European Commission

ISSN 2443-8022 (online)

The Semi-Elasticities Underlying the Cyclically-Adjusted Budget Balance: An Update & Further Analysis

Gilles Mourre, Aurélien Poissonnier and Martin Lausegger

DISCUSSION PAPER 098 | MAY 2019

EUROPEAN ECONOMY

Economic and Financial Affairs

European Economy Discussion Papers are written by the staff of the European Commission's Directorate-General for Economic and Financial Affairs, or by experts working in association with them, to inform discussion on economic policy and to stimulate debate.

The views expressed in this document are solely those of the author(s) and do not necessarily represent the official views of the European Commission.

Authorised for publication by Lucio Pench, Director for Fiscal Policy and Policy Mix.

This paper exists in English only and can be downloaded from
https://ec.europa.eu/info/publications/economic-and-financial-affairs-publications_en.

Luxembourg: Publications Office of the European Union, 2019

PDF ISBN 978-92-79-77435-5 ISSN 2443-8022 doi:10.2765/72585 KC-BD-18-025-EN-N

European Commission
Directorate-General for Economic and Financial Affairs

The Semi-Elasticities Underlying the Cyclically-Adjusted Budget Balance:

An Update and Further Analysis

Gilles Mourre, Aurélien Poissonnier and Martin Lausegger

Abstract

We update the semi-elasticities of the budget balance to output for the 28 EU Member States using new weights based on ESA2010 data (with unchanged elasticities for individual fiscal items). The revisions of the semi-elasticities are fairly small across Member States and leave the assessment of fiscal developments in the EU broadly unchanged. The revision of the Cyclically Adjusted Balance (CAB) is mainly driven by that in the headline balance and the estimated output gap, not by the update of the fiscal semi-elasticities. A sensitivity analysis shows that revenue and expenditure weights, if allowed to vary over time, can have a larger impact on the semi-elasticities than the present update would suggest, although this would affect the CAB only marginally. Based on the existing four vintages of the estimated semi-elasticities, exploratory panel data analysis confirms that semi-elasticities are country-specific structural parameters, mostly of fiscal nature: they are linked to the size of government, the share of unemployment-related spending, the share of non-tax revenue and tax progressivity. They can also be influenced by the belonging to specific country groupings and an emulation effect between neighbours.

JEL Classification: E62, H62, E32.

Keywords: budgetary semi elasticity, cyclically-adjusted budget balance (CAB), structural balance, revenue and expenditure elasticities, EU fiscal surveillance.

Acknowledgements: We would like to thank the members of the output gap working group for their comments. We are also grateful to Savina Princen for her useful detailed comments and suggestions.

Contact: Gilles Mourre, European Commission, Directorate-General for Economic and Financial Affairs, gilles.mourre@ec.europa.eu. Aurélien Poissonnier, European Commission, Directorate-General for Economic and Financial Affairs, aurelien.poissonnier@ec.europa.eu. Martin Lausegger substantially contributed to the early stage of the project, when he was a Commission trainee.

Executive Summary

We recall the method to adjust the budget balance from the effect of the business cycle, which is used in the context of the EU fiscal surveillance, and present the recent update of one of its key elements, namely the fiscal semi-elasticities. They capture the reactivity of the budget balance in % of GDP to a change in the output gap. While an elasticity applies to a level, (e.g. a monetary amount), a semi-elasticity applies to a ratio. This is particularly relevant since the EU fiscal framework deals with ratios, that is, variables expressed as percentage of GDP. The semi-elasticity captures both changes in numerator *and* denominator due to the business cycle.

The paper presents the update of the fiscal semi-elasticities, which follows the calendar and methodology agreed with the Member States. The semi-elasticity for each Member State is a weighted average of the individual elasticities of each revenue and spending item. The present exercise focuses on the update of the weights. It yields the following results:

- The revisions of the semi-elasticities are overall small and more marked on the expenditure than revenue side. They are close to null in terms of EU average and downward in a majority of Member States.
- Consequently, for the 28 EU Member States, the update of the weights has a negligible effect on the cyclically adjusted budget balance and therefore our assessment of the fiscal developments in the EU remains unchanged compared with the last update in 2014.

We analyse the semi-elasticity revisions and find that:

- Three factors drive the revisions: i) better data availability (concerning several Member States who acceded as of 2004), ii) a new time window for the weights and iii) the changeover to a new European System of Accounts (ESA 2010) since the last update.
- The latter two factors account for the bulk of the revisions, to a comparable extent.
- Despite the changeover to ESA 2010, revisions remain particularly small compared with the volatility of semi-elasticities appearing if we were to update the weights every year.

We examine the robustness of the EU methodology of fiscal cyclical adjustment to the use of some simplifying assumptions, which is confirmed, noticeably:

- The approximations made for the calculation of the cyclically adjusted budget balance by the EU common methodology, such as using constant weights or making a linear approximation, are empirically negligible.

We run exploratory panel data analysis based on the four available vintages of semi-elasticities to investigate their determinants and find that:

- The semi-elasticities used by the Commission are not affected by a residual impact of the business cycle, which is a desirable property.
- The semi-elasticities are are related to structural fiscal variables, in particular the size of government and the share of non-tax revenue, which capture the share of budgetary items which are less affected by the business cycle in nominal terms. The share of unemployment-related spending is also highly significant, as expected. Indicators of tax progressivity also appear to significantly influence the semi-elasticity.

- Many non-fiscal structural economic variables tested in this paper turn out to be not robustly correlated to the semi-elasticities, such as the income per capita, the economic size, the labour share in the value added and the economic output volatility.
- This said, some economic or geographical clustering effects seem to be relevant: EU Member States with lower income or those having acceded as of 2004 tend to have lower semi-elasticities. Moreover, semi-elasticities appear to be subject to an emulation effect between neighbouring EU Member States.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Governments' budget balance fluctuates with the business cycle, which requires computing a cyclically adjusted balance (CAB). To get a fair picture of the fiscal stance taken by the government, it is key to correct for the cyclical fluctuations of the budget balance, which are outside the control of the general government.

The EU methodology to compute the CAB aims to achieve the triple goals of economic soundness, communicability and stability. On the one hand, the methodology should be economically sound, capturing the adequate concept with a proper measurement using regularly updated information. On the other hand, the measure should be simple enough to be communicable and remain intuitive, avoiding the 'black-box' syndrome. This justifies the use of first-order approximation and some other simplifying assumptions in the derivation of the indicator. Lastly, the methodology should remain stable over time, so as to ensure time-consistent fiscal surveillance and comparability of the data over the years. This makes the case for the stability of the key parameters underlying the cyclical adjustment of the budget balance and a not overly frequent update of the methodology.

The methodology requires computing both the output gap – measuring the position in the business cycle – and the semi-elasticity of the budget balance to the output gap – measuring the reaction of the budget balance to macroeconomic conditions, which is the focus of this paper. The output gap methodology has been agreed with Member States and is regularly reviewed by Member States at the Output Gap Working Group (Havik et al., 2014; Mc Morrow, 2015). The second key parameter, namely the semi-elasticity of the budget balance to the output gap measures the reactivity of the budget balance (expressed as a ratio to GDP) to a change in the output gap. The cyclical component of the budget balance is the product of this semi-elasticity and the output gap, which is subtracted from the budget balance to compute the CAB.

As a useful clarification, why are we dealing with a *semi-elasticity* and not with a simple elasticity? An intuitive answer is that i) a semi-elasticity applies to a ratio, while an elasticity applies to a level (i.e. absolute number or monetary amount) and ii) the EU fiscal framework deals with ratios, that is, variables expressed as percentage of GDP. The semi-elasticity captures both changes in numerator *and* denominator due to the business cycle.

This paper presents the regular update of the semi-elasticities of the budget balance of the EU Member States, consisting in revising the 10-year average revenue and spending weights based on the most recent government statistics. The semi-elasticities are computed by combining i) the individual elasticities of each revenue and expenditure category composing the government budget balance and ii) their weights as a percentage of GDP. The present revision focuses exclusively on the weights of revenue and expenditure categories. They are now calculated as an average over the period 2008-2017, instead of 2002-2011 in the last updates carried out in Mourre et al. (2013). In addition to the change of time period, another source of revision is the implementation of the 2010 European System of Accounts (ESA 2010) which took place after the previous update of the weights. By contrast, the individual elasticities are unchanged with respect to their last update (Mourre et al, 2014).

The methodology currently used by the Commission to compute the semi-elasticity is the result of two decades of research. The estimates and the underlying method have been gradually revised and improved. Early estimations of the fiscal elasticities include Giorno *et al.* (1995). The Commission's method for the cyclical adjustment of government budget balances used at the time is also presented in European Commission (1995). In 2000, Van den Noord (2000) updated the elasticities of revenue and expenditure components, which were included in the method used by the OECD and the Commission (OECD 1999, European Commission 2000). In parallel, Bouthevillain *et al.* (2001) provided alternative estimates of the fiscal elasticities, used by the Eurosystem. A new

update was performed five years later for OECD countries by Girouard and André (2005). The European Commission (2005, 2006, 2010) extended these estimations *à la* Girouard and André to *all* EU countries, including the subsequent waves of accession to the EU. More recently, Mourre *et al.* (2013) propose a change in the methodology to compute actual semi-elasticities, rather than sensitivities, where the denominator is not corrected for the impact of the output gap. A re-estimation of the output elasticities of the individual revenue and expenditure components for the EU is set out in Price *et al.* (2014), who also explore the cyclical pattern of component assumed a-cyclical, such as earning-related transfers or non-tax revenue. Mourre *et al.* (2014) use these new estimates to compute the semi-elasticities for EU Member States. Price *et al.* (2015) perform a similar update for OECD countries.

In addition to the CAB calculation, the fiscal semi-elasticities find several applications. They play several roles in the context of fiscal surveillance, more specifically of the preventive arm of the SGP as shown in Box 1.1. The fiscal semi-elasticities (and the underlying elasticities of tax revenue components to their base) are also key parameters in the forecast of fiscal variables (see Mourre *et al*, 2016). Finally, the fiscal elasticities can be used in the analysis of fiscal policy (e.g. Blanchard and Perotti, 2002 and Perotti, 2005, employing a structural vector autoregressive model (VAR) to calculate the fiscal multipliers).

Some limitations of the EU *aggregate* methodology are discussed in the literature. The EU methodology is often referred to as an *aggregate* approach, since it is using the output gap as a single (synthetic) measure of the business cycle, applied to all fiscal items. By contrast, more disaggregated methodologies identify a specific cyclical pattern for each and every component of the budget balance. Advocates of disaggregated approaches often argue that the cyclical correction based on the output gap could overlook important dimensions. First, the economic cycles may differ across revenue and expenditure components (Bouthevillain *et al.*, 2001), while the EU methodology uses the output gap for all components. Second, the EU method corrects for real business cycle fluctuations but neglects the price effects which can be sizeable in times of high inflation (Tanzi, 1977; Tanzi *et al.*, 1987; Escolano, 2010; Morris and Schuknecht, 2007). Third, fiscal elasticities can differ in the short and long run and, therefore, be varying substantially over time (Koester and Priesmeier, 2017; Mourre and Princen, 2015; Belinga *et al.*, 2014). A side criticism relates to the assumption of the constancy of the weights, which could be made time-variant. This said, Mourre and Princen (2019) highlight the difficulty to measure time-varying elasticities for all countries, given the lack of long time series corrected for tax policy changes and the absence of a clear pattern in the volatility of implicit/empirical elasticities in some Member States. All these factors could account for the residual cyclical component identified by studies carried out before the Great Financial Crisis, such as Alberola *et al.* (2003) or Morris *et al.* (2009).

The EU methodology seeks to weigh these limitations against practical objectives, relevant for fiscal surveillance. Taking the above limitations into account would render the methodology much more complex and difficult to communicate, also less transparent in practice for users. This is an important issue given the current complexity of the fiscal rules (Deroose *et al.* 2018). The current intuitive formula to correct the effect of the business cycle (using the output gap times the semi-elasticities) would not apply anymore in a more disaggregated approach: the cyclical component would become a weighted average of the different tax bases, which should be filtered in real time[1]. The use of time-varying weight would pose a new problem when forecasting the CAB or the structural balance, since the weights would need to be forecast as well. Lastly, the performance of the EU method appeared to be not so bad during the economic and financial crisis, compared with more disaggregated approaches, since the cyclical pattern of some specific granular components could be

[1] The weight of each component would be varying over time as well. It is far from guaranteed that filtering specific cycles for each component of the CAB or prices would reduce the revision frequency of the real-time estimates of the cyclical component of the budget, compared with the current method based on the output gap. The opposite is likely given the absence of fixed parameters.

particularly erratic in periods of strong recession and thereby very difficult to identify based on past behaviours.

Overall, the present revision has a limited impact on fiscal elasticities. In the EU,[2] the average semi-elasticity of the budget balance remains equal to 0.50. Comparing the new estimates with the previous values (Mourre *et al*, 2014) the semi-elasticities are revised downward in a majority of Member States, where the government budget balance has become less cyclical. In the great majority of cases, the revisions were lower than 0.04 in absolute terms. The revisions are due, to an equal proportion, to the introduction of ESA 2010 and to the new window used to compute the weights (2008-2017 against 2002-2011 previously). Despite the changeover to ESA 2010, it is remarkable that the revisions in the semi-elasticities remain within the range of the intrinsic volatility of the weights (when left to vary annually). Furthermore, the revision affects the expenditure side more markedly than the revenue side.

The revisions of the cyclical correction of the headline budget balance are also limited. The evolution of the fiscal stance over the past years is broadly unchanged. In fact, revisions linked to the new elasticities are much smaller than those related to revisions in the headline balance or the output gap.

Beyond the application of the EU common methodology, the paper runs some exploratory analysis of the possible determinants of semi-elasticities. We run a panel data analysis of the last four vintages of the semi-elasticities, resting on a theory-related baseline and including – non-exhaustively – public finance, economic and geographical factors. Reassuringly, we find no sign of cyclical bias in the semi-elasticities used by the Commission. The empirical analysis confirms that the fiscal semi-elasticities are structural parameters – i.e. country-specific lasting features –, which are largely related to budgetary variables, such as the size of government, the share of non-tax revenue, the share of unemployment-related expenditure and the progressivity of the tax system. Other structural features of the economies, of non-fiscal nature, do not seem to explain the level of fiscal semi-elasticities. There are nevertheless some identifiable geographical patterns: newly acceded Member States and lower-income Member States tend to have lower semi-elasticities. Semi-elasticities also appear to be subject to an emulation effect between neighbouring Member States within the EU.

We also confirm the robustness of our methodology to some simplifying assumptions. Alternative calculations of the CAB, relaxing some simplification assumptions made by the EU common methodology, do not affect the results substantially, validating our methodology empirically.

The remainder of this paper is organised as follows: Section 2 recalls the methodology to compute the semi-elasticities and the CAB. Section 3 sets out the revised estimates of the fiscal semi-elasticities and the sources of revision. Section 4 offers some sensitivity analysis and examines the determinants of the fiscal semi-elasticities by way of panel data econometrics. Section 5 exposes how these revisions affect the CAB. The different annexes present i) a pedagogical step-by-step derivation of the value of the semi-elasticities, also with the aim to ensuring the replicability of the results, ii) the detailed mathematical derivation of the cyclical adjustment formula, iii) the data sources, codes and data treatments, iv) the value of weights and semi-elasticities in 2018 compared with that of last update in 2014, v) additional information on the sensitivity analysis and the exploratory econometric analysis on possible determinants.

[2] Throughout, EU refers to the 28 EU Member States at the time of our analysis

Box 1.1. **THE ROLE OF FISCAL ELASTICITIES IN THE EU BUDGETARY RULES AND CALENDAR ISSUES**

Fiscal elasticities are instrumental to the implementation of the EU fiscal rules, known as Stability and Growth Pact (SGP). Indeed, the change in the structural balance, defined as the CAB minus one-off measures, is a key indicator to measure the fiscal effort made by the government, in response to the requirement of fiscal rules (Larch and Turrini, 2009). This is true in the preventive arm, where the expenditure benchmark- a spending rule often considered as more predictable - is the other indicator to measure the fiscal adjustment by government. This is also true in the corrective arm, where the nominal deficit targets to correct the excessive deficit are then converted in structural balance terms and finally expressed in operational spending growth limit.

The revision of the semi-elasticities follows a pre-defined institutional process involving the Member States (Figure 1.1). Every 9 years (i.e. 3 MTO cycles), the individual output elasticities of the revenue and expenditure components of the government budget balance are re-estimated. The next update will be completed by end-2024. It will then be used in fiscal surveillance as of spring 2025 to determine the fiscal requirement for 2026, 2027 and 2028. The weights used to combine these elasticities into an aggregate semi-elasticity of the government balance to output are updated every 6 years (i.e. 2 MTO cycles). The present update has been endorsed by the Member States (in the context of the Economic Policy Committee) and will be used in setting the next MTO as of 2019. For sake of consistency, the new elasticity will also be used as of 2019 to compute the structural balance. The next update should be completed by the end 2024, alongside the revisions of the individual revenue and spending elasticities. These updates are conducted in cooperation with Member States and overseen by the members of the output gap working group (OGWG). The structural balance is computed with the new semi-elasticities as from the start of the year following the endorsement of the update.

Figure 1.1. **Timeline of the revisions of the semi-elasticities**

	2013 MTO cycle (2014-16)	**2016 MTO cycle** (2017-19)	**2019 MTO cycle** (2020-22)	**2022 MTO cycle** (2023-25)	**2025 MTO cycle** (2026-28)
	Update:	Update:	Update:	No update	Update:
New weights	✓		✓		✓
New individual elasticities		✓			✓

Note: The MTO cycle is identified by the year T, when the country appoints their new MTO, which is applied to determine the fiscal requirement applying you're the three following year (T+1, T+2 and T+3). These three years of application are shown in bracket.
Source: European Commission Services

2. THEORETICAL FRAMEWORK FOR COMPUTING THE CYCLICALLY-ADJUSTED BUDGET BALANCE

2.1. CYCLICAL ADJUSTMENT: THE MAIN CONCEPTS

The cyclically-adjusted budget balance (CAB) corresponds to the deficit/surplus-to-GDP ratio that would prevail if the economy was running at its potential. It is computed as the difference between the actual balance-to-GDP ratio and an estimated cyclical component. In algebraic terms:

$$CAB_t = \frac{(R_t - G_t)}{Y_t} - \varepsilon\, OG_t = B - \varepsilon\, OG_t \quad (1)$$

where R and G stand for the nominal government revenue and expenditure respectively and Y for nominal GDP. The headline budget balance B is defined as the difference between the nominal government revenue and expenditure (in percentage of GDP). The cyclical component of the budget balance is the product of a cyclical adjustment parameter (ε, the semi-elasticity of the headline budget balance to output) and the output gap (OG). This cyclical component is subtracted from B to obtain the CAB. This formula is the linear approximation of an exponential expression[3]. It has the merit of being easily calculated and clearly communicable to policymakers. To avoid any undesirable breaks in statistics, we apply the most recent semi-elasticities ε consistently over time in order to derive the whole CAB time-series used in the fiscal surveillance and available in AMECO.

