08, implying a negative contribution of the business cycle to the headline balance, not echoed by the remaining models. In 2017-18, IMF and OECD indicators suggest a negative or nil impact of the business cycle on the headline budget balance, in contrast with the remaining estimates.

In terms of amplitude, the difference between the maximum and minimum point estimates across databases, in percentage of potential output estimates, reaches 1.5 p.p. between 1999-2018. The amplitude stood close to 1.2 p.p. until 2007-08, and increased to almost 2.0 p.p. in 2013-14, before receding to 1.5 p.p. during the last part of the sample. Excluding the IMF and the OECD, the maximum amplitude was reached in 2010 (1.4 p.p.), and stood around 1.0 p.p. in 2019.

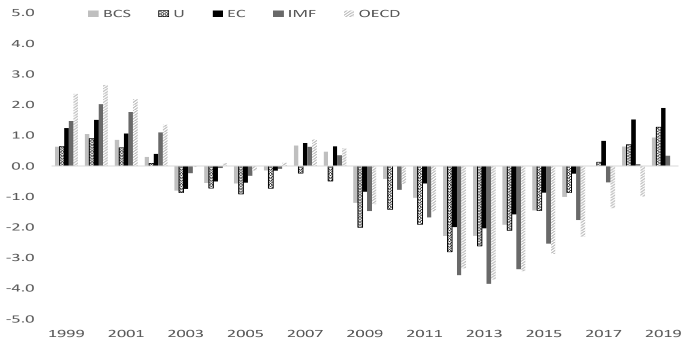
Discrepancies against EC estimates reach their highest level during the international financial crisis in the case of the U model and thereafter in the case of the IMF and OECD data. The BCS model depicts the smallest deviations, yet with an increasing trend in the recent past.

The dispersion of structural balance point estimates reported in Figure 1a and 1b suggests primarily that model uncertainty should not be ignored. However, unobserved

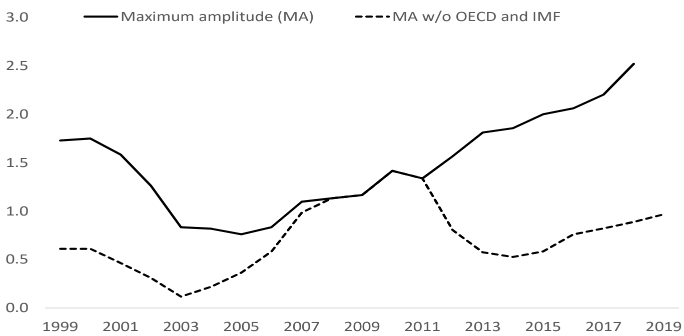
[11]The EC, IMF and OECD data was retrieved from the Annual macro-economic database (AMECO), World Economic Outlook, and Economic Outlook, respectively. All databases are available from the authors upon request.



(A) Headline and structural balances | Levels



(B) Business cycle contribution | Levels



(C) Amplitude | Levels

FIGURE 1: The impact of cyclical output on structural balances

Sources: Banco de Portugal, EC, IMF, OECD and authors' calculations.

Notes: Structural balances are in percentage of potential output and observed data, which correspond to headline values free of temporary measures, in percentage of GDP (identified by "Obs"). The EC, BCS and U models are briefly presented in Appendix A. The grey area corresponds to alternative outcomes of the U model along a 5th-95th percentile range of possible outcomes drawn from the posterior distribution. The maximum amplitude (MA) corresponds to the difference between maximum and minimum datapoints. The reference "w/o OECD and IMF" indicates the results obtained when excluding OECD and IMF databases.

variables are also associated with other sources of uncertainty, among them parameter and data uncertainty, including not only the variables underlying equation (1) and those used in each model, but also the sample period that is subject to the filtering process that decomposes observed data into trends and cycles.[12] Although this feature is well known in the literature, most models are only used to produce one set of point estimates. Herein we use the U model to follow another route and consider alternative values along a 5th-95th percentile range of possible outcomes drawn from the posterior distribution. This range is depicted as the grey area in Figure 1a. The area encompasses most of the remaining point estimates, as most lie within or very close to this region since 1999. However, this is not always the case, which indicates the presence of clear differences in terms of data generation processes. For instance, IMF and OECD figures lie outside this area on several occasions, as well as the EC in recent years.