The cyclical component ($\varepsilon\, OG_t$) is by definition proportional to the output gap. The assessment of the cyclical position of the economy is the first key input for the computation of the CAB. It is provided by the output gap, i.e. the distance between actual and potential real GDP in percentage points of potential output: $OG = (Y - Y^p)/Y^p$. The method currently applied by the Commission to measure the output gap is based on a production function (Havik *et al.*, 2014; Mc Morrow, 2015). Output gap estimates are surrounded by a degree of uncertainty and, therefore, often subject to significant revisions. It appears difficult in practice to estimate potential output in real time, especially at cyclical turning points or in the presence of structural breaks (see D'Auria *et al.*, 2010). As we show in Section 5.2.1, revisions to the output gap have a more sizeable impact on the CAB than the semi-elasticity revisions.

The budgetary semi-elasticity (ε) measures the sensitivity of the budget balance as a share of GDP to the economic cycle. Mathematically, it measures the *absolute* change of a variable (here the budget-to-GDP ratio) as a result of the relative change of another (here GDP). More intuitively, it measures by how many percentage points the budget-to-GDP ratio changes for a 1% increase in GDP. Importantly, this concept allows for reflecting the impact of the business cycle both on the numerator of the budget balance ratio (budget balance in monetary terms) and on its denominator (GDP). The semi-elasticity of the budget-to-GDP ratio differs from the concept of budgetary elasticity, which measures the relative variation of the budget balance expressed in monetary terms (e.g. in euro) resulting from a unitary relative variation in output (say an output gap of 1%). As seen in the next sub-section, the budgetary semi-elasticity can be derived as a linear combination of the tax and expenditures elasticities.

$$Semi - elasticity\ of\ the\ ratio\ B/Y = \varepsilon = \frac{d\left(\frac{B}{Y}\right)}{\frac{dY}{Y}} \quad (2)$$

[3] See Annex II for the mathematical derivation of this approximation and Section 4.1 for a sensitivity analysis.

$$\neq \ Elasticity\ of\ B = \eta = \frac{\frac{dB}{B}}{\frac{dY}{Y}}$$

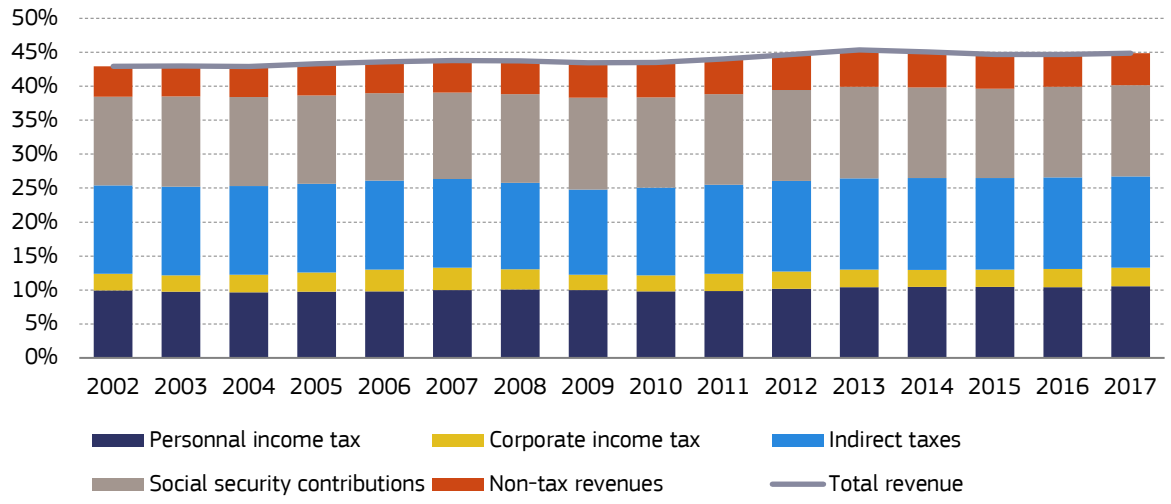
The budgetary semi-elasticity is equal to the difference of the semi-elasticity of revenue and the semi-elasticity of expenditure. Rewriting the actual surplus/deficit in terms of its components (revenue and expenditure), the semi-elasticity ε can be broken down into the semi-elasticities of the two sides of the budget balance (revenue and expenditure).

$$\varepsilon = \frac{d\left(\frac{B}{Y}\right)}{\frac{dY}{Y}} = \frac{d\left(\frac{R}{Y}\right)}{\frac{dY}{Y}} - \frac{d\left(\frac{G}{Y}\right)}{\frac{dY}{Y}} = \varepsilon_R - \varepsilon_G \qquad (3)$$

where ε_R and ε_G denote respectively the semi-elasticity of (total) revenue and expenditure with respect to GDP.

The semi-elasticity of revenue is fairly close to zero, since the revenue to GDP ratio is quite stable over time. Revenues in the Member States - except for non-tax revenue - broadly follow the cyclical developments in GDP. Therefore, total revenue *as a percentage of GDP* does not vary much with the cycle (Figure 2.1). Hence, while the elasticity of revenue (expressed in monetary amount) is close to 1, the *semi-elasticity* of revenue ε_R is close to zero, which is a frequent source of confusion.

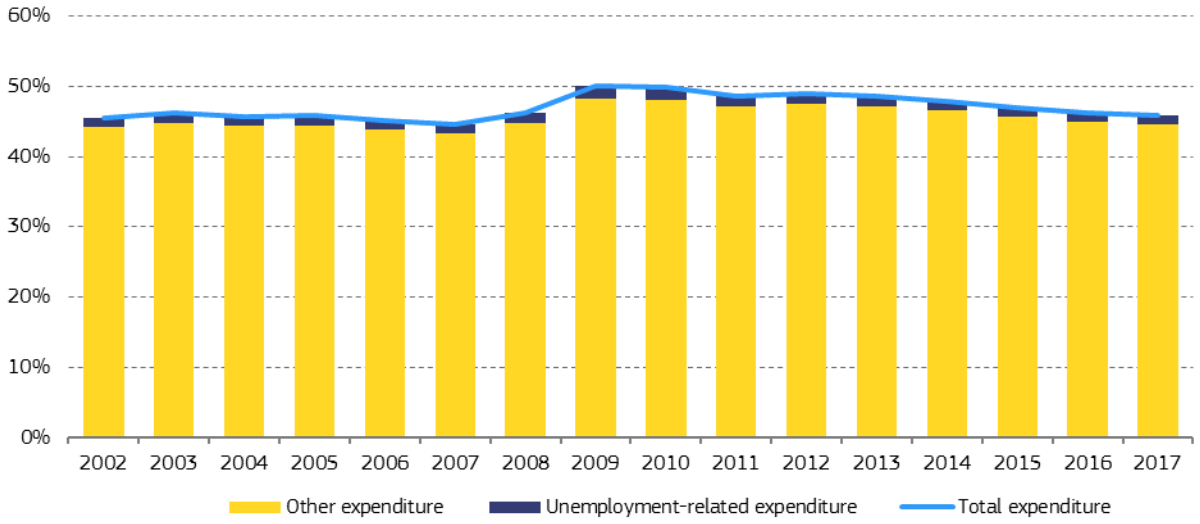
Figure 2.1. **Composition of the general government revenue (EU, % of GDP)**



Note: EU refers to the EU Member States at the time of our analysis
Source: AMECO, Spring forecast 2018, authors' calculations

Among all expenditures, only unemployment-related spending is considered to have a marked cyclical pattern. Unemployment-related spending follows the unemployment rate variations, which are closely linked to the economic cycle. However, they only form a small fraction of total public spending (Figure 2.2). Other expenditure is assumed invariant with the cycle. In other words, the low cyclicality of expenditure makes the expenditure-to-GDP ratio clearly counter cyclical, since the ratio is mainly influenced by its denominator (GDP) with little offsetting effect from the numerator (expenditure). In particular, the expenditure to GDP ratio increased from 45% to 50% during the crisis. As this ratio rises in bad times and decreases in good times: ε_G is negative.

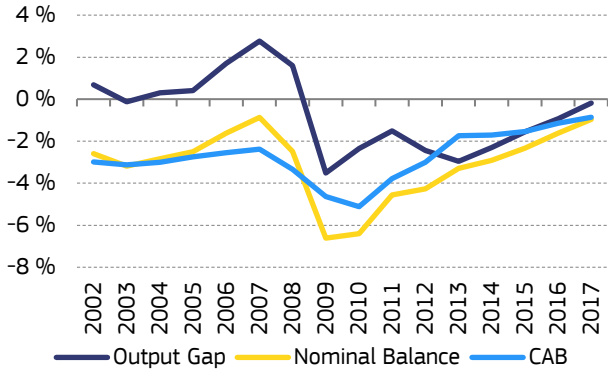
Figure 2.2. **Composition of the general government expenditure (EU, % of GDP)**



Note: EU refers to the EU Member States at the time of our analysis
Source: AMECO, Spring forecast 2018, authors' calculations

A positive fiscal semi-elasticity for all Member States ($\varepsilon > 0$) means that the headline budget balance increases in good times and deteriorates in bad times. The cyclical inertia of public spending (see above, $\varepsilon_G < 0$), combined with the cyclically-driven pattern of public revenue (see above, $\varepsilon_R \approx 0$), corresponds to the so-called fiscal stabilisers: the headline budget balance deteriorates in economic troughs and improves in booms, which mitigates the business cycle itself by supporting domestic demand (i.e. exercising a counter-cyclical effect). The correlation between the output gap and the headline balance in the EU is equal to 71%, whereas the correlation of the output gap with the CAB (correcting for this cyclical component) drops dramatically to 17% (Figure 2.3). The CAB is therefore more representative of the fiscal stance decided by governments.

Figure 2.3. **Composition of the general government expenditure (EU, % of GDP)**



Note: EU refers to the EU Member States at the time of our analysis
Source: AMECO, Spring forecast 2018, authors' calculations

2.2. COMPONENTS OF THE REVENUE AND EXPENDITURE ELASTICITIES

This paper updates the aggregate semi-elasticities. The aggregate semi-elasticities of revenue and expenditure are based on the elasticities of their components (Mourre *et al.*, 2014). Four individual revenue categories (personal income taxes, corporate income taxes, indirect taxes, social security contributions, denoted $R_{1<i<4}$) and one spending category (unemployment-related expenditure, denoted G_u) are found sensitive to the economic cycle. Non-tax revenue (sales and capital transfers other than capital taxes, R_5) and other expenditure (G_o) are assumed to be non-cyclical.[4] For each Member State, the elasticities (η_R and η_G) of total revenue (R) and expenditure (G) are calculated as a weighted

[4] Attempts to identify a cyclical pattern in non-tax revenue and other expenditure, such as income-based transfers, were inconclusive (e.g. Price *et al.*, 2015).

average of the elasticities of their components ($\eta_{R,i}$ and $\eta_{G,u}$). These aggregate elasticities can then be converted into the semi-elasticities ε_R and ε_G as follows (see also annex I):

$$\varepsilon = \varepsilon_R - \varepsilon_G = (\eta_R - 1)\frac{R}{Y} - (\eta_G - 1)\frac{G}{Y} = \underbrace{\left(\sum_{i=1}^{4} \eta_{R,i}\frac{R_i}{R} - 1\right)\frac{R}{Y}}_{\varepsilon_R} - \underbrace{\left(\eta_{G,u}\frac{G_u}{G} - 1\right)\frac{G}{Y}}_{\varepsilon_G} \quad (4)$$

$$\varepsilon = \sum_{i=1}^{4}(\eta_{R,i} - 1)\frac{R_i}{Y} - \frac{R_5}{Y} - (\eta_{G,u} - 1)\frac{G_u}{Y} + \frac{G_o}{Y} \quad (5)$$

In the present update only the weights used to aggregate the elasticities of the revenue and expenditure components into the headline budget balance semi-elasticity are updated. The following weighting parameters are updated in order to derive the new budgetary semi-elasticities (Table IV.1 Table IV.2 in annex IV):

- The revenue and expenditure structure
  - the share of the five individual revenue categories in % of total general government revenue (R_i/R),
  - the share of the unemployment-related expenditure in % of total general government expenditure (G_U/G).
- The aggregate revenue and expenditure ratios
  - the weight of total general government revenue in % of GDP (R/Y),
  - the weight of total general government expenditure in % of GDP (G/Y).

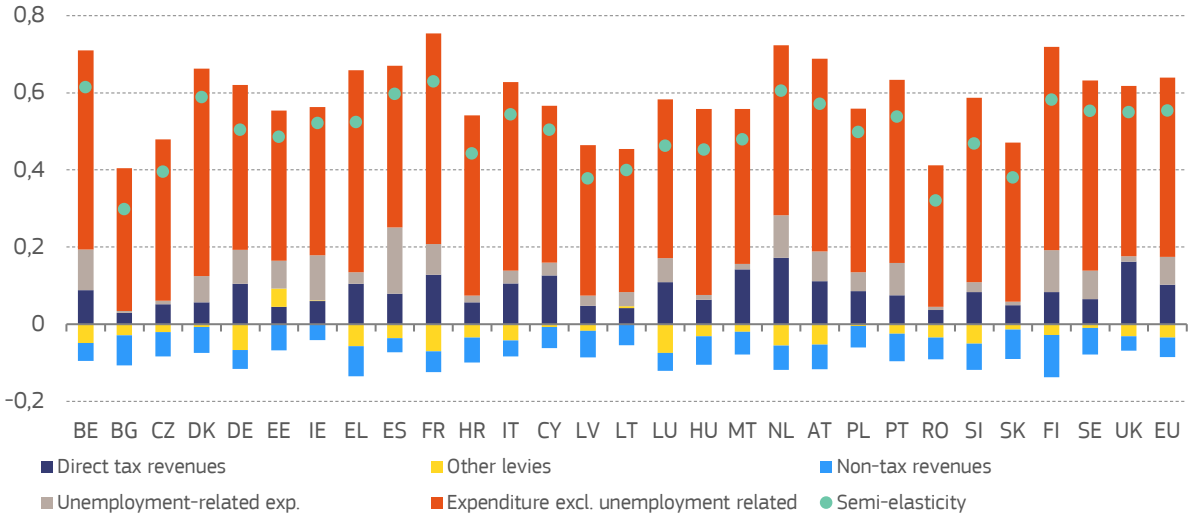
Elasticities are assumed to be constant in Equation (4). The elasticities of the revenue and expenditure components are taken from (Mourre *et al.*, 2014; Price *et al.*, 2014), and are assumed to be constant. They are recalled in Table III.1 in annex. The elasticities of the cyclical revenue are above 1 for personal income tax and corporate income tax, below 1 for social security contributions (except for EE, IE and LT) and by assumptions equal to 1 for indirect taxes (except for IT) and equal to 0 for non-tax revenue.[5] The elasticity of unemployment related expenditure is (very) negative but its weight in total expenditure is no larger than 6%. Other expenditure has an elasticity of 0 by assumption.[6]

The weights are computed as ten year averages. The weights are in principle time varying. It is however, much more convenient to assume that they are constant in order to compute a unique semi-elasticity per Member State (see Sections 4.1 and 5.2.2 for a sensitivity analysis of the time-varying nature of the weights). In Mourre *et al.*, 2013, weights were computed as 10-year averages over the 2002–2011 period. For the current update they are computed as 10-year averages over the 2008–2017 period. Since the previous estimation, these weights have also been revised according to the new ESA 2010 framework for National Accounts. These are the two main sources of revisions of the fiscal elasticities (see Section 3.2.1).

[5] The elasticity of non-tax revenue is set at 0. Attempts in the past to identify a cyclical pattern turn very inconclusive (Price *et al.*, 2015).

[6] In this respect, it should be recalled that attempts to identify the cyclicality of other expenditure, such as income-based transfers were inconclusive (Price *et al.*, 2015).

Figure 2.4. **Decomposition of the fiscal semi-elasticities**



Note: EU refers to the EU Member States at the time of our analysis.
Source: AMECO, Spring forecast 2018, authors' calculations

The main contributor to fiscal semi-elasticities is by far public expenditure, especially that unrelated to unemployment, while the contribution of various tax items broadly offset each other's. Looking at the EU average, expenditure *excluding* unemployment-related spending appears the main driver of fiscal semi-elasticities (Figure 2.4). This is directly due to its large size, around 46% of GDP, and its stability in terms of monetary amount, making the expenditure-to-GDP ratio cyclical due to the denominator effect. Unemployment-related expenditure brings an additional contribution of almost 0.1, because of the highly cyclical fluctuations of unemployment benefits and despite their low size as a percentage of GDP. Direct taxes (personal and corporate income taxes) contribute to fiscal semi-elasticities by 0.1 as well, due to their progressivity. In contrast, non-tax revenue and other levies (indirect taxes and social security contributions) contribute negatively to the semi-elasticities, due to no or limited responsiveness to the business cycles. This decomposition of the semi-elasticities for the EU is similar across Member States.

3. REVISIONS OF THE FISCAL SEMI-ELASTICITIES

This section first presents the updated semi-elasticities and compares them to those from Mourre *et al.* (2014). We then analyse the causes of revision along several dimensions.

3.1 THE REVISED SEMI-ELASTICITIES

The semi-elasticity of the budget balance in the EU is equal to 0.50 on average and ranges from 0.29 (BG) to 0.63 (FR). (Table I.3 in annex) Due to these differences, the cyclical component of the budget balance corresponding to a one-percent output gap would be around 0.6% of (potential) GDP in FR compared to around 0.3% of (potential) GDP in BG.

Three categories of Member States could be identified regarding the size of their fiscal semi-elasticities. The "higher semi-elasticity" countries experience a semi-elasticity (somewhat) higher than 0.55, which corresponds to the semi-elasticity of the EU treated as a single country. This category includes "old" Member States (i.e. Members of the EU before 2004) with fairly high size of government (FR, BE, DK, FI and AT) or/and with high expenditure elasticity due to a large share of unemployment-related expenditure (NL and ES). The "medium-sized semi-elasticity" countries show a semi-elasticity ranging from almost 0.45 to 0.55. This category corresponds to the majority of EU Member States and is fairly heterogeneous (SE, UK, IT, PT, EL, IE, CY, DE, PL, EE, MT, SI, LU, HU and HR). The "lower semi-elasticity" countries have a semi-elasticity comprised between 0.3 and 0.4. This category covers countries with a relatively low size of government and having acceded the EU in 2004 or thereafter (LT, CZ, SK, LV, RO and BG).[7]

On the revenue side, the semi-elasticities are close to zero. As mentioned in Section 2, this result stems from the fact that revenue is almost as cyclical as GDP and therefore the revenue-to-GDP ratio remains broadly stable throughout the business cycle. The semi-elasticity of revenue ranges from -0.08 (BG) to 0.09 (UK). It is positive for EE, IE, ES, IT, CY, MT, NL, PL and UK which indicates that the tax system in those countries is overall (slightly) progressive: the revenue to GDP ratio increases (slightly) following an increase in GDP. In FR, the tax system is almost neutral while in the remaining Member States, the tax system is (slightly) regressive.

The expenditure semi-elasticity is on average equal to -0.50, ranging from -0.37 (RO) to -0.64 (FI). Expenditure semi-elasticities contribute to a larger extent than revenue semi-elasticities to disparities across Member States. Their values broadly correspond to the share of total expenditure in GDP: as mentioned in Section 2, for the most part, expenditure is assumed acyclical; therefore the semi-elasticity of public expenditure to output is close to the share of this expenditure to GDP (see Equation (4)). It follows that the expenditure to GDP ratio has a first order scaling effect on the semi-elasticity of the budget balance (Figure 3.2). In particular, low shares of expenditure to GDP in Member States who joined the EU as of 2004 are associated with low budget balance semi-elasticities.[8]

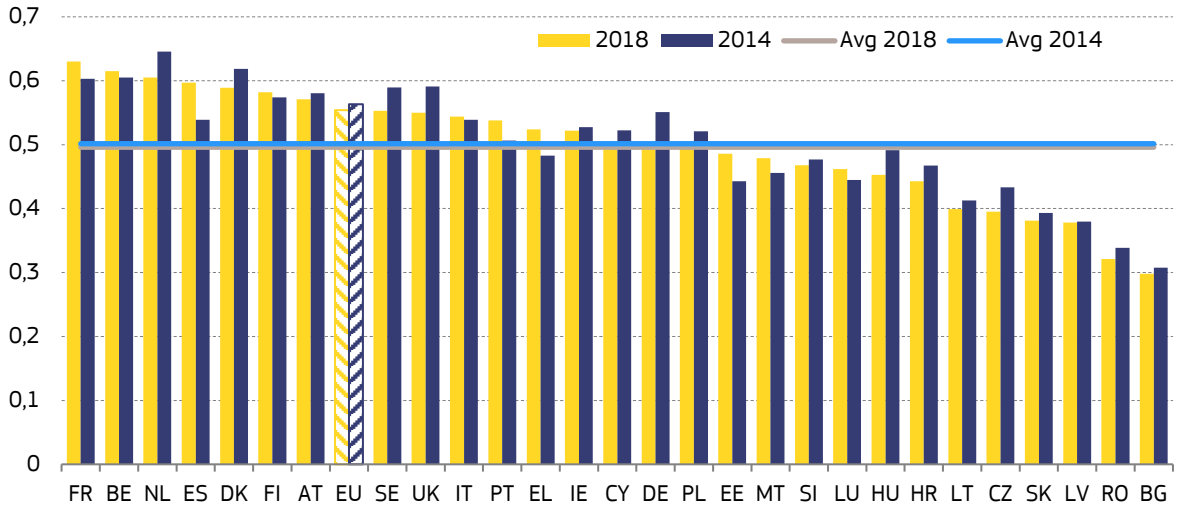
The 2018 semi-elasticities of the budget balance are very close to the 2014 estimates (Table IV.3 in annex and Figure 3.1). Overall, the revisions to the total semi-elasticities are negative in 18 cases out of 28. On average they are equal to -0.01 and the standard deviation of the revisions is equal to 0.03 which remains small compared to the average semi-elasticity (0.50). The semi-elasticities

[7] While the gap between the lower and medium size categories is large (0.4), it is more moderate between the high and medium size categories (almost 0.2), which could be seen as the existence of a continuum between those.

[8] Especially BG, CZ, EE, HR, LV, LT, HU, PL, RO, SI and SK.

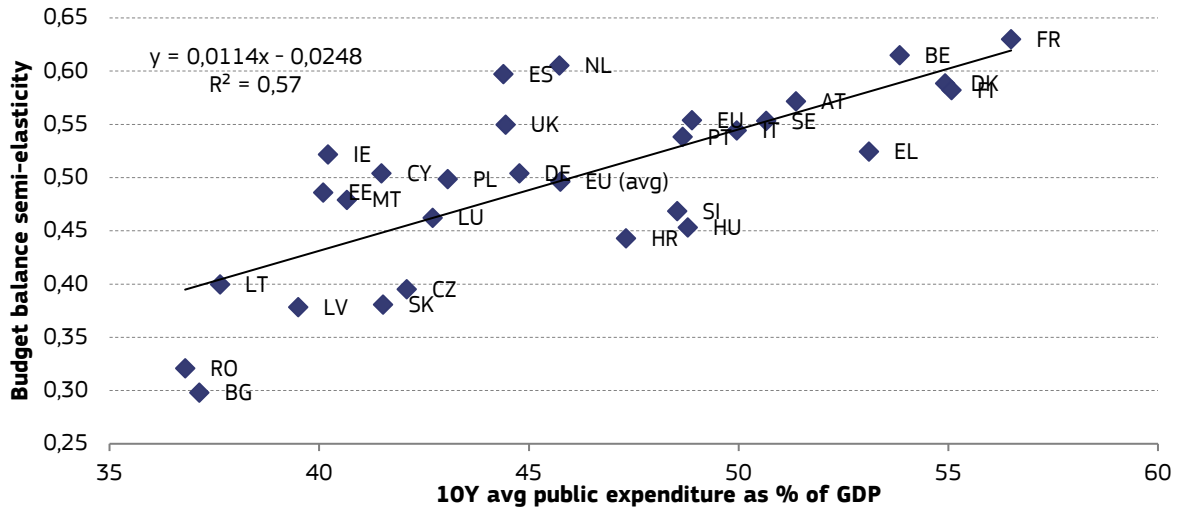
changed by 0.04 point in absolute terms in EE, EL, CZ, HU, NL, SE and UK, by 0.05 point in DE and 0.06 in ES. For the other Member States, the absolute revisions are lower.

Figure 3.1. **Revised budget balance semi-elasticities**



Note: EU refers to the EU Member States at the time of our analysis.
Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

Figure 3.2. **Expenditure to GDP and the semi-elasticities of the budget balance**



Note: EU refers to the EU Member States at the time of our analysis.
Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

3.2 REVISIONS AND THEIR CAUSES

3.2.1 Sources of revision of semi-elasticities

With respect to the latest estimates, three methodological sources of revisions affect the semi-elasticities. First, a major revision of the European System of Accounts in 2010 led to major changes in the categorisation of transactions in the general government accounts as well as a redefinition of GDP. Second, the new weights are computed on a more recent time window (2008-2017 instead of 2002-2011) which includes almost all years of the Great Recession and its aftermath, including major

changes in countries' fiscal policies (see Section 4.1). Finally, the treatment of the data has been improved, noticeably thanks to better data availability and time coverage, which allows reducing the use of imputations for missing data and of other data sources than AMECO. We use consistently AMECO for all weights, including the breakdown of direct taxes into personal and corporate income taxes (see annex III).

The revisions of the semi-elasticities are smaller on the revenue side than on the expenditure side (Figure 3.3). On the revenue side, the revisions to the semi-elasticities are in most cases negative and primarily explained by the introduction of ESA2010 and the change in the time window. On the expenditure side, the revisions are primarily driven by the change of the time window and are positive for the EU.

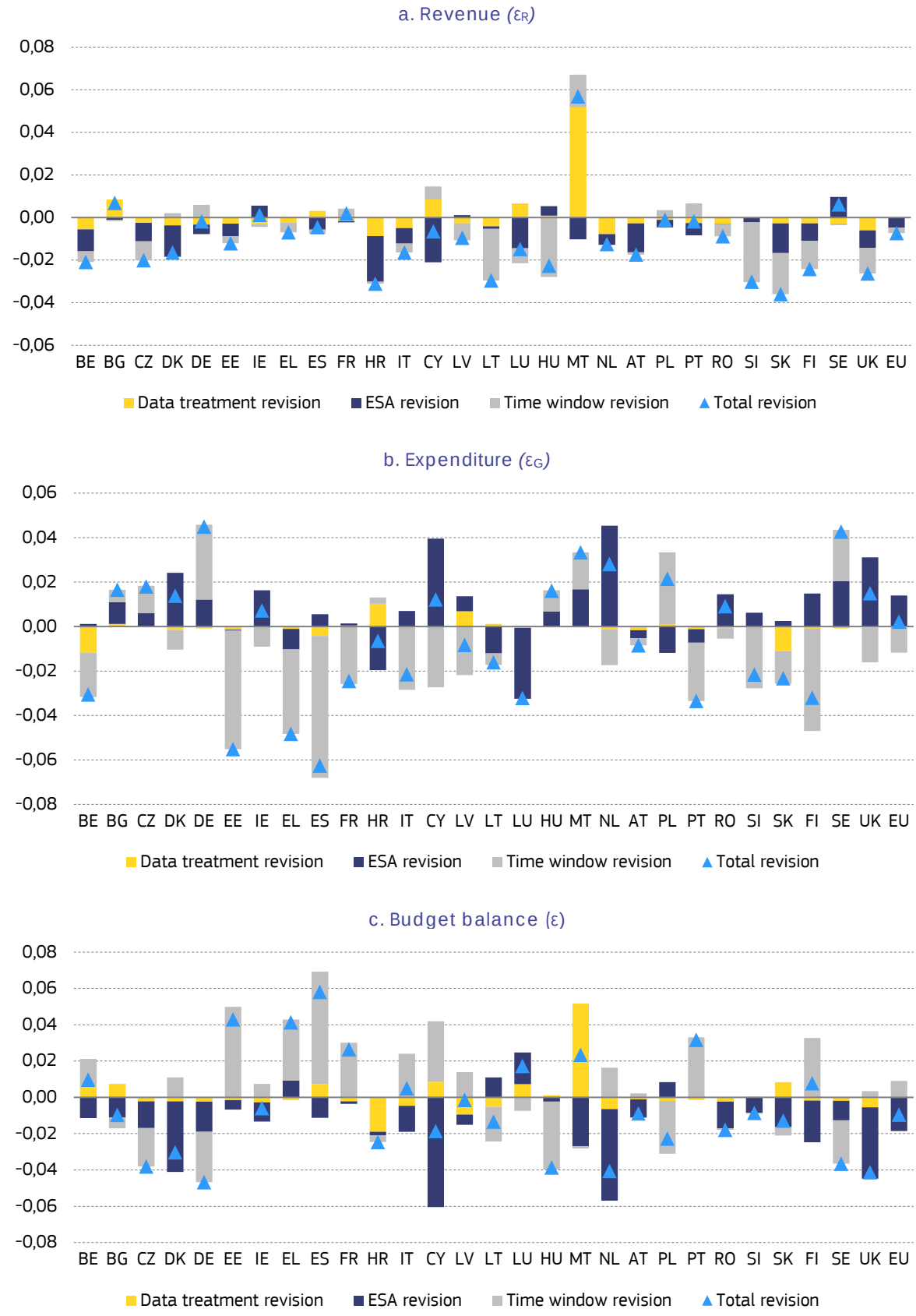
On the revenue side, all but five revisions are downward. These revisions are slightly smaller than those on the expenditure side. They are linked to the shift in time period and the new national accounts system (ESA 2010), both contributing negatively in the majority of cases.

On the expenditure side, there are downward revisions in 15 cases out of 28.[9] These downward revisions are associated with increases in the share of public expenditure to GDP, primarily due to the new time window which is centred on the crisis years. The new national accounts system (ESA 2010) often has a positive contribution to the revision of the expenditure semi-elasticities. On the budget balance semi-elasticities, the contributions from the expenditure side will therefore be reversed: downward for the ESA revision and upward for the new time window.

Increased data coverage explains the largest data treatment revisions (HR and MT). The data treatment revision for revenues in MT can be explained by the fact that for MT personal and corporate income taxes are estimated, since their values are missing in the AMECO database. However, with the new estimate, their sum is benchmarked on reported data (see annex III for further information). For HR the data treatment revision is explained by the shift from using the IMF as data source for personal income and corporate taxes (Mourre et al., 2014) towards using the AMECO database for the 2018 calculations. This unification of data sources is possible because HR has been reporting more information to Eurostat following its accession.

[9] We recall here that $\varepsilon = \varepsilon_R - \varepsilon_G$ and $\varepsilon_G = \left(\eta_{G,u} \frac{G_u}{G} - 1\right) \frac{G}{Y}$, see Equation (4)

Figure 3.3. **Sources of revision of the semi-elasticities**



Note: EU refers to the EU Member States at the time of our analysis.
Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

3.2.2 Contribution of the revenue and expenditure components to the revision

We can decompose the revisions of the semi-elasticities into the effect of the revenue/expenditure-to-GDP ratios (R/Y, G/Y) and the composition effect reflected by their elasticities (η_R, η_G; Equation (6)).[10]

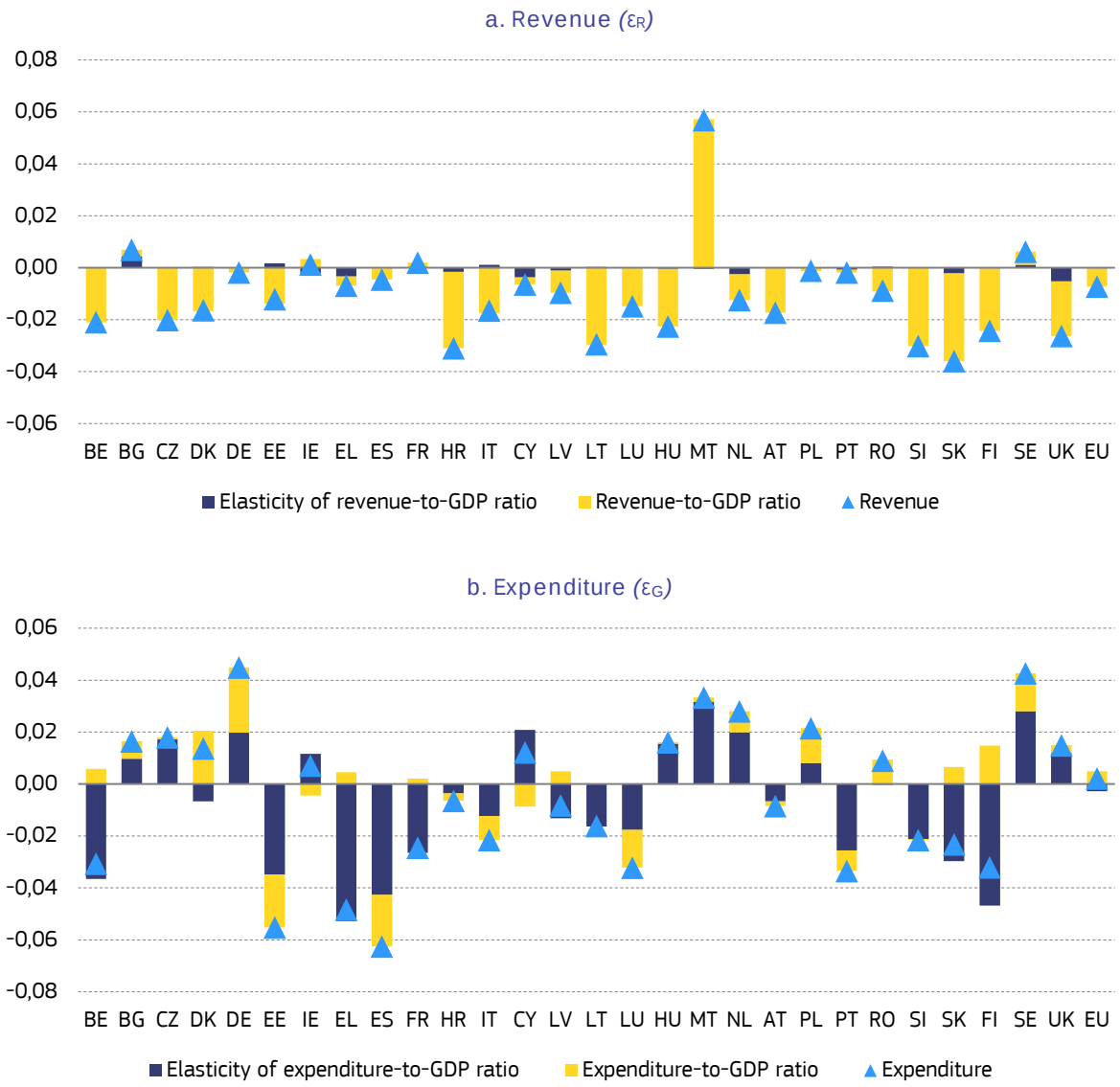
$$\varepsilon_R = \frac{R}{Y} * (\eta_R - 1) \; and \; \varepsilon_G = \frac{G}{Y} * (\eta_G - 1) \tag{6}$$

While the revenue revisions are primarily driven by changes in the revenue-to-GDP ratio, the expenditure revisions are mostly driven by changes in the aggregate revenue elasticity (Figure 3.4). On the revenue side, revisions are primarily driven by changes in the total revenue-to-GDP ratio: as most revenue categories have non-zero elasticities, changes in their relative weights have a limited impact on the revision of total revenue elasticity η_R. The total expenditure elasticity is, on the contrary, quite sensitive to expenditure composition effects. Because of the strong difference in elasticity of unemployment related expenditure and other expenditure, revisions are mainly driven by changes in η_G.

In more details, revisions can be decomposed into the contribution of the individual revenue and expenditure components (Box 5.1). On the revenue side, the revisions' primary driving force is non-tax revenue (Figure 3.5.a), which saw an increase of its share in total revenue between the 2014 and the 2018 estimate in all Member States beside PL and CY. This together with a decrease in the share of corporate tax in most Member States led to negative revisions of the revenue semi-elasticities. The large contributions of personal and corporate income tax for HR and MT are linked to the data revisions mentioned in Subsection 3.2.1. On the expenditure side, unemployment-related expenditure and other expenditure equally drive the revisions, which frequently have the same directionality (Figure 3.5.b). The share of unemployment-related expenditure, as % of total expenditure, decreased in 18 countries (Table IV.2 in annex), contributing positively to the revision of the semi-elasticity. This was caused by both time-window and ESA revisions.