3.2. *Impact on the change*

Figures 2a and 2b depict the same set of information as Figures 1a and 1b, but now in terms of changes between two consecutive years. In sharp contrast with the previous assessment, results are now relatively similar across databases, *i.e.* the impact of cyclical output on changes in the structural balances have the same sign, or are close to nil, and amplitudes have no systematic decouplings. All business cycle contributions are also highly correlated with the real growth rate of GDP, also reported in Figure 2b.[13]

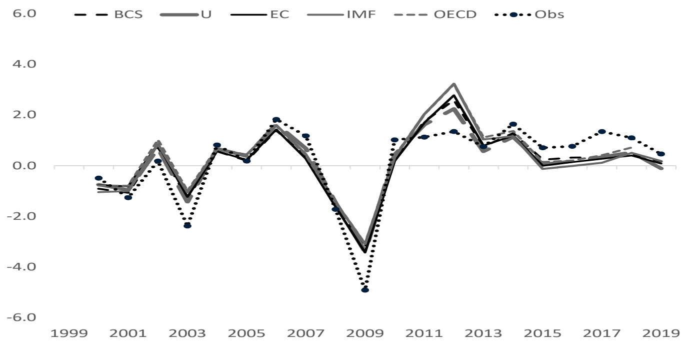
In terms of amplitude, the difference between the maximum and minimum point estimates across databases stood close to 0.3 p.p. over 1999–2018, increased temporarily to 1 p.p. in 2012, and stood at 0.3 p.p. in 2018. Excluding the IMF or the OCDE results in marginal differences.

Similarities in term of changes in structural balances are grounded on similar potential output growth estimates, suggesting on this dimension a noticeable reduction in model uncertainty. This decrease extends to other sources of uncertainty, as shown in the case of the U model by Duarte *et al.* (2020), who robustly confirm that potential output growth is much less uncertain than potential output levels. Furthermore, note that uncertainty around level estimates is irrelevant if the possible range of output gaps is symmetric around a focal point. Although this is not the case of the U model, the qualitative value added of including these figures is negligible and therefore omitted.

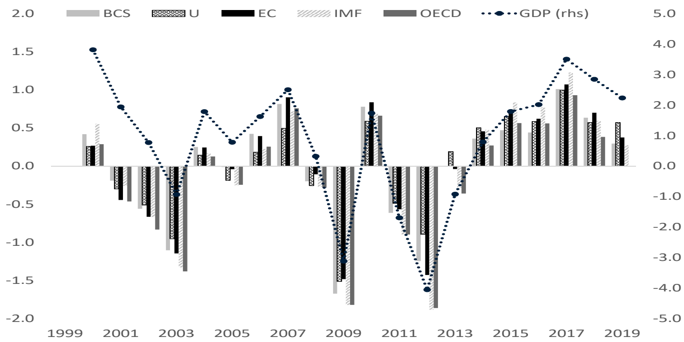
The proximity across models should not be taken, erroneously, by identical matches. The years 2012 and 2013 are, for instance, clear exceptions. In 2012, the IMF and OECD models feature the highest cyclical output impact, and in 2013 we detect the largest difference across models: the U model signals a positive business cycle contribution, the IMF a negative contribution, and the BCS and EC a close to nil impact.

[12] See Duarte *et al.* (2020) for an evaluation of the uncertainty surrounding the U model. It should also be noted that the EC established a "constrained judgement" approach, which includes expert judgement, to cope with large degrees of uncertainty surrounding output gap estimates. On this issue, see Hristov *et al.* (2017) and Roeger *et al.* (2019).

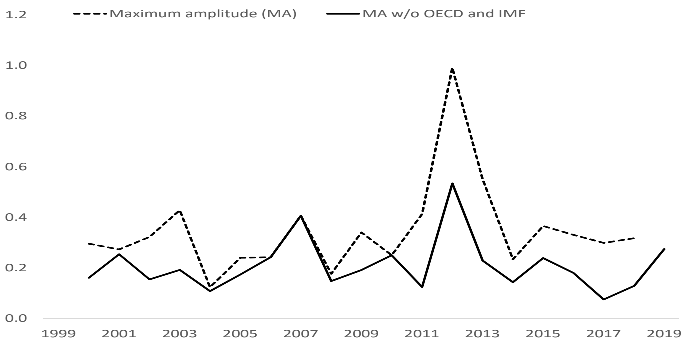
[13] The correlation coefficient is above 0.8 over 1999-2018 in all cases.



(A) Headline and structural balances | Changes



(B) Business cycle contribution | Changes



(C) Amplitude | Changes

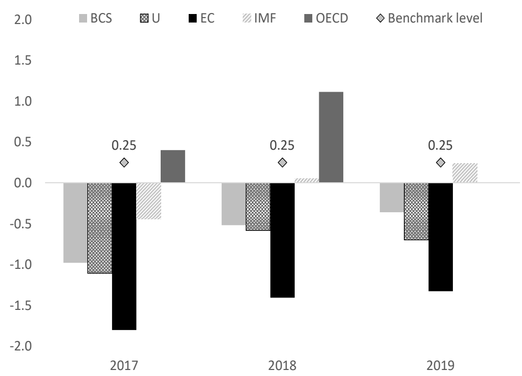
FIGURE 2: The impact of cyclical output on the change in structural balances

Sources: Banco de Portugal, EC, IMF, OECD and authors' calculations.

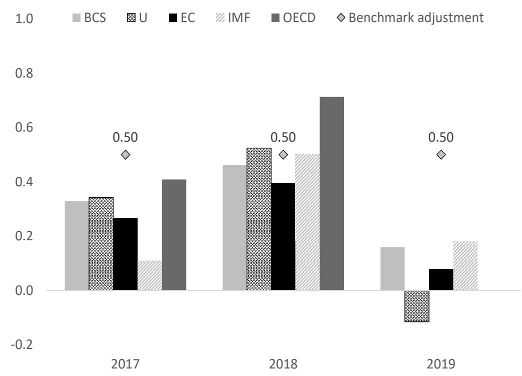
Notes: All data is in p.p., except "GDP (rhs)", which is in percentage. This series corresponds to real growth rate and is measured on the right-hand scale (rhs). The maximum amplitude (MA) corresponds to the difference between maximum and minimum datapoints. For further information, see notes of Figure 1.

3.3. *Comparison with selected benchmarks*

This subsection assesses to what extent the previously identified discrepancies and similarities affect the comparison with selected benchmarks. This implies moving away from the EU criteria, given that compliance with the relevant institutional rules is solely assessed against figures produced by the commonly agreed methodology of the European Commission. Figure 3 reports our results.



(A) Structural balance



(B) Changes in the structural balance

FIGURE 3: Comparison with selected benchmarks

Sources: Banco de Portugal, EC, IMF, OECD and authors' calculations.

Notes: Structural balance levels are in percentage and their changes in p.p. We selected a "Benchmark level" of 0.25% and a benchmark change of 0.5 p.p. (identified by "Benchmark adjustment"), which intends to capture, respectively, plausible levels and minimum required changes during normal times.

We focus on the 2017-19 period, after the EDP was abrogated and Portugal entered the preventive arm of the pact. For illustrative purposes, we selected a structural balance benchmark of 0.25% and an annual adjustment benchmark of 0.5 p.p.[14]

Figure 3a confronts the structural balances levels with the selected benchmark level. It illustrates that the differences across models could lead to different assessments with regard to the distance from the benchmark. Indeed, OECD figures suggest that Portugal had already reached the benchmark in 2017, while according to the IMF estimate it was only reached in 2019. In contrast, the remaining estimates suggest that a distance of 0.6 to 1.6 p.p remains in 2019.