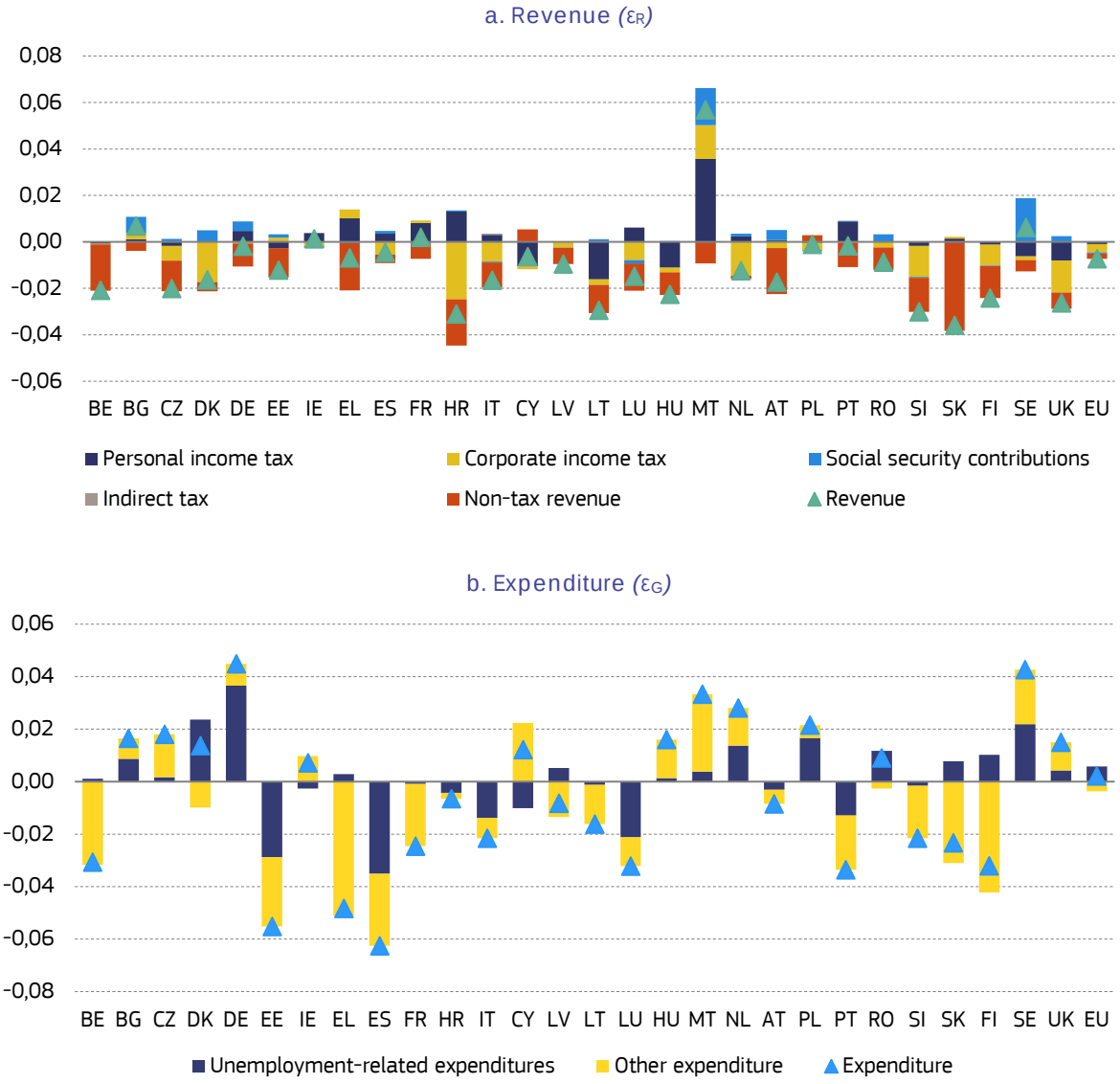
[10] The effect of the revision of the total revenue and expenditure elasticities is fully due to the change in the composition of revenue and expenditure since the individual elasticities of their components are unchanged.

Figure 3.4. **Contribution to the revision of the semi-elasticities**



Note: EU refers to the EU Member States at the time of our analysis.
Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

Figure 3.5. **Components' contribution to the revision of the semi-elasticities**



Note: EU refers to the EU Member States at the time of our analysis.
Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

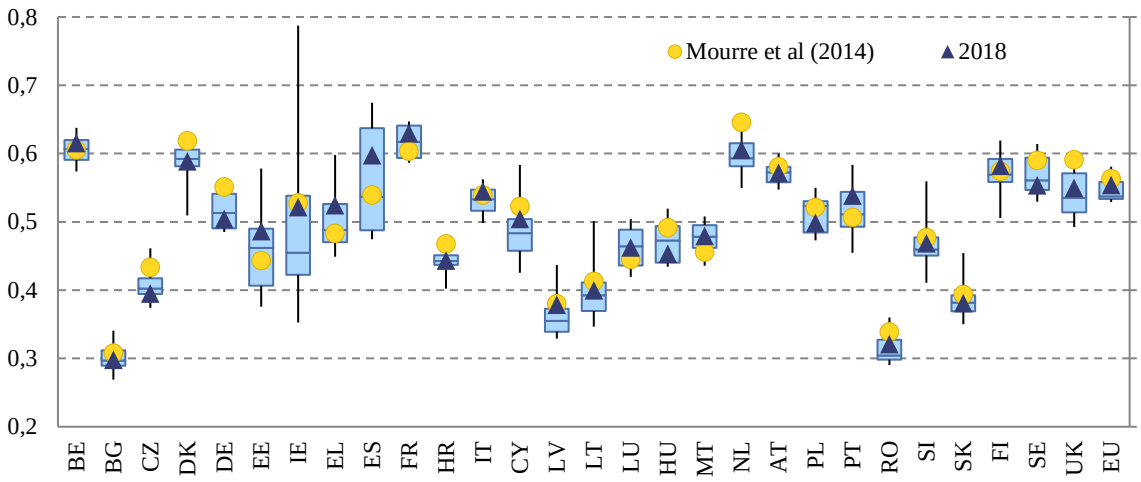
4. ANALYSIS OF THE SEMI-ELASTICITIES

In this section, we examine the robustness of the EU methodology of fiscal cyclical adjustment to the use of some simplifying assumptions, by introducing time-varying weights. We also run exploratory panel data analysis based on the four available vintages of semi-elasticities to investigate the relationship between semi-elasticities and economic and geographical factors.

4.1 SENSITIVITY ANALYSIS TO TIME VARIATION

We undertake a preliminary sensitivity analysis by calculating the semi-elasticities of the budget balance with annual time varying weights (Figure 4.1). The whiskers illustrate the maximum and minimum values while the boxes illustrate the middle 50% of the estimations between 2002 and 2017. For EE, IE, EL, ES, CY, LT, SI, the max to min distance is larger than 0.15. As expected, the new estimates, which rely on 10-year average weights, are within the middle of the distribution. Interestingly, despite the new ESA, the revisions of semi-elasticities since the last update appear relatively minor compared to the hypothetical revisions occurring if annual time varying weights were to be used. For some countries, the potentially large year-on-year volatility in the semi-elasticity highlights the trade-off between the communicability of a simple measure in the context of fiscal surveillance and tracking changes in the revenue and expenditure structure in the Member States.

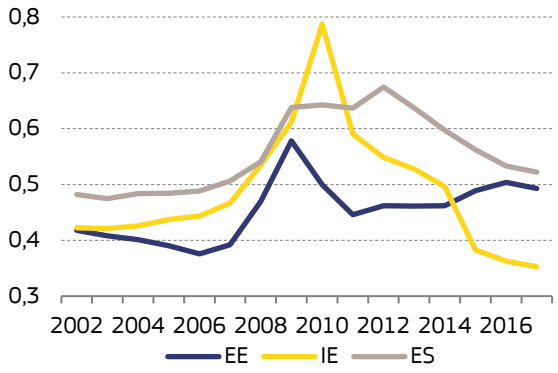
Figure 4.1. **Dispersion of budget balance semi-elasticities with time varying weights between 2002 and 2017**



Note: EU refers to the EU Member States at the time of our analysis.
Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

For EE, IE, and ES, the dispersion of the time varying semi-elasticity is quite large (0.20, 0.43 and 0.20 respectively). The recent crisis led to drastic increases of the semi-elasticities from 2008 onwards (Figure 4.2). This was primarily driven by decreasing expenditure semi-elasticities across all three countries, which was caused by increasing unemployment expenditure. While they amounted to 0.94% of GDP (EE), 4.23% of GDP (IE) and 4.02% of GDP (ES) in 2006, they increased to 4.51%, 4.79% and 6.69% respectively in 2009. The extent of decreasing expenditure semi-elasticities (which has a positive effect on the budget balance elasticities) more than compensated for the parallel decreasing revenue semi-elasticities.

Figure 4.2. **Time varying fiscal semi-elasticities (three examples)**



Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

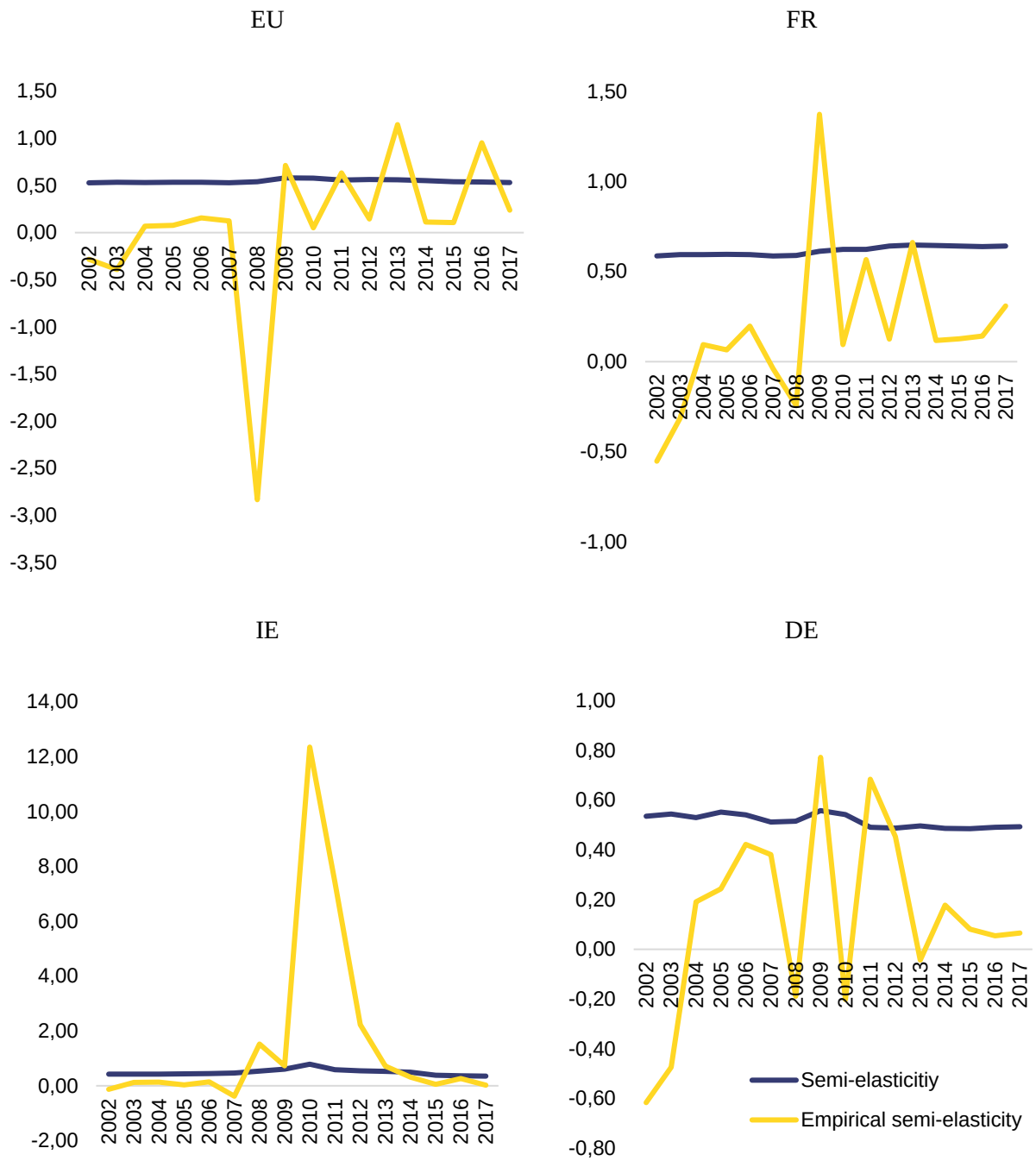
Smoothing out the effect of the economic and financial crisis barely affects the semi-elasticities, which would become only marginally lower than the revised value (Table V.1 in annex**).** We smooth out the effect of the Great Recession in two ways. First, we exclude capital transfers[11] from total expenditure in order to exclude one-off capital transfers (bank recapitalisation) that occurred during the financial crisis. Excluding capital transfers from public expenditure (denoted G in Equation (4)) would automatically decrease the semi-elasticities compared to the proposed update. The effect on the semi-elasticity is on average only of -0.01 and ranges between 0 and -0.03. Second, we also calculate the semi-elasticities using the full 2002-17 time-window to reduce the weight of the crisis in an expanded sample. The revisions compared to the present estimates would be negative for most Member States (also -0.01 on average) and range from 0.02 to -0.04. The decrease in the semi-elasticities would be the most sizeable for the three countries were the weights are the most time varying (-0.04 for EE and ES, -0.03 for IE). In the case of EE or ES, this would mitigate the upward revision of the semi-elasticity. For IE it would further increase the downward revision of the semi-elasticity.

Empirically observable semi-elasticities – measured from a year to another - are far more volatile than our time varying estimates and their information is not easy to interpret (Figure 4.3). By making the weights time-varying, we capture part of the year-on-year variations of the fiscal elasticities. Our estimates however neglect other sources of volatility, in particular changes to the individual elasticities and the impact of new policy decisions. While the comparison between our estimates and the empirical elasticity illustrates the existence of other sources of volatility, it should be borne in mind that the empirically observable semi-elasticities remain a temporal concept (measured between two years) and cannot be equated to the underlying cyclical semi-elasticities (unobserved concept, used to correct the cyclical component for a given year). In practice the empirical semi-elasticities greatly depart from our estimates and show large variations, sometimes linked numerically to small GDP growth rates in the denominator. For instance on the IE case, which shows one of the greatest volatility, the pic observed in 2010 in the time-varying semi-elasticities (Figure 4.2) is very limited compared to the jump in the empirical semi-elasticity that same year (Figure 4.3). In addition to this high volatility, country comparisons show that the empirical semi-elasticity does not fluctuate around the value computed using the EU methodology (from a detailed approach considering each revenue and expenditure item separately). The effective semi-elasticities are therefore hardly exploitable in the context of fiscal policy analysis. This confirms the results of Princen et al. (2013).

[11] AMECO code UKTGT, ESA/Eurostat D9 paid.

This very strong volatility of empirical elasticities could be traced back to a number of factors. Princen et al. (2013) recall the web of possible drivers of empirical semi-elasticities. Four types of factors can be distinguished: i) the composition of growth, with more or less tax-rich components; ii) asset price cycle effects (generating tax shortfall/windfall); iii) dynamic effects (fiscal drags, but also declaration/collection lags) and iv) tax compliance effect (due to higher credit constraints or higher rate of bankruptcy in bad times). These elements – not taken into account in the EU methodology – are mostly country-specific.

Figure 4.3. **Comparison with the empirical semi-elasticities**



Note: EU refers to the EU Member States at the time of our analysis
Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

4.2 EXPLORATORY ANALYSIS OF DETERMINANTS

This section investigates which cyclical and structural factors can be associated with the semi-elasticities. We consider four vintages of the semi-elasticities for the 28 EU countries: i) the present estimates, ii) those of Mourre et al (2014), iii) those of Mourre et al (2013), and iv) those of Girouard and André (2005), as extended to the EU27 (European Commission, 2005 and 2006).[12]

We derive a simple model to explain the semi-elasticities from Equation (5) in Section 2. This develops the Equation (4) by isolating individual tax and non-tax revenue on the one side and unemployment and other expenditure on the other, all taken as a percentage of GDP. Our econometric model specification (7) closely follows this formula. The estimated coefficients for α and β capture the average semi-elasticity of the two types of expenditure (unemployment-related spending and the rest), while the estimated value for γ_k capture the average semi-elasticity of each revenue component *k*. The residual corresponds to the cross country dispersion and time variations in individual elasticities. Part of these effects can be captured with country and vintage fixed effects:

$$\varepsilon_{i,v} = \alpha \frac{G_{u_{i,v}}}{Y_{i,v}} + \beta \frac{G_{o_{i,v}}}{Y_{i,v}} + \sum_{k=1}^{5} \gamma_k \frac{R_{k,i,v}}{Y_{i,v}} + \mu X_{i,v} + \delta_i + \mu_v + \rho_{i,v} \quad (7)$$

with i and v the country and vintages indexes, δ_i country fixed effects, μ_v vintage fixed effects, X additional explanatory variables and $\rho_{i,v}$ a residual.

We run several specifications sequentially to seek a parsimonious model (Table 4.1). A *minimalistic model* (column a), including only the total revenue and expenditure to GDP ratio (alongside two measures of the business cycle), shows the significance of these two aggregate ratios but has a limited explanatory power, due to missing variables. An *exhaustive model* including all revenue and expenditure components (column b, Equation (7)) has a much larger explanatory power, but may be partly tautological, since based on the very formula defining the semi-elasticities. Its usefulness remains to empirically identify the significant and non-significant variables. For instance, the effect of tax revenue categories turns out to be not significant. This result is robust to the *introduction of vintage dummies* (column c) and to *the grouping of taxes* (column d). This allows specifying a *reduced model with vintage dummies* (column e), which includes only the non-tax revenue-to-GDP ratio, the ratios of unemployment-related spending and other expenditure to GDP.

We obtain a baseline specification, which is in line with the expectation from the theory. Throughout the models shown in columns (a) to (e), there is no evidence of a residual cyclical effect, either measured by the output gap or unemployment gap, which is a desirable feature. Adding the deficit does not turn out significant. In an *amended reduced model*, which we use as our baseline in the subsequent regressions shown in annex (column f), we remove all cyclical variables (and the deficit) to only retain three significant variables at the 1% threshold (plus vintage dummies, which are jointly statistically significant at the 1% threshold). These variables correspond to structural fiscal parameters, in particular the size of government, the share of non-tax revenue and the share of unemployment-related expenditure.[13] The non-significance of tax variables can be related to their weak contribution to fiscal semi-elasticities, as shown in Figure 2.4. We also test the restrictions that the coefficient on non-

[12] The 2005 vintage of semi-elasticities excludes HR.

[13] The size of government (proxied here by the total amount of expenditure – excluding unemployment benefits) and the share of non-tax revenue are little affected by the business cycle when expressed in nominal terms and therefore highly cyclical when expressed as a ratio to GDP. The unemployment-related expenditure completes the picture, since the ratio to GDP is very cyclical, with the combined effects of the numerator and denominator.

tax revenue is equal to -1 and that the coefficient on other expenditure is equal to 1, which is accepted at the standard 5% threshold, as expected from Equation (5). Also in line with Equation (5), the estimated coefficient of unemployment expenditure is not statistically different from 5.15, which is the opposite of the panel average of the unemployment expenditure output semi-elasticity. Finally, the baseline model is robust to the presence of country fixed effects, which do not substantially improve the goodness to fit, although statistically significant.