Changes in the structural balances are depicted in Figure 3b. All estimates point to a shortfall in 2017 and 2019, considering the benchmark adjustment, suggesting that the differences in the underlying cycle indicators do not play a major role. The exception is 2018, where the BCS and EC estimates fall short of the benchmark adjustment, in contrast with the remaining results.

In short, comparisons with our selected benchmarks lead to a model-dependent assessment, which suggests the presence of important model-uncertainty effects.[15]

[14] Although our selected benchmarks intend to map plausible estimates for an MTO and a minimum adjustment required during normal times under the European fiscal surveillance framework, our goal is solely to evaluate how alternative output gaps impact on the comparison with these benchmarks. We are neither reproducing the published figures from the institutions, nor considering the exact recommendations that were made at the time.

[15] Results are qualitatively identical if we were to qualify the deviations as significant, since 2017, namely when their magnitude surpasses 0.5 p.p. in a given year, or 0.25 p.p. on average over two consecutive years. Results are available from the authors upon request.

4. Revisions in structural balances

Cyclical outputs are subject to revisions, and therefore structural balances are subject to revisions. Even if one uses the same model, it is well known that potential output estimates may change as new observations become available, or as new out-of-sample projections are modified, if those are included in data-filtering processes. The new information set may have an impact not only on the last unobserved data point of the sample, but also on historical estimates.

Until now we have focused on impacts of alternative cyclical outputs on the determination of structural balances. In this section we abstract from model uncertainty and focus on uncertainty surrounding real-time estimates.

We initiate this section by providing a stylised example of what might occur under unexpected shocks, and later retrieve EC output gap vintages to illustrate their impact on structural balance estimates.[16]

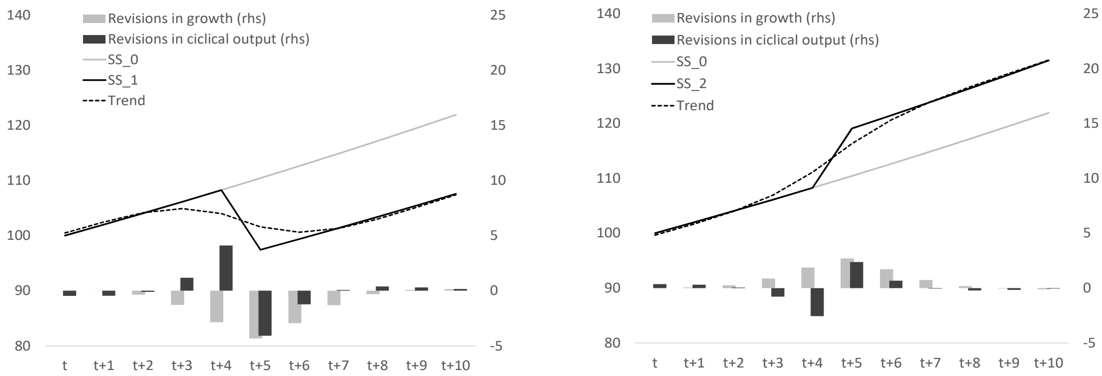
4.1. A stylised example

Figure 4 report highly stylized and simple examples that may clarify the possible impact of an unexpected crisis, or, in contrast, an unexpected expansion period on the revisions of structural balances. Suppose that the economy is growing along a balanced-growth path of 2% per period (identified by the straight line SS_0), actual and trend output grow at the same rate, the output gap is nil, and for simplicity headline and structural balances are stable at a nil value. In such state of the world, with no shocks, note that the contribution of cyclical output to government budget balances remains nil at all times. Assume now that a negative/positive shock occurs at a particular time period, say $t+5$, after which the economy jumps back to the same expansion rate of 2% (identified as SS_1). By design, the shock is temporary on the growth rates and permanent on the level. Under the unexpected crisis scenario, the output level at $t+10$ is already close to the one recorded before the crisis at $t+4$, but there is a permanent loss close to 10% against the level that would have prevailed if no crisis had existed.