We investigate the link between the semi-elasticities and economic factors or geographical factors. For the present analysis, we consider economic factors potentially related to fiscal elasticities (e.g. Figure 3.2, Figure 4.4). In particular, we consider factors related to i) the fundamentals of the economy (relative size in the EU, economic volatility, GDP per capita), wage to value-added ratio), ii) fiscal and taxation policy (debt and deficit-to-GDP ratio, top personal income tax (PIT) and corporate income tax (CIT) rates). We also test the significance of geographical clusters, such as the euro area membership, Member States who joined the EU in 2004 and after,[14] lower-income countries,[15] programme countries,[16] and the GDP-weighted elasticity of the neighbouring countries.[17] In order to identify the additional explanatory power of these variables/dummies (introduced in the baseline model one by one), we remove the country fixed effects.

Unlike fiscal variables, many non-fiscal economicvariables tested in this paper turn out to be not robustly related to the elasticities. The semi-elasticities are structural parameters specific to EU economies. However, the income per capita, the economic size, the labour share and the output gap volatility do not turn out to be statistically significant. When considering additional fiscal variables, the progressivity of the tax system (as roughly proxied by PIT and CIT top statutory rates) appears to significantly affect the semi-elasticity.[18] This result was expected, since the tax progressivity should capture part of the cross-country variability related to different elasticities of direct taxes.

Some economic or geographical grouping of Member States seems to be relevant as well as an emulation effect between neighbours. Using geographical dummies (see Table V.3, column c to f in annex) we find that Member States who joined the EU since 2004 or those with lower income tend to have lower semi-elasticities. We also test for the influence of close peers with the GDP-weighted semi-elasticity of the neighbouring countries as a regressor. Member States tend to have higher semi-elasticities when the semi-elasticity of their neighbours is higher (Table V.3 column b in annex). This would suggest that Member States are somehow aligning their semi-elasticities, or rather, some elements of their tax and benefit systems underlying those, with those of the neighbouring countries.

[14] BG, CZ, CY, EE, HR, LV, LT, MT, HU, PL, RO, SI and SK

[15] BG, HR, HU, PL, RO. This follows the categories used by the IMF.

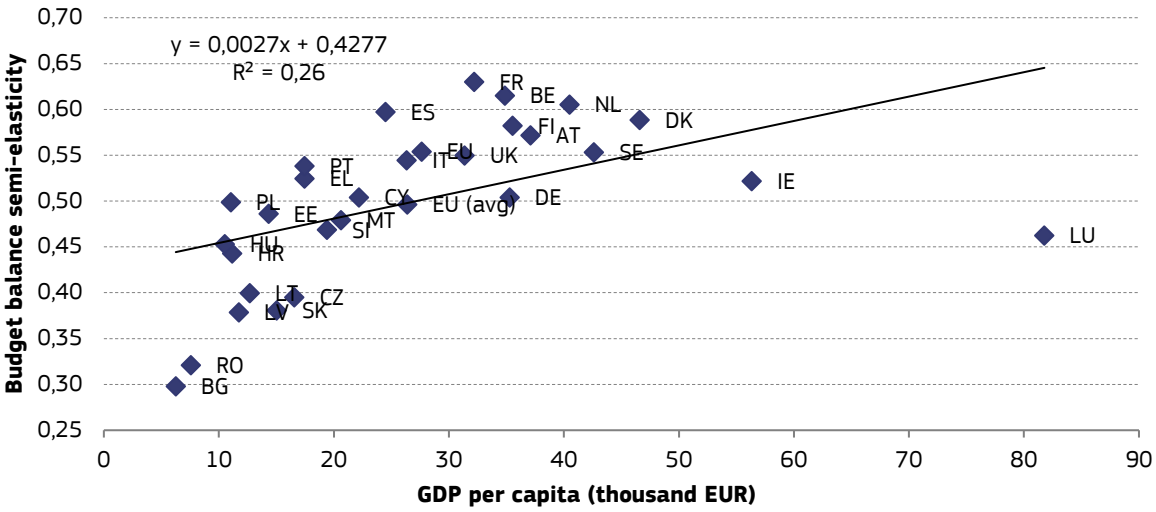
[16] This includes the euro area Member States once covered by an Economic Assistance Programme or non-euro-area Member States once subject to a Balance of Payment Programme following the crisis (IE, EL, ES, CY, LV, PT, RO).

[17] Using the elasticity of the neighbouring countries in our model tests for the influence of neighbours on each Member State, which can be interpreted as a sort of peer pressure or exemplarity effect.

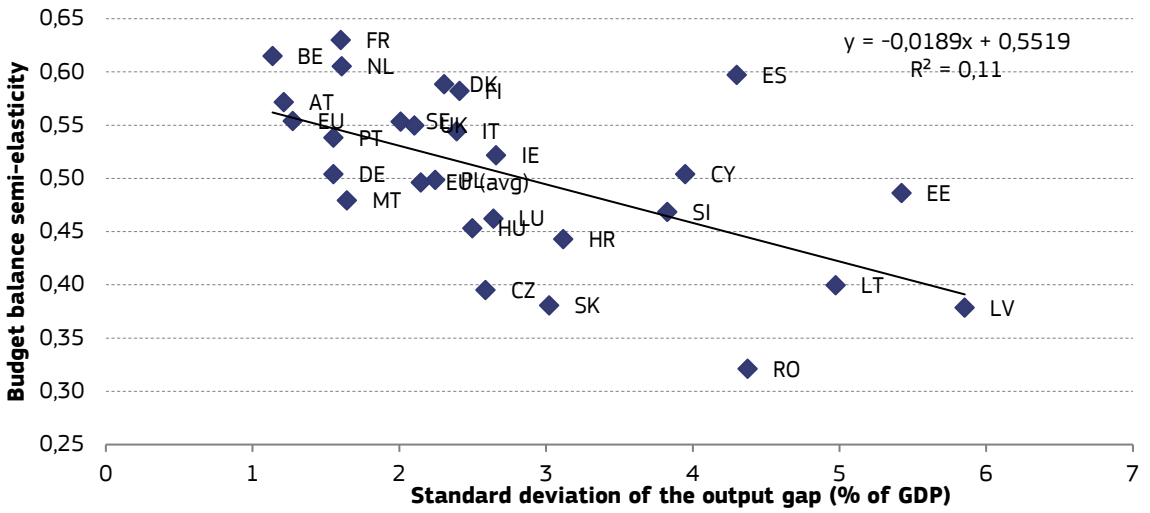
[18] Time series on top marginal statutory rates are available on-line and correspond by definition to reliable data (DG TAXUD): https://ec.europa.eu/taxation_customs/business/economic-analysis-taxation/data-taxation_en. A high top marginal statutory rate generally means a very progressive tax scale for personnel income taxation. This is even true for "flat tax" countries, because of the existence of a tax-free allowance. For corporate income taxation, the link is more indirect, given the existence of many tax expenditures, e.g. for small and medium size firms taxed at a lower rate than the top statutory rate.

Figure 4.4. **Economic factors and the semi-elasticities of the budget balance**

a. Economic development



b. Output gap volatility



Note: EU refers to the 28 EU Member States at the time of our analysis

Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

Table 4.1. **Baseline models for semi-elasticities in a four-vintage panel**

	(a)	(b)	(c)	(d)	(e)	(f)
Expenditure						
Expenditure/GDP	0.986***					
	(0.000)					
Unemployment spending/GDP		8.680***	7.646***	7.584***	7.622***	7.026***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other expenditure / GDP		1.011***	0.890***	0.871***	0.998***	0.867***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Revenue						
Revenue / GDP	-0.881***					
	(0.000)					
Total taxes / GDP				0.0702		
				(0.828)		
Direct taxes (PIT+CIT) / GDP				0.182		
				(0.643)		
PIT / GDP		-0.384	0.249			
		(0.511)	(0.530)			
CIT / GDP		-0.502	0.184			
		(0.406)	(0.751)			
SSC / GDP		-0.921***	-0.0154			
		(0.007)	(0.961)			
Indirect tax / GDP		-0.124	0.329			
		(0.731)	(0.362)			
Non tax revenue / GDP		-0.910***	-0.798***	-0.776***	-0.898***	-0.803***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Possible residual cyclical effect						
Output gap	0.00239	0.00459	0.00425	0.00438	0.00410	
	(0.507)	(0.217)	(0.230)	(0.226)	(0.230)	
Unemployment gap	0.00504*	0.00233	-0.00232	-0.00186	-0.00204	
	(0.084)	(0.444)	(0.360)	(0.459)	(0.406)	
Budget balance					0.133	
					(0.617)	
Vintage dummies						
Vintage 2013			-0.00882	-0.00984	-0.0102	-0.00803
			(0.186)	(0.175)	(0.170)	(0.212)
Vintage 2014			0.0361***	0.0359***	0.0358***	0.0385***
			(0.001)	(0.001)	(0.001)	(0.000)
Vintage 2018			0.0409***	0.0411***	0.0410***	0.0376***
			(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.403***	0.162*	-0.0404	-0.00980	-0.00870	0.0457
	(0.000)	(0.070)	(0.681)	(0.917)	(0.926)	(0.257)
Observations	111	111	111	111	111	111
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Vintage fixed effects	No	No	Yes	Yes	Yes	Yes
R2 within	0.238	0.418	0.674	0.670	0.669	0.660
R2 between	0.0243	0.804	0.841	0.839	0.823	0.831
R2 overall	0.0617	0.737	0.809	0.807	0.795	0.801

Note: p-values in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
Source: authors' calculations

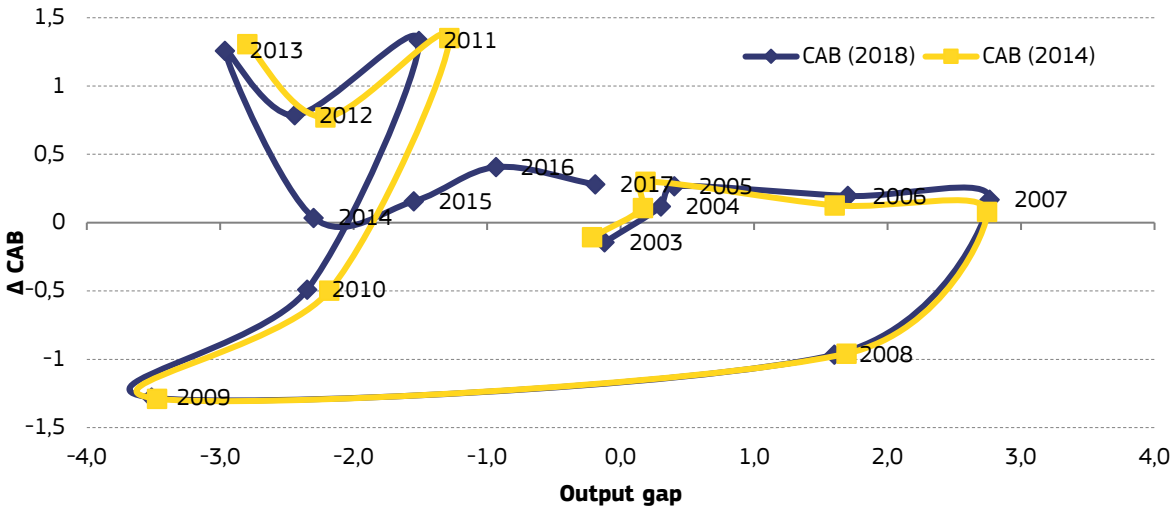
5. IMPACT OF REVISIONS ON THE CYCLICALLY-ADJUSTED BUDGET BALANCE (CAB)

While the previous section focused on the semi-elasticities, this section examines the impact of the semi-elasticity updates on the CAB itself. It first compares the updated CAB estimates with those based on the 'old' semi-elasticities, set out in Mourre *et al.* (2014). Next, we decompose the revision and show that the semi-elasticities are only a minor source of CAB revisions. In a sensitivity analysis, we compute the CAB without first order approximation and with time-varying weights. This analysis reassuringly shows that little information is lost with the simplified approach used by the Commission.

5.1 THE REVISED CAB

Despite revisions of its components, our assessment of the CAB for the EU as a whole over the last 15 years is unchanged (Figure 5.1). Changes in the CAB are a key measure of the fiscal effort analysed in perspective of the position in the economic cycle (output gap). For the EU as a whole, the CAB is equal to the aggregation of the 28 CAB of the Member States. The revisions of the semi-elasticities do not generate sizeable revisions of the aggregate EU CAB, since the more sizeable revisions of the nominal balances and (most importantly) output gaps broadly cancel out across Member States. In all, over the period common with the previous update (2003-2013), the revisions of the aggregate CAB are minor.

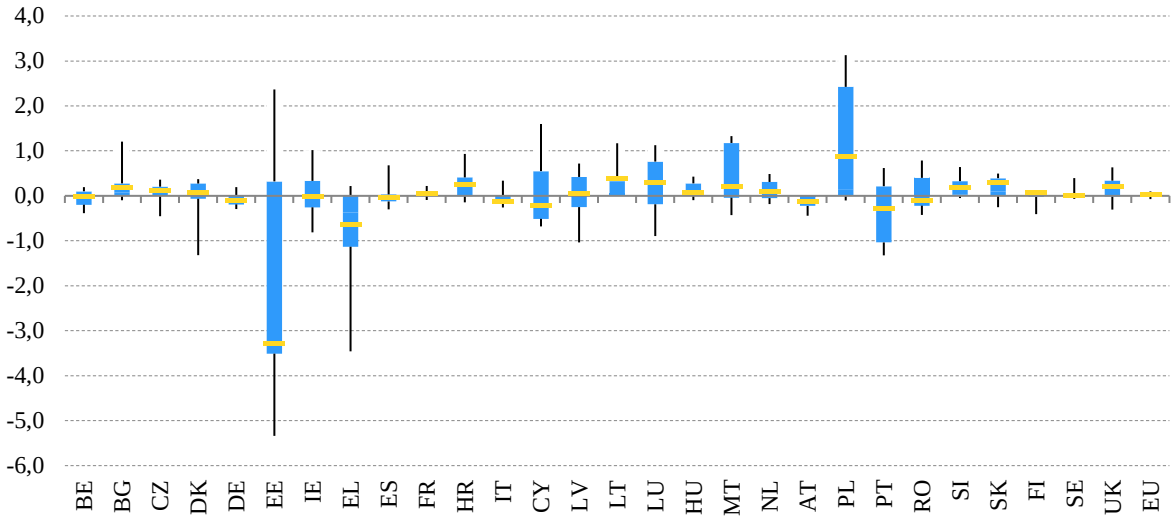
Figure 5.1. **EU CAB change vs output gap**



Note: EU refers to the EU Member States at the time of our analysis
Source: AMECO 2018 Spring forecast and 2014 Spring forecast, Mourre et al. (2014) and authors' calculations

At country level, the CAB estimates were sizeably revised since 2014, especially for EE, EL and PL (Figure 5.2). Comparing the new country-specific estimates with the ones from Mourre *et al.* (2014) between 2002 and 2013, revisions ranged from -5.3pp (EE, 2005) to 3.1pp (PL, 2007), while revisions of the EU aggregate CAB only ranged from -0.1 to 0.1 (Figure 5.2). This is mainly due to some annual CAB estimates for EE, EL and PL, which are outliers as compared to the annual estimates of other Member States.

Figure 5.2. **CAB annual revisions (2002-2013)**



Note: EU refers to the EU Member States at the time of our analysis
Source: AMECO 2018 Spring forecast and 2014 Spring forecast, Mourre et al. (2014) and authors' calculations

5.2 REVISION AND ITS CAUSES

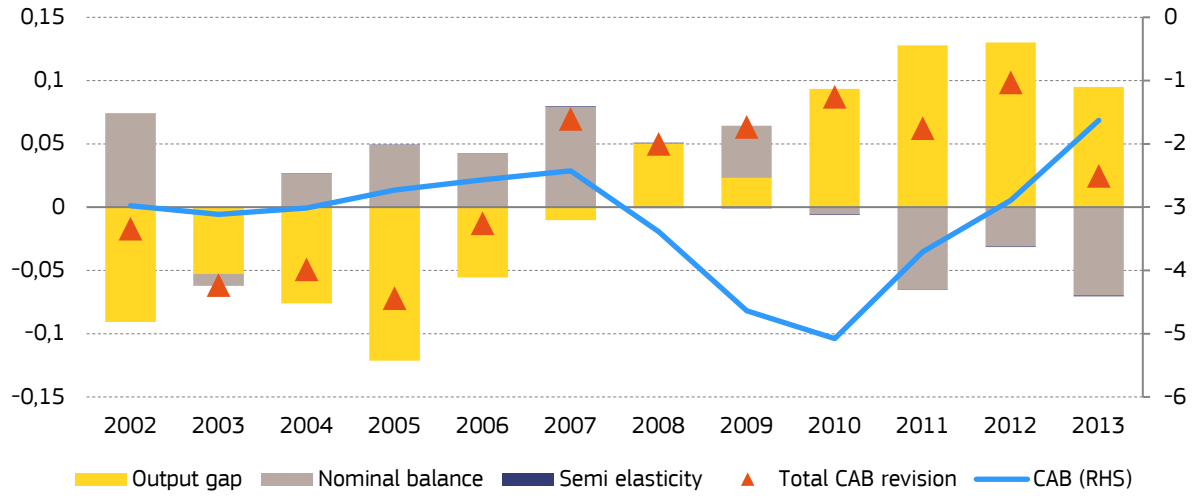
5.2.1 Contributions to the CAB revisions

CAB revisions can be decomposed into contributions of the output gap, the headline balance and the semi-elasticities (Box 5.1). The causes for the semi-elasticity revisions have been discussed in detail in Section 3.2. The headline balance revisions are directly linked to the shift from ESA-1995 to ESA-2010. For the output gap, econometric revisions and methodological changes are causing revisions in addition to the new ESA.

The EU CAB revisions are primarily driven by revisions of the output gap. The EU CAB revision between 2002 and 2013 (Figure 5.3)[19] is mainly caused by output gap revisions, while also the contribution of the headline balance is sizeable. However, revisions linked to the semi-elasticities are barely visible. The output gap revisions are counter-cyclical: negative in times of economic expansions and positive in times of economic contractions. However, output gaprevisions are complex, as cyclical turning points are difficult to identify and first estimates of the output gap tend to be conservative during crisis and booms. As more data becomes available, output gap estimates improve, making the output gap more negative during crisis (more positive during upturns) and leading to a positive (negative) revision of the CAB.

[19] This EU CAB revision is based on computation for the EU as if it were a Member State. In annex II, we discuss the aggregation of the CAB.