Under the assumption that potential output is given by the slow-moving output level that changes from the initial to the new steady-state path, *i.e.* towards SS_1, from SS_0, then one might expect to have an evolution similar to the one given by the dotted line. Herein we used an Hodrick-Prescott filter but other options would give the same qualitative outcome (*e.g.* a centered moving average).

Figures 4a and 4b show that during the unexpected crisis/expansion periods registered at $t+5$, both the trend growth and output gap move in the same direction, as reported by the bars, but note that before the shock their revisions have opposite signs. For instance, in the crisis scenario depicted in Figure 4a both are revised downwards

[16] Real-time estimates found herein focus solely on alternative output gap data, as in previous sections, and therefore do not account for all changes that occurred during our sample period, including GDP revisions or methodological revisions. Note also that the EC does not re-evaluate their historical assessments, as new output gap data is released. All EC vintages are available from the authors upon request.



(A) Unexpected crisis

(B) Unexpected expansion

FIGURE 4: Output gap and potential output growth revisions

Source: Authors' calculations.

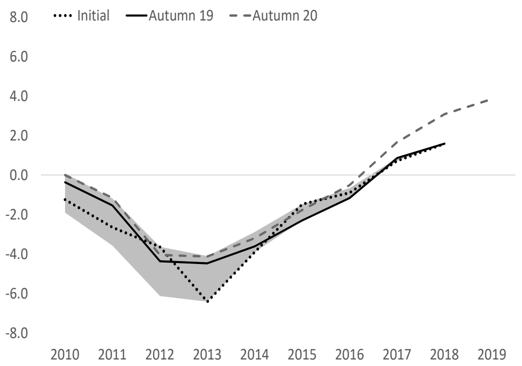
Notes: Revisions in growth (*i.e.* potential output growth) and in cyclical output (*i.e.* the output gap) are measured in p.p. in the right-hand scale (rhs). In Figure 4a output falls by 10% and in Figure 4b there is an expansion of 10% at $t+5$. Initial and final steady-state trends are identified with SS_0 and SS_1, respectively.

at $t+5$, but before the crisis the growth rate is revised downwards and the output gap upwards. This brings along a change in the assessment. Before the crisis, at $t+4$, the contribution of the business cycle to the headline budget balance is suddenly revised from nil to positive, and therefore the structural balance is revised downwards. The opposite effect occurs in Figure 4b.

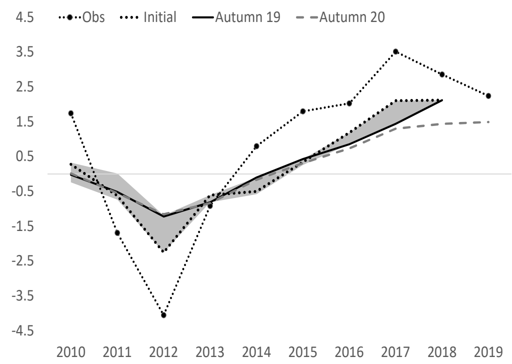
4.2. The EC case

Figure 5 reports revisions in potential output and structural balances. The upper row, namely Figures 5a and 5b, reports output gaps and potential output revisions, whereas the lower row, namely Figures 5c and 5d, map these data points into structural balance estimates, both in terms of levels and changes. To reduce the end-of-period bias, all estimates for year t are retrieved from the publication of year $t+1$, and therefore already incorporate information available at that period. For instance, initial output gap estimates for 2010 refer to the values published in Autumn 2011. By the same token, the growth rate of potential at year t, $t-1$, etc, is computed with the output gaps of t, $t-1$, $t-2$, etc, published at $t+1$. We include not only the initial and most recent estimates, but also a shaded area highlighting the range of published outcomes until the Autumn 2019 publication.

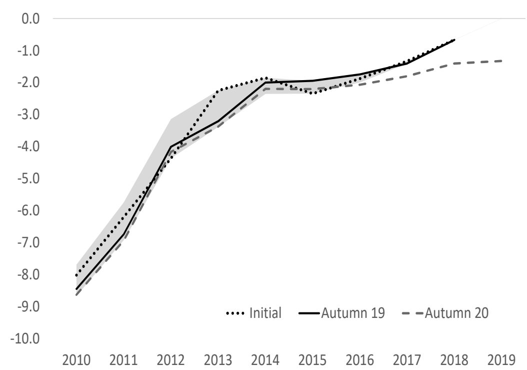
A comparison between the initial and Autumn 2019 publications reveals considerable output gap revisions in several years, reaching magnitudes of 2 p.p. The shaded area shows that revisions until 2018, when the area is non-existent by design, do not always move in the same direction, *i.e.*, the revisions that take place after the initial estimate do not necessarily approximate it to the most recent figure. When we consider the Autumn publication of 2020, the output gap is substantially revised upwards before 2018. One possible explanation may be linked to the effects reported in Figure 4a. The



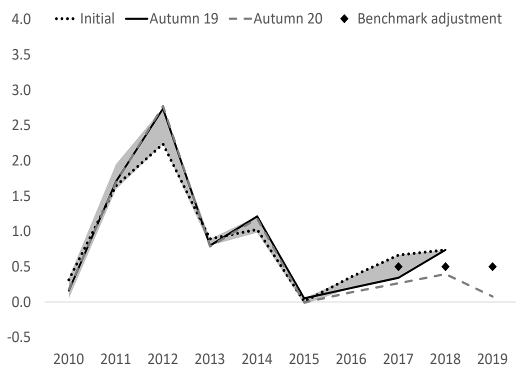
(A) Output Gap | In percentage



(B) Potential output growth | In percentage



(C) Structural balance (levels) | In percentage



(D) Structural balance (changes) | In percentage points

FIGURE 5: Revisions in potential output and structural balances

Sources: Banco de Portugal, EC and authors' calculations.

Notes: All data is based on Autumn publications. The shaded area corresponds to the range of estimates for year t, where the initial estimate refers to autumn of year $t+1$ and the most recent to Autumn 2020. Figure 5d also features our "Benchmark adjustment" of 0.50 p.p. (as in Figure 3b). The growth rate of real GDP is identified in Figure 5b as "Obs".

results released in Autumn 2020 are obtained from a sample that already includes data associated with the pandemic crisis, which is a large negative shock.

Revisions in growth rates are of a much lower order of magnitude. In general, all estimates depict a low-frequency movement around actual GDP growth, also reported in Figure 5b. The difference between the maximum and minimum growth rates over 1999-2018 stands at 0.5 p.p., reaching the highest level in 2012 (close to 1.0 p.p.). When we consider the Autumn publication of 2020, we detected a downward revision that reaches 0.7 p.p. in 2018—again, in line with the stylised example of Figure 4a.

Structural balance revisions have amplitudes conditioned by the use of equation (1), namely the semi-elasticity $\varepsilon = 0.5$. Thus, changes of 2 p.p. in the output gap correspond to changes of around 1 p.p. in structural balances, and therefore lower revisions in growth rates of potential output implies lower revisions on structural balance changes. The average revision in changes over 2010-18 stood at 0.23 p.p., and the highest reached 0.51 p.p. in 2012, against a background where vintages, since 2010, often do not move the estimated data in the same direction.

	Mean absolute revisions									
Elapsed time	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	$t-6$	$t-7$	$t-8$	$t-9$	$t-10$ [t]
Levels	0.51	0.42	0.44	0.38	0.30	0.19	0.14	0.13	0.17	0.21
Changes	0.22	0.13	0.10	0.13	0.14	0.11	0.12	0.10	0.09	0.05 [b]

TABLE 1. Structural balances: levels and changes

Sources: Banco de Portugal, EC and authors' calculations.

Notes: All data is based on Autumn publications. Mean absolute revisions are in p.p. and are computed with 9 observations.