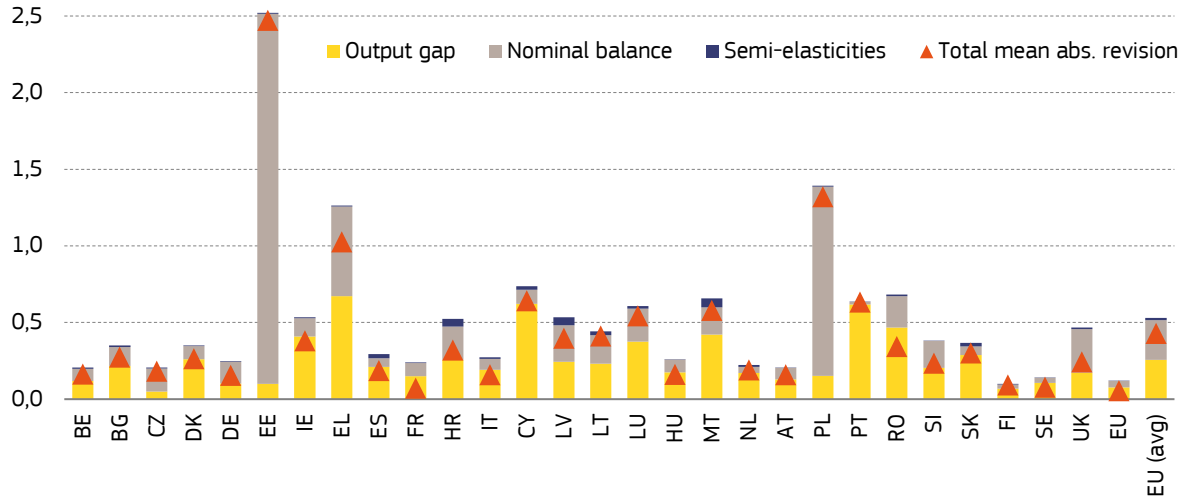
Figure 5.3. **Contributions to EU CAB revision and 2018 vintage of the CAB**



Note: EU refers to the EU Member States at the time of our analysis
Source: AMECO 2018 Spring forecast and 2014 Spring forecast, Mourre et al. (2014) and authors' calculations

These findings are confirmed by the mean absolute CAB revisions per Member State over the same time period (Figure 5.4). The largest annual revisions identified in Figure 5.2 are caused by large revisions in the headline balance for EE (around 2005), PL (2006-2007) and to some extend EL (2003-2004). Apart from these cases, the CAB revisions are caused primarily by output gap revisions with semi-elasticity revisions having a marginal effect. In particular, for ES and DE, the two Member States with the largest revisions of their semi-elasticities, the effect on the CAB revision remains small. For other Member States (MT, LV, HR, DK) the effect of the semi-elasticity revision can be more pronounced, even though the revision of the semi-elasticities itself is not large, as it is amplified by the magnitude of their output gaps.

Figure 5.4. **Absolute mean contribution to CAB revision across Member States (2002-2013)**



Note: EU refers to the EU Member States at the time of our analysis. Mean absolute contribution to the revision do not add up to the mean absolute revision as the different sources of revisions don't cancel-out in absolute terms.
Source: AMECO 2018 Spring forecast and 2014 Spring forecast, Mourre et al. (2014) and authors' calculations

Box 5.1. **COMPUTING CONTRIBUTIONS TO THE REVISION OF THE SEMI-ELASTICITY AND OF THE CYCLICALY ADJUSTED BALANCE**

Contributions to the revision of the semi-elasticity

We recall the expression for the semi-elasticity:

$$\varepsilon = \varepsilon_R - \varepsilon_G = \left(\sum_{i=1}^{4} \eta_{R,i} \frac{R_i}{R} - 1\right) \frac{R}{Y} - \left(\eta_{G,u} \frac{G_U}{G} - 1\right) \frac{G}{Y}$$

Introducing $R_5 = R - \sum_{i=1}^{4} R_i$ with $\eta_{R,5} = 0$ and $G_{\bar{U}} = G - G_U$ with $\eta_{G,\bar{U}} = 0$, one can also write:

$$\varepsilon = \sum_{i=1}^{5} (\eta_{R,i} - 1) \frac{R_i}{Y} - \sum_{x \in \{U,\bar{U}\}} (\eta_{G,x} - 1) \frac{G_x}{Y}$$

The current revision leaves the elasticities of the revenue and expenditure components ($\eta_{R,i}, \eta_{G,u}$) unchanged. One can therefore directly relate the change in the elasticity to the changes in the share of each revenue and expenditure component to GDP:

$$\Delta\varepsilon = \varepsilon^n - \varepsilon^o = \sum_{i=1}^{5} (\eta_{R,i} - 1)\, \Delta\left(\frac{R_i}{Y}\right) - \sum_{x \in \{U,\bar{U}\}} (\eta_{G,x} - 1)\, \Delta\left(\frac{G_x}{Y}\right)$$

with superscripts "o" and "n" identifying the old and new values and Δ the revision operator.

Contributions to the revision of the CAB

We recall the expression for the CAB calculation

$$CAB_t = B_t - \varepsilon\, OG_t$$

Revisions to the CAB can come from three sources: revisions to the headline balance (ΔB), revision to the output gap estimates (ΔOG) and revision to the semi-elasticity (Δε):

$$\Delta CAB_t = {CAB_t}^n - {CAB_t}^o = \Delta B_t - \Delta(\varepsilon\, OG_t)$$
$$\Delta CAB_t = \Delta B_t - \frac{{OG_t}^o + {OG_t}^n}{2} \Delta\varepsilon - \frac{\varepsilon^o + \varepsilon^n}{2} \Delta OG_t$$

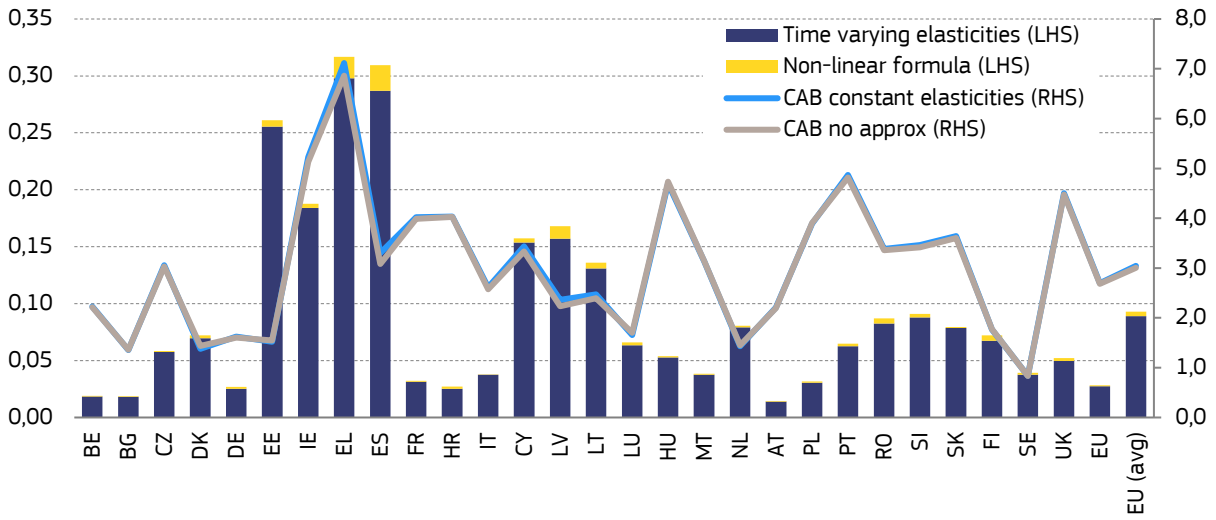
The three sources of revisions differ markedly: revisions to the headline balance are direct revisions of the national accounts; revisions to the output-gap can be more substantial and also reflect econometric revisions and methodological changes; revisions to the semi-elasticities are explained in detail in Section 3.2.

5.2.2 A validation of the Commission's CAB methodology

The EU common methodology to estimate the CAB relies on a linear approximation[20] and some simplifications (constant semi-elasticities and weights). To test the robustness of the CAB estimates, we calculate the CAB with time varying weights and don't make a linear approximation.

CAB estimates are robust to using time-varying semi-elasticities[21] and a non-linear approximation, validating the EU common methodology. As illustrated in Figure 5.5 and Figure 5.6 both approximations are relatively small compared to the level of the CAB. This empirically validates the Commission's CAB methodology and reassuringly shows that little information is lost with the simplified approach used by the Commission. Figure 5.6 displays the CAB for some Member States with the most time varying semi-elasticities (IE, ES, EE), with the most volatile output gap (EL, LV, EE), or with the highest semi-elasticity (FR). It shows that the CAB is only marginally impacted by the use of time varying elasticities (the effect is most visible during the crisis) and almost not impacted by the nonlinear approximation). This is confirmed across Member States by the mean absolute effect over the 2002-17 time-period of using time varying weights or not making a first order approximation (Figure 5.5).

Figure 5.5. **Absolute mean CAB approximations across Member States (2002 to 2017)**

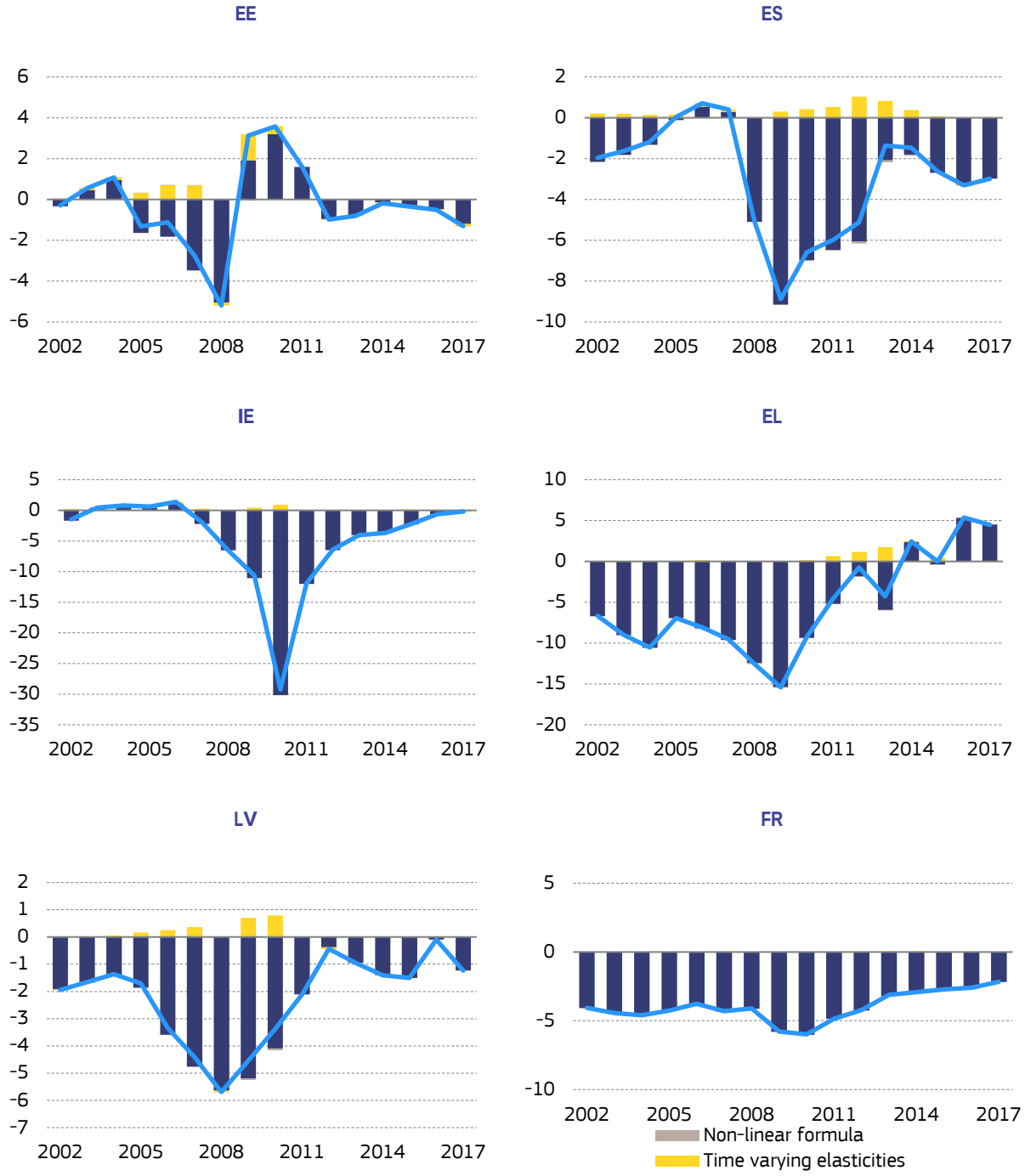


Note: EU refers to the EU Member States at the time of our analysis.
Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

[20] To compute the CAB as in Equation (1), one has to assume that $(1+OG_t)^{1-\eta} \approx 1+(1-\eta)OG_t$ both for the expenditure and revenue side, see annex II, Equations (10) to (12).

[21] Note that this time-varying estimation of the semi-elasticities solely uses time-varying weights and not time-varying individual elasticities, due to the non-availability of the latter.

Figure 5.6. **CAB calculation (and approximation) in selected Member States**



Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

REFERENCES

Deroose, S., Carnot, N., Pench, L. R., and Mourre, G. (2018). EU fiscal rules: Root causes of its complexity. *VoxEU.org*. https://voxeu.org/article/eu-fiscal-rules-root-causes-its-complexity

Alberola, E., González Mínguez, J.M., Hernández de Cos, P., and Marqués, J.M. (2003). How cyclical do cyclically-adjusted balances remain? An EU study. *Hacienda Pública Española*, IEF, vol. 166(3), pages 151-181, (Sept.) https://ideas.repec.org/a/hpe/journl/y2003v166i3p151-181.html

Blanchard, O., and Perotti, R. (2002). An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *The Quarterly Journal of Economics*, *117*(4), 1329-1368. http://www.jstor.org/stable/4132480

Bouthevillain, C., Cour-Thimann, P., van den Dool, G., Hernandez de Cos, P., Langenus, G., Mohr, M., Momigliano, S. and Tujula, M. (2001). Cyclically Adjusted Budget Balances: An Alternative Approach. *ECB Working Paper Series* 77. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp077.pdf

Belinga V., D. Benedek, R. A. de Mooij and Norregaard, J. (2014). Tax Buoyancy in OECD Countries. *IMF Working Paper* 110. http://www.imf.org/external/pubs/ft/wp/2014/wp14110.pdf

D'Auria, F., Denis, C., Havik, K., Mc Morrow, K., Planas, C., Raciborski, R., Roeger, W. and Rossi, A. (2010). The production function methodology for calculating potential growth rates and output gaps. *European Economy Economic Papers* No. 420. doi: 10.2765/71437

Escolano, J. (2010). A Practical Guide to Public Debt Dynamics, Fiscal Sustainability, and Cyclical Adjustment of Budgetary Aggregates. *IMF Technical Note and Manuals* 10/02. http://www.imf.org/external/pubs/ft/tnm/2010/tnm1002.pdf

European Commission (1995). The Commission services' method for the cyclical adjustment of government budget balances. *Technical note in European Economy Broad economic policy guidelines* vol 60, p 35:90 http://ec.europa.eu/economy_finance/publications/pages/publication_summary7975_en.htm

European Commission (2000). Public Finances in EMU. *European Economy* 3/2000 https://publications.europa.eu/en/publication-detail/-/publication/f54190f8-5e37-4388-b079-432cdaed454d/language-en/format-PDF/source-80716032

European Commission (2005). New and updated budgetary sensitivities for the EU Budgetary Surveillance. September. http://ec.europa.eu/economy_finance/economic_governance/sgp/pdf/budg_sensitivities_092005_v02_en.pdf

European Commission (2006). Public Finances in EMU. *European Economy* 3/2006. Part II.4.3 pp 115-122. http://ec.europa.eu/economy_finance/publications/pages/publication_summary429_en.htm

European Commission (2010). Public Finances in EMU. *European Economy* 4/2010. doi: 10.2765/36026

European Commission (2018). Vade mecum on the stability and growth pact. *European Economy Institutional paper* 075/2018 (March). doi: 10.2765/698908

Giorno, C., Richardson, P. and van den Noord, P. (1995). Estimating Potential Output, Output Gaps and Structural Budget Balances. *OECD Economics Department Working Papers* 24. https://doi.org/10.1787/533876774515

Girouard, N. and Andre, C. (2005). Measuring Cyclically-Adjusted Budget Balances for the OECD Countries. *OECD Economics Department Working Papers* 434. https://doi.org/10.1787/787626008442

Havik, K., Mc Morrow, K., Orlandi, F., Planas, C., Raciborski, R., Röger, W., Rossi, A., Thum-Thysen, A. and Vandermeulen, V. (2014). The production function methodology for calculating potential growth rates and output gaps. *European Economy Economic Papers* No. 535 (Nov.). doi: 10.2765/71437

Koester, G. and Priesmeier, C. (2017). Revenue elasticities in euro area countries An analysis of long-run and short-run dynamics. *ECB Working Paper* No. 1989 (Jan.) doi: 10.2866/47408

Larch, M. and Turrini, A. (2010). The Cyclically Adjusted Budget Balance in EU Fiscal Policymaking: A Love at First Sight Turned into a Modern Relationship. *Intereconomics*. Volume 45, Issue 1, pp 48–60 https://doi.org/10.1007/s10272-010-0324-9

Morris, R. and Schuknecht, L. (2007). Structural Balances and Revenue Windfalls: The Role of Asset Prices Revisited. *ECB Working Papers* No. 737. https://ssrn.com/abstract=970621

Morris, R., Rodrigues Braz, C., de Castro, F., Jonk, S., Kremer, J., Linehan, S., Marino, M.R., Schalck, C. and Tkacevs, O. (2009). Explaining Government Revenue Windfalls and Shortfalls: An Analysis for Selected EU Countries. *ECB Working Papers* No. 1114. https://ssrn.com/abstract=1502683

Mc Morrow K., Roeger, W., Vandermeulen, V. and Havik, K. (2015). An assessment of the relative quality of the Output Gap estimates produced by the EU's Production Function Methodology. *European Economy Discussion Papers* No. 20. doi: 10.2765/374342

Mourre, G., Isbasoiu, G.-M., Paternoster, D. and Salto, M. (2013). The cyclically-adjusted budget balance used in the EU fiscal framework: an update. *European Economy Economic Papers* No. 478. doi: 10.2765/3922

Mourre, G., Astarita, C. and Princen, S. (2014). Adjusting the budget balance for the business cycle: the EU methodology. *European Economy Economic Papers* No. 536. doi: 10.2765/71756

Mourre, G., Astarita, C. and Maftei, S. (2016). Measuring the Uncertainty in Predicting Public Revenue. *European Economy Discussion Papers* No. 39. doi: 10.2765/195166

Mourre, G. and Princen, S. (2015). Tax Revenue Elasticities Corrected for Policy Changes in the EU *European Economy Discussion Papers* No. 18. doi: 10.2765/622532

Mourre, G. and Princen, S. (2019). The dynamics of tax elasticities in the whole European Union, *CESifo Economic Studies*. Oxford University Press. 25 January, 1–32.

OECD (1999). OECD Economic Outlook. December https://doi.org/10.1787/eco_outlook-v1999-2-en

Perotti, R., (2005) Estimating the Effects of Fiscal Policy in OECD Countries. *CEPR Discussion Paper* No. 4842. Available at SSRN: https://ssrn.com/abstract=717561

Price, R., Dang, T., and Guillemette, Y. (2014). New Tax and Expenditure Elasticity Estimates for EU Budget Surveillance. *OECD Economics Department Working Papers* No. 1174, OECD Publishing, Paris, https://doi.org/10.1787/5jxrh8f24hf2-en.

Price, R., Dang, T. and Botev, J. (2015). Adjusting fiscal balances for the business cycle: New tax and expenditure elasticity estimates for OECD countries. *OECD Economics Department Working Papers*, No. 1275, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jrp1g3282d7-en.

Princen S., Mourre G., Paternoster D. and Isbasoiu G.M. (2013). Discretionary tax measures: pattern and impact on tax elasticities. *European Economy Economic Papers* No. 499, May. doi: 10.2765/44081

Tanzi, V. (1977). Inflation, Lags in Collection, and the Real Value of Tax Revenue. *Staff Papers (International Monetary Fund)*, Vol. 24, No. 1 (Mar.), pp. 154-167 http://www.jstor.org/stable/3866540

Tanzi, V., Blejer, M.I. and Teijeiro, M.O. (1987). Inflation and the Measurement of Fiscal Deficits. *Staff Papers (International Monetary Fund)*, Vol. 34, No. 4 (Dec.), pp. 711-738 http://www.jstor.org/stable/3867195

van den Noord, P. (2000). The Size and Role of Automatic Fiscal Stabilizers in the 1990s and Beyond, *OECD Economics Department Working Papers* No. 230. https://doi.org/10.1787/18151973

ANNEXES

I. MAIN TABLES: DERIVING THE SEMI-ELASTICITY VALUES

Table I.1. **Elasticities of individual revenue and expenditure categories**

Country	Revenue					Expenditure	
	Income tax	Corporate tax	Social security contributions	Indirect tax	Non-tax revenue	Unemployment-related expenditure	Other expenditure
	(A)	*(B)*	*(C)*	*(D)*	*(E)*	*(F)*	*(G)*
BE	1.31	2.48	0.71	1.00	0.00	-3.70	0.00
BG	1.15	2.13	0.61	1.00	0.00	-3.91	0.00
CZ	1.65	1.78	0.86	1.00	0.00	-2.45	0.00
DK	1.00	3.15	0.41	1.00	0.00	-4.97	0.00
DE	1.87	1.91	0.60	1.00	0.00	-3.30	0.00
EE	1.58	1.78	1.40	1.00	0.00	-5.18	0.00
IE	1.58	1.25	1.04	1.00	0.00	-5.45	0.00
EL	2.22	1.90	0.58	1.00	0.00	-3.15	0.00
ES	1.84	1.56	0.72	1.00	0.00	-5.83	0.00
FR	1.86	2.76	0.63	1.00	0.00	-3.23	0.00
HR	1.71	2.29	0.70	1.00	0.00	-2.39	0.00
IT	1.46	3.07	0.58	1.10	0.00	-2.29	0.00
CY	2.28	2.26	0.91	1.00	0.00	-3.08	0.00
LV	1.50	1.99	0.81	1.00	0.00	-3.94	0.00
LT	1.79	1.67	1.04	1.00	0.00	-5.60	0.00
LU	1.34	2.36	0.39	1.00	0.00	-3.06	0.00
HU	1.73	2.21	0.76	1.00	0.00	-1.25	0.00
MT	2.07	2.11	0.71	1.00	0.00	-1.96	0.00
NL	2.37	3.13	0.62	1.00	0.00	-5.76	0.00
AT	1.66	2.74	0.65	1.00	0.00	-4.71	0.00
PL	1.88	2.92	0.97	1.00	0.00	-6.18	0.00
PT	1.97	1.33	0.79	1.00	0.00	-6.04	0.00
RO	1.29	2.02	0.62	1.00	0.00	-3.91	0.00
SI	1.63	3.76	0.66	1.00	0.00	-2.81	0.00
SK	1.93	1.58	0.89	1.00	0.00	-2.98	0.00
FI	1.41	2.03	0.77	1.00	0.00	-3.66	0.00
SE	1.32	1.56	0.71	1.00	0.00	-4.42	0.00
UK	1.68	3.92	0.60	1.00	0.00	-4.21	0.00
EU	1.68	2.27	0.74	1.00	0.00	-3.91	0.00

Note: EU refers to the EU Member States at the time of our analysis. For the EU, individual elasticities have been estimated as if the Union was a country of its own.

Source: Mourre et al. (2014); Price et al. (2014).

Table I.2. **Updated shares of revenue and expenditure categories (% of total revenue/expenditure)**

Country	Revenue					Expenditure	
	Income tax	Corporate tax	Social security contributions	Indirect tax	Non-tax revenue	Unemployment-related expenditure	Other expenditure
	(H)	*(I)*	*(J)*	*(K)*	*(L)*	(M)	*(N)*
BE	25.95	6.42	32.72	25.82	9.10	4.15	95.85
BG	8.70	6.18	21.04	42.32	21.76	0.24	99.76
CZ	9.93	8.18	36.62	29.45	15.82	0.65	99.35
DK	50.28	4.82	2.14	30.32	12.44	2.07	97.93
DE	21.33	5.53	37.49	24.50	11.15	4.55	95.45
EE	14.28	3.95	29.77	34.94	17.06	2.91	97.09
IE	29.13	8.48	17.02	32.26	13.11	4.52	95.48
EL	13.11	7.95	29.91	32.00	17.02	1.38	98.62
ES	21.10	5.97	34.23	28.90	9.80	5.69	94.31
FR	18.73	4.87	35.98	29.93	10.48	3.34	96.66
HR	11.09	4.12	27.30	42.58	14.91	1.05	98.95
IT	26.21	5.08	28.54	31.14	9.04	2.00	98.00
CY	9.58	16.65	21.01	38.36	14.40	1.94	98.06
LV	17.07	4.68	24.29	35.04	18.92	1.38	98.62
LT	11.80	4.36	34.27	33.59	15.99	1.47	98.53
LU	19.46	13.43	28.14	28.44	10.53	3.59	96.41
HU	12.81	3.85	28.44	38.67	16.23	1.07	98.93
MT	22.44	11.24	17.41	33.80	15.11	1.13	98.87
NL	19.84	5.82	33.80	25.97	14.57	3.56	96.44
AT	22.56	4.49	30.62	29.25	13.07	2.64	97.36
PL	12.35	5.82	33.19	34.31	14.33	1.58	98.42
PT	15.60	7.43	27.59	32.70	16.68	2.45	97.55
RO	10.85	7.90	27.56	36.50	17.20	0.49	99.51
SI	13.81	3.75	33.92	32.84	15.68	1.39	98.61
SK	9.09	8.06	34.89	27.68	20.28	0.52	99.48
FI	25.35	5.03	23.43	25.84	20.35	4.22	95.78
SE	30.44	5.48	6.59	43.83	13.65	2.69	97.31
UK	30.29	7.44	20.19	32.44	9.65	0.62	99.38
EU	23.00	5.79	30.07	29.72	11.42	3.06	96.94

Note: EU refers to the EU Member States at the time of our analysis. COFOG database is used to compute the share of unemployment-related expenditure in total expenditure (except for DK, using LMP database of OECD). See annex III "Data sources, codes and treatment" for more details, in particular the treatment of missing data. For the EU, the reported shares are the shares of the revenue or expenditure categories in the EU as a whole over GDP of the EU.
Source: Authors' calculations, mainly based on DG ECFIN's AMECO database (2018 Spring vintage).

Table I.3. **Decomposition of the semi-elasticity of budget balance to output gap**

Country	Elasticities				Weights (% of GDP)		Semi-elasticity		
	Revenue	Expenditure	Revenue-to-GDP ratio	Expenditure-to-GDP ratio	Total revenue	Total expenditure	Revenue	Expenditure	Budget balance
	(a)	*(b)*	*c = a - 1*	*d = b - 1*	*(e)*	*(f)*	*g = c * e*	*h = d * f*	*i = g - h*
BE	0,99	-0,15	-0,01	-1,15	50,74	53,84	-0,006	-0,621	0,615
BG	0,78	-0,01	-0,22	-1,01	35,73	37,14	-0,077	-0,375	0,298
CZ	0,92	-0,02	-0,08	-1,02	40,09	42,08	-0,033	-0,428	0,395
DK	0,97	-0,10	-0,03	-1,10	54,04	54,93	-0,017	-0,606	0,589
DE	0,97	-0,15	-0,03	-1,15	44,26	44,77	-0,011	-0,515	4
EE	1,06	-0,15	0,06	-1,15	39,72	40,10	0,025	-0,461	0,486
IE	1,06	-0,25	0,06	-1,25	31,60	40,21	0,021	-0,501	0,522
EL	0,93	-0,04	-0,07	-1,04	45,45	53,11	-0,030	-0,554	0,524
ES	1,02	-0,33	0,02	-1,33	37,32	44,39	0,006	-0,591	0,597
FR	1,01	-0,11	0,01	-1,11	51,99	56,50	0,004	-0,626	0,630
HR	0,90	-0,03	-0,10	-1,03	43,09	47,31	-0,042	-0,485	0,443
IT	1,05	-0,05	0,05	-1,05	46,76	49,96	0,022	-0,522	0,544
CY	1,17	-0,06	0,17	-1,06	38,10	41,48	0,064	-0,440	0,504
LV	0,90	-0,05	-0,10	-1,05	36,30	39,50	-0,038	-0,416	0,378
LT	0,98	-0,08	-0,02	-1,08	34,25	37,63	-0,008	-0,407	0,399
LU	0,97	-0,11	-0,03	-1,11	43,67	42,71	-0,012	-0,474	0,462
HU	0,91	-0,01	-0,09	-1,01	45,67	48,79	-0,041	-0,494	0,453
MT	1,16	-0,02	0,16	-1,02	39,05	40,66	0,063	-0,416	0,479
NL	1,12	-0,21	0,12	-1,21	43,37	45,73	0,054	-0,551	0,605
AT	0,99	-0,12	-0,01	-1,12	48,96	51,37	-0,006	-0,577	0,571
PL	1,07	-0,10	0,07	-1,10	38,95	43,07	0,026	-0,473	0,499
PT	0,95	-0,15	-0,05	-1,15	42,75	48,66	-0,021	-0,559	0,538
RO	0,83	-0,02	-0,17	-1,02	32,73	36,80	-0,054	-0,375	0,321
SI	0,92	-0,04	-0,08	-1,04	43,68	48,53	-0,036	-0,504	0,468
SK	0,89	-0,02	-0,11	-1,02	37,75	41,52	-0,041	-0,422	0,381
FI	0,90	-0,15	-0,10	-1,15	53,57	55,08	-0,054	-0,636	0,582
SE	0,97	-0,12	-0,03	-1,12	50,62	50,66	-0,014	-0,567	0,553
UK	1,24	-0,03	0,24	-1,03	38,41	44,44	0,094	-0,456	0,550
EU	1,04	-0,12	0,04	-1,12	44,40	47,94	0,017	-0,537	0,554
EU (avg)	0,99	-0,10	-0,01	-1,10	42,45	45,75	-0,006	-0,502	0,496

Note: The parameters (a) and (b) are derived from Table I.1 and Table I.2;
(a) = (A * H + B * I + C * J + D * K + E * L) / 100; (b) = (F * M + G * N)/ 100. The semi-elasticities for revenue and expenditure are rounded to three decimals. These rounded values are the ones used for the cyclical adjustment in the framework of EU fiscal surveillance. EU refers to the EU Member States at the time of our analysis.
For sake of illustration, the row "EU (avg)" shows the unweighted average. The row "EU" displays the results for the EU as a whole, directly computed from aggregate data (as if EU was a single country).
Source: AMECO 2018 Spring vintage, Mourre et al. (2014) and authors' calculations

II. MATHEMATICAL DERIVATIONS

From the headline balance to the CAB (and the first order approximation)

We recall Equation (1): the cyclically-adjusted budget balance (CAB) is computed as the difference between the actual balance-to-GDP ratio and an estimated cyclical component.

$$CAB_t = \frac{(R_t - G_t)}{Y_t} - \varepsilon\, OG_t \tag{8}$$

This formula can be derived from the definition of the CAB:

$$CAB_t = \frac{B_t^p}{Y_t^p} = \frac{\left(R_t^p - G_t^p\right)}{Y_t^p} = \frac{R_t}{Y_t^p}\frac{R_t^p}{R_t} - \frac{G_t}{Y_t^p}\frac{G_t^p}{G_t} \tag{9}$$

The revenue and expenditure elasticities allow us to link the deviation of R and G from potential to the deviation of output from its potential:[22]

$$\frac{R_t^p}{R_t} = \left(\frac{Y_t^p}{Y_t}\right)^{\eta_{R,t}} \quad and \quad \frac{G_t^p}{G_t} = \left(\frac{Y_t^p}{Y_t}\right)^{\eta_{G,t}} \tag{10}$$

Replacing Equation (10) in Equation (9) yields:

$$\begin{aligned} CAB_t &= \frac{R_t}{Y_t^p}\left(\frac{Y_t^p}{Y_t}\right)^{\eta_{R,t}} - \frac{G_t}{Y_t^p}\left(\frac{Y_t^p}{Y_t}\right)^{\eta_{G,t}} = \frac{R_t}{Y_t}\left(\frac{Y_t^p}{Y_t}\right)^{\eta_{R,t}-1} - \frac{G_t}{Y_t}\left(\frac{Y_t^p}{Y_t}\right)^{\eta_{G,t}-1} \\ CAB_t &= \frac{R_t}{Y_t}(1+OG_t)^{1-\eta_{R,t}} - \frac{G_t}{Y_t}(1+OG_t)^{1-\eta_{G,t}} \end{aligned} \tag{11}$$

It is then possible to approximate Equation (11) with a first order development around OG=0:

$$\begin{aligned} CAB_t &= \frac{R_t}{Y_t} - \frac{G_t}{Y_t} + \left[\left(1-\eta_{R,t}\right)\frac{R_t}{Y_t} - \left(1-\eta_{G,t}\right)\frac{G_t}{Y_t}\right] OG_t = \frac{B_t}{Y_t} - \left(\varepsilon_{R,t} - \varepsilon_{G,t}\right) OG_t \\ &= \frac{B_t}{Y_t} - \varepsilon_t * OG_t \end{aligned} \tag{12}$$

This equation takes the same form as Equation (1), with semi-elasticities of revenue and expenditure $(\varepsilon_R, \varepsilon_G)$ which are not constant a priori, both because of the time varying shares of revenue and expenditure to GDP and the underlying elasticities. For practical reasons, semi-elasticities are computed based on constant weights and elasticities which constitutes an additional simplification. Under this assumption, Equation (10) is no longer an approximation but Equation (16) shows that this assumption is unlikely to hold already because of the changing composition of revenue and expenditure.

In all, one can therefore see Equation (1) as the results of one assumption (constant elasticities of the revenue and expenditure components), a first order approximation (see Equations (10) and (12)) and a simplification (constant weights of total revenue and expenditure in GDP and of their components).

[22] This formula is the result of a first order Taylor development of R and G (in logs) around their potentials. Note that elasticities are not assumed to be constant in time since we only compare two states of the economy within the same period.

From elasticities to semi-elasticities

The budgetary semi-elasticity (ε) measures the sensitivity of an economic variable as a share of GDP (e.g. revenue) to the economic cycle. It measures by how many percentage points the revenue to GDP ratio changes for a 1% increase in GDP.

$$\varepsilon_R = \frac{d\left(\frac{R}{Y}\right)}{\frac{dY}{Y}} \tag{13}$$

By comparison to the semi-elasticity, the elasticity captures the relative variation of one variable to the relative variation of another variable, i.e. measures by how many percent revenue changes for a 1% increase in GDP:

$$\eta_R = \frac{dR/R}{dY/Y} \tag{14}$$

The same definition and relation between the elasticity and semi-elasticity apply to the expenditure side of the headline budget balance and to the subcomponents.

There is a direct link between the elasticities and semi-elasticities of revenue and expenditure to GDP:

$$\varepsilon_R = \frac{d\left(\frac{R}{Y}\right)}{\frac{dY}{Y}} = \frac{\frac{dR}{Y} - \frac{dY}{Y^2}R}{\frac{dY}{Y}} = \frac{\frac{R}{Y}\left(\frac{dR}{R} - \frac{dY}{Y}\right)}{\frac{dY}{Y}} = \frac{R}{Y}(\eta_R - 1) \Rightarrow \eta = \varepsilon_R \frac{Y}{R} + 1 \tag{15}$$

The term 1 between the two concepts corresponds to the elasticity of the denominator (GDP) of the revenue-to-GDP ratio to itself. The fraction $\frac{R}{Y}$ corrects for the different reference (changes in the revenue-to-GDP ratio for the semi elasticity, changes in revenue as a fraction of total revenue for the elasticity).