Comparisons with selected benchmarks, however, cannot always be assessed in a stable manner, as clarified by Figure 5d. In some particular cases the evaluation depends on the data vintage. Note that the Autumn 2020 publication brought along a downward revision of the structural balance of 2018. Moreover, this estimate is below our selected benchmark adjustment of 0.5 p.p., in contrast with the previous assessment.

Finally, Table 1 reports mean absolute revisions *vis-à-vis* the Autumn 2020 publication, both of the level of structural balances and of the change. For instance, $t-k$ mean values collect all $t-k$ revisions published in year t, starting in the Autumn 2011 publication, where $k = 1, 2, ..., 10$. Considering changes, mean values are relatively small—below 0.2 p.p after $t-1$ and close to 0.1 p.p thereafter. Mean revisions for levels are higher, reaching 0.51 p.p at $t-1$, and only falling below 0.2 p.p after $t-6$.

5. Concluding remarks

We reported similarities and discrepancies in cyclical output impacts on structural balances over 1999-2019. Differences are solely originated by alternative cyclical indicators. The similarities, particularly in the changes of structural balances, imply that an assessment of the Portuguese fiscal policy stance would lead to broadly similar conclusions across models.

The discrepancies, particularity striking when focusing on the levels of structural balances, may cast doubts on their usefulness, especially if not properly taken into account by policymakers. Unsurprisingly, if the output gap is subject to high uncertainty, especially in real time, it is only natural to expect that fiscal rules relying on this unobserved variable would inherit, to some extent, identical characteristics. The conflicting signals reinforce the need for a more encompassing analysis because comparisons with point-specific benchmarks—even when measured by changes in structural balances—lead to model-dependent assessments.

In spite of the challenges, potential output and structural balances are valuable indicators in policymakers' toolkit. Assessing the low-frequency characteristics of the economy is crucial to promote adequate policies envisaging sustainable growth and a sound fiscal position.

Appendix: Brief overview of potential output estimation methods

The estimation of potential output shares some characteristics across the EC, OECD, BSP and *U* models. All use Cobb-Douglas production functions with labour, capital and total factor productivity (TFP), and all set the potential capital stock equal to actual values, which implies that all models only require the estimation of labour and TFP potential levels. All models use the capital stock of the whole economy, except the OECD, which excludes housing.

The EC model (Havik *et al.* 2014)
The labour input is computed as the product of actual working age population and the trend components of average hours worked (per worker) and participation rates (computed with an Hodrick-Prescott (HP) filter), as well as a measure of the Non-Augmenting Wage Inflation Rate of Unemployment (NAWRU) measure. The NAWRU is estimated by maximum likelihood techniques within a Phillips curve that ensures a convergence towards a structural unemployment indicator (obtained from a panel regression on several labour market indicators). Trend TFP is obtained through Bayesian methods using a model that explores a relationship between cyclical components and capacity utilization.

The OECD model (Chalaux and Guillemette 2019)
The labour input takes into account trend working age population and labour force, obtained by HP filters, and featuring a component that accounts for the gap between national accounts (NA) and Labour Force Survey (LFS) employment levels. The authors prefer the concept of "labour efficiency", instead of TFP, obtained as a residual. The trend unemployment rate is estimated with a Kalman filter within a Phillips curve specification.

The BCS model (Braz *et al.* 2019)
The labour input is computed as the product of actual working age population, HP-filtered series of the participation rate, average hours per worker, and an adjustment term that takes into account the gap between NA and LFS levels, as well as NAWRU estimates that are in line with the proposal of Duarte *et al.* (2020). Trend TFP is computed as the HP-filtered Solow residual.

The *U* model (Duarte *et al.* 2020)
The model uses reduced-form theoretical equations that are jointly estimated with Bayesian techniques. The output gap is linked to the unemployment gap through Okun's law, and wage and price equations establish links with labour and product markets. The trend component of labour results from a measure of the NAWRU and the labour force (measured in hours). TFP is endogenously determined within the model, closing the link between output and prices.

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