Aggregation of elasticities

The aggregate elasticities are the weighted average of their components' elasticities. Taking the revenue elasticities as an example, one can write:

$$\eta_R = \frac{dR/R}{dY/Y} = \frac{\frac{\sum_{i=1}^{n} dR_i}{R}}{dY/Y} = \sum_{i=1}^{n} \frac{\frac{dR_i}{R_i}}{dY/Y}\frac{R_i}{R} = \sum_{i=1}^{n} \eta_{R,i}\frac{R_i}{R} \tag{16}$$

Five individual revenue categories η_{Ri} (personal income taxes, corporate income taxes, indirect taxes, social security contributions, non-tax revenue) and one spending category η_{GU} (unemployment-related expenditure) are found sensitive to the economic cycle (their elasticity is not zero). One can therefore write the aggregate revenue and expenditure elasticities as:

$$\eta_R = \sum_{i=1}^{5} \eta_{R,i}\frac{R_i}{R} \; and \; \eta_G = \eta_{G,u}\frac{G_u}{G} \tag{17}$$

EU aggregation of elasticities

There are several possibilities to compute the CAB at the EU level (or for any other group of countries). In practice, the aggregate CAB is the aggregation of the CAB of its components. In contrast, it is also possible to treat the EU as its own country using the elasticities of each of the revenue and expenditure categories estimated at the EU level (Price *et al.*, 2014). The aggregation of the CABs of the Member States shows that applying a formula similar to (1) at the EU level would miss a cyclical effect linked to the business cycle differentials between the EU and it Member States:

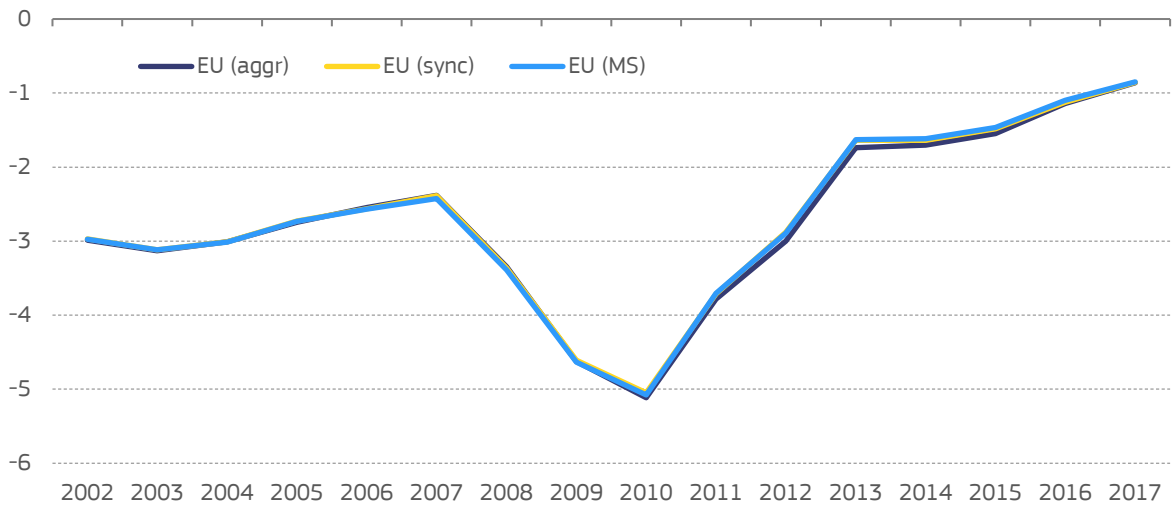
$$CAB^{EU} = \frac{\sum_{EU} R^* - G^*}{\sum_{EU} Y^*} = \sum_{EU} \frac{Y^*}{Y^{EU*}} CAB$$

$$CAB^{EU} = \cdots = \frac{R^{EU} - G^{EU}}{Y^{EU}} - \varepsilon^{EU}\, OG^{EU} + \underbrace{\sum_{EU} \frac{Y^*}{Y^{EU*}} \left(\frac{R - G}{Y(1 + OG^{EU})} + \varepsilon \right) (OG^{EU} - OG)}_{cycle\ non\ sync.corection} \quad (18)$$

with $\varepsilon^{EU} = \sum_{EU} \frac{Y^*}{Y^{EU*}} \varepsilon$.

Even on average over 10 years, the semi-elasticity for the EU treated as any other Member State may note coincide with ε^{EU} in the above formula (the weighted average of the Member State's semi-elasticities, with the weights being their potential GDP). This is however the case here to the third decimal, ε^{EU} is equal to 0.554 which is equal to the value estimated for the EU as if it was a Member State (Table IV.3).

Figure II.1. **EU CAB three calculations**



Note: EU refers to the EU Member States at the time of our analysis. (aggr) is the aggregation of the MS's CAB, (sync) is the same calculation forgetting the correction for non-synchronisation of the business cycles, (MS) is the CAB of the EU computed as for any other MS.
Source: AMECO 2018 Spring forecast, Mourre et al. (2014) and authors' calculations

In addition, the term correcting for cyclical desynchronisation is small because desynchronisations cancel each other out. Therefore, the CAB computed for the EU as if it were a single Member State or

computed as the aggregation of the Member States' CABs (without or without the corrective term for non-synchronisation of the business cycles) are almost identical (Figure II.1).

III. DATA SOURCES, CODES AND TREATMENT

The data for the updated weights was collected from AMECO's 2018 spring vintage. All variables (Table III.1) are in current prices and are converted to EUR (for non euro area Member States) using time varying annual exchange rates. This conversion has no effect on country specific semi-elasticities but facilitates the calculation of EU aggregates for analytical purposes. The calculations were cross checked with data in percentage of GDP and in national currency.

Total revenue and expenditure coincide with excessive deficit procedure (EDP) notifications. Total revenue is URTG and total expenditure is UUTG. Apart from their publication calendar, these correspond to the revenue and expenditure notified by Member States as part of the EDP notification.

The revenue categories before adjustments are:

- UTYC for corporate income tax,
- UTYH for personal income tax,
- UTVG for indirect taxes,
- UTSG for social contributions,
- UKTTG+UTOG for non-tax revenue.

Two adjustments are necessary to compute the weights of the revenue categories:

- First, the sum of current taxes on income and wealth paid by corporations (UTYC) and households and non-profit institutions serving households (UTYH) is not equal to the total current taxes on income and wealth collected by the government (UTYG), because of direct taxes received from or paid to the rest of the world. We redistribute the missing direct taxes in proportion of UTYC and UTYH to ensure that personal and corporate income tax amounts add up to the direct taxes received by the government.
- Second, capital taxes, which represent a relatively small amount, are used to compute total tax revenue. The individual elasticities calculated by OECD do not specify the elasticity of capital taxes. As the elasticity of capital taxes is unlikely to be 0, the revenue generated by them (UKTG) is spread across personal income tax, corporate income tax, social security contributions, indirect taxes in proportion to their size.

On the expenditure side, the share of unemployment related expenditure is taken from the COFOG classification of expenditure. The corresponding code is UUTG105. Total government expenditure in the COFOG classification (UUTG00) are almost always equal to the baseline ESA estimates for total expenditure (UUTG). However, to avoid small inconsistencies, the ratio of UUTG105 to UUTG00 is applied to UUTG to compute the government's unemployment related expenditure.[23]

Data availability has much improved since the last revision of weights, but limited country specific adjustments were still needed to fill some gaps in the data. Mourre *et al.* (2013) identified

[23] To ensure the consistency of unemployment-related expenditure across MS and respond to an issue raised by Denmark during past updates (including the 2013 one), we use the OECD database on Labour Market Programmes ('Public expenditure and participant stocks on LMP') and use the variable 'Full unemployment benefits' instead of AMECO's UUTG105 variable. This is because the elasticity of unemployment related expenditure was estimated based on the OECD data and those present a large discrepancy with the COFOG data for Denmark.

a lot of data gaps, which were filled using other data sources or assumptions, especially for non-OECD EU countries. These are very limited now. To estimate the missing data points of several variables for the time period under consideration (all 2017 data points for UTTG00; several data points for UTYC, UTYH, UTTG105 in the early 2000s), we apply a constant ratio to a total (e.g. total revenue, total expenditure) with respect to the previous or following year's value. To estimate the missing UTYH and UTYC series for MT, we take their average annual weights in UTYG from the other 9 countries who joined the EU in the 2004 accession round.

Table III.1. **List of variables for replication**

AMECO Code	ESA (*Eurostat*) code	Description
UVGD	B1g	Gross domestic product at current prices
URTG	*TR* by S13	Total revenue; general government - ESA 2010
UTYG	D5r (r for received) by S13	Current taxes on income and wealth (direct taxes); general government - ESA 2010
UTYH	D5 paid by S14 and S15	Current taxes on income and wealth; households and NPISH
UTYC	D5 paid by S11 and S12	Current taxes on income and wealth; corporations
UTVG	D2r S13	Taxes linked to imports and production (indirect taxes); general government - ESA 2010
UTSG	D61r S13	Net social contributions received; general government - ESA 2010
UKTTG	D9r S13	Capital transfers received; general government - ESA 2010
UTKG	D91r S13	Capital taxes; general government - ESA 2010
UTOG	P11+P12+P131+D39+D4 +D7 of S13	Other current revenue including sales; general government - ESA 2010
UUTG00	COFOG 01 to 10	General government; Total expenditure
UUTG105	COFOG 10.5	General government; Social protection; unemployment; total expenditure
UUTG	*TE*	Total expenditure; general government - ESA 2010

Source: Authors

In the context of fiscal surveillance, semi-elasticities are rounded to the third decimal. The semi-elasticities of revenue and expenditure are rounded to the third decimal with the semi-elasticity of the budget balance being the difference of those two rounded estimates (Table I.3). This allows for the full replication of the calculation of the CAB by either the Commission or the Member States.

IV. COMPARING THE RESULTS 2018 VS 2014

Table IV.1. **Shares of revenue categories (% of total revenue), average 2002-2011**

Country	Revenue									
	Income tax		Corporate tax		Social security contributions		Indirect tax		Non-tax revenue	
	(H)		*(I)*		*(J)*		*(K)*		*(L)*	
	2014	2018	2014	2018	2014	2018	2014	2018	2014	2018
BE	27.43	25.95	6.68	6.42	33.92	32.72	26.61	25.82	5.36	9.10
BG	6.11	8.70	5.29	6.18	24.81	21.04	44.23	42.32	19.56	21.76
CZ	10.68	9.93	10.25	8.18	39.05	36.62	27.44	29.45	12.58	15.82
DK	47.85	50.28	6.11	4.82	3.57	2.14	31.14	30.32	11.33	12.44
DE	20.25	21.33	5.74	5.53	40.06	37.49	24.99	24.50	8.96	11.15
EE	16.31	14.28	3.55	3.95	30.50	29.77	35.00	34.94	14.64	17.06
IE	24.30	29.13	9.77	8.48	18.45	17.02	35.76	32.26	11.72	13.11
EL	12.83	13.11	7.99	7.95	33.69	29.91	31.20	32.00	14.29	17.02
ES	19.55	21.10	8.38	5.97	34.57	34.23	28.91	28.90	8.59	9.80
FR	17.62	18.73	4.96	4.87	37.14	35.98	30.70	29.93	9.59	10.48
HR	7.25	11.09	9.09	4.12	29.49	27.30	43.23	42.58	10.94	14.91
IT	25.70	26.21	6.17	5.08	29.40	28.54	31.77	31.14	6.95	9.04
CY	11.12	9.58	15.99	16.65	19.97	21.01	37.98	38.36	14.94	14.40
LV	17.65	17.07	5.52	4.68	24.96	24.29	34.30	35.04	17.56	18.92
LT	18.48	11.80	5.60	4.36	27.40	34.27	35.58	33.59	12.94	15.99
LU	16.03	19.46	15.38	13.43	28.78	28.14	31.61	28.44	8.20	10.53
HU	16.41	12.81	4.28	3.85	29.15	28.44	35.84	38.67	14.32	16.23
MT	13.74	22.44	7.79	11.24	30.89	17.41	35.00	33.80	12.58	15.11
NL	18.65	19.84	7.08	5.82	33.13	33.80	27.50	25.97	13.63	14.57
AT	22.55	22.56	4.86	4.49	33.50	30.62	29.96	29.25	9.13	13.07
PL	12.52	12.35	6.28	5.82	31.00	33.19	35.07	34.31	15.13	14.33
PT	14.02	15.60	7.91	7.43	29.09	27.59	34.21	32.70	14.77	16.68
RO	10.47	10.85	8.55	7.90	29.74	27.56	37.09	36.50	14.14	17.20
SI	14.54	13.81	4.88	3.75	33.80	33.92	34.39	32.84	12.40	15.68
SK	9.60	9.09	8.43	8.06	37.88	34.89	32.83	27.68	11.26	20.28
FI	26.13	25.35	6.71	5.03	23.41	23.43	25.81	25.84	17.93	20.35
SE	32.11	30.44	5.69	5.48	18.33	6.59	31.95	43.83	11.92	13.65
UK	31.79	30.29	8.24	7.44	20.71	20.19	31.81	32.44	7.45	9.65
EU	23.04	23.00	6.35	5.79	29.34	30.07	30.51	29.72	10.76	11.42

Note: EU refers to the EU Member States at the time of our analysis. For the EU, the reported shares are the shares of the revenue or expenditure categories in the EU as a whole over GDP of the EU.
Source: AMECO 2018 Spring vintage

Table IV.2. **Shares of expenditure categories (% of total expenditure), average 2002-2011**

Country	Expenditure			
	Unemployment-related expenditure		Other expenditure	
	(M)		*(N)*	
	2014	2018	2014	2018
BE	4.46	4.15	95.54	95.85
BG	0.70	0.24	99.30	99.76
CZ	0.74	0.65	99.26	99.35
DK	2.82	2.07	97.18	97.93
DE	6.22	4.55	93.78	95.45
EE	1.89	2.91	98.11	97.09
IE	4.32	4.52	95.68	95.48
EL	1.66	1.38	98.34	98.62
ES	4.89	5.69	95.11	94.31
FR	3.46	3.34	96.54	96.66
HR	0.80	1.05	99.20	98.95
IT	1.18	2.00	98.82	98.00
CY	1.28	1.94	98.72	98.06
LV	1.70	1.38	98.30	98.62
LT	1.48	1.47	98.52	98.53
LU	2.46	3.59	97.54	96.41
HU	1.15	1.07	98.85	98.93
MT	1.35	1.13	98.65	98.87
NL	3.87	3.56	96.13	96.44
AT	2.56	2.64	97.44	97.36
PL	2.08	1.58	97.92	98.42
PT	2.18	2.45	97.82	97.55
RO	1.14	0.49	98.86	99.51
SI	1.36	1.39	98.64	98.61
SK	1.06	0.52	98.94	99.48
FI	4.98	4.22	95.02	95.78
SE	3.32	2.69	96.68	97.31
UK	0.78	0.62	99.22	99.38
EU	3.33	3.06	96.67	96.94

Note: EU refers to the EU Member States at the time of our analysis. For the EU, the reported shares are the shares of the revenue or expenditure categories in the EU as a whole over GDP of the EU.
Source: AMECO 2018 Spring vintage

Table IV.3. **Revised aggregate semi-elasticities of fiscal variables**

Country	Revenue		Expenditure		Budget balance	
	2014	2018	2014	2018	2014	2018
BE	0,015	-0,006	-0,591	-0,621	0,605	0,615
BG	-0,084	-0,077	-0,391	-0,375	0,308	0,298
CZ	-0,012	-0,033	-0,446	-0,428	0,433	0,395
DK	-0,001	-0,017	-0,620	-0,606	0,619	0,589
DE	-0,009	-0,011	-0,560	-0,515	0,551	0,504
EE	0,037	0,025	-0,406	-0,461	0,443	0,486
IE	0,019	0,021	-0,508	-0,501	0,528	0,522
EL	-0,023	-0,030	-0,506	-0,554	0,483	0,524
ES	0,011	0,006	-0,528	-0,591	0,539	0,597
FR	0,002	0,004	-0,601	-0,626	0,603	0,630
HR	-0,011	-0,042	-0,479	-0,485	0,467	0,443
IT	0,038	0,022	-0,501	-0,522	0,539	0,544
CY	0,071	0,064	-0,452	-0,440	0,523	0,504
LV	-0,028	-0,038	-0,408	-0,416	0,380	0,378
LT	0,022	-0,008	-0,391	-0,407	0,413	0,399
LU	0,003	-0,012	-0,442	-0,474	0,445	0,462
HU	-0,019	-0,041	-0,511	-0,494	0,492	0,453
MT	0,007	0,063	-0,449	-0,416	0,456	0,479
NL	0,066	0,054	-0,579	-0,551	0,646	0,605
AT	0,012	-0,006	-0,569	-0,577	0,580	0,571
PL	0,027	0,026	-0,494	-0,473	0,521	0,499
PT	-0,019	-0,021	-0,525	-0,559	0,506	0,538
RO	-0,045	-0,054	-0,384	-0,375	0,339	0,321
SI	-0,006	-0,036	-0,483	-0,504	0,477	0,468
SK	-0,005	-0,041	-0,398	-0,422	0,393	0,381
FI	-0,030	-0,054	-0,604	-0,636	0,574	0,582
SE	-0,020	-0,014	-0,609	-0,567	0,590	0,553
UK	0,120	0,094	-0,471	-0,456	0,591	0,550
EU	0,024	0,017	-0,539	-0,537	0,563	0,554
EU (avg)	0,005	-0,006	-0,497	-0,502	0,502	0,496

Note: EU refers to the EU Member States at the time of our analysis. EU calculations are based on elasticities and weights of the EU28 while the EU (avg) is the arithmetic average of the 28 countries.

Source: AMECO (2018 Spring vintage), Mourre et al. (2014) and authors' calculations

V. SENSITIVITY AND EXPLORATORY ANALYSIS

Table V.1. **Sensitivity analysis of budget balance semi-elasticities**

Country	Budget balance				Revisions compared to 2014	Revisions compared to 2018	
	2014	2018	2018 excl capital transfers (D9p)	2018 weights computed over extended window 2002-17	2018	2018 excl capital transfers (D9p)	2018 weights computed over extended window 2002-17
BE	0,61	0,61	0,60	0,61	-0,01	-0,01	0,00
BG	0,31	0,30	0,29	0,30	0,01	-0,01	0,00
CZ	0,43	0,40	0,39	0,40	0,04	-0,01	0,00
DK	0,62	0,59	0,58	0,59	0,03	-0,01	0,00
DE	0,55	0,50	0,49	0,52	0,05	-0,01	0,02
EE	0,44	0,49	0,47	0,45	-0,04	-0,02	-0,04
IE	0,53	0,52	0,49	0,49	0,01	-0,03	-0,03
EL	0,48	0,52	0,50	0,50	-0,04	-0,02	-0,02
ES	0,54	0,60	0,59	0,56	-0,06	-0,01	-0,04
FR	0,60	0,63	0,62	0,61	-0,03	-0,01	-0,02
HR	0,47	0,44	0,43	0,45	0,02	-0,01	0,01
IT	0,54	0,54	0,53	0,53	-0,01	-0,01	-0,01
CY	0,52	0,50	0,48	0,49	0,02	-0,02	-0,01
LV	0,38	0,38	0,37	0,37	0,00	-0,01	-0,01
LT	0,41	0,40	0,39	0,40	0,01	-0,01	0,00
LU	0,44	0,46	0,45	0,46	-0,02	-0,01	0,00
HU	0,49	0,45	0,43	0,47	0,04	-0,02	0,02
MT	0,46	0,48	0,47	0,47	-0,02	-0,01	-0,01
NL	0,65	0,61	0,60	0,60	0,04	-0,01	-0,01
AT	0,58	0,57	0,56	0,57	0,01	-0,01	0,00
PL	0,52	0,50	0,50	0,51	0,02	0,00	0,01
PT	0,51	0,54	0,53	0,52	-0,03	-0,01	-0,02
RO	0,34	0,32	0,31	0,32	0,02	-0,01	0,00
SI	0,48	0,47	0,45	0,47	0,01	-0,02	0,00
SK	0,39	0,38	0,37	0,38	0,01	-0,01	0,00
FI	0,57	0,58	0,58	0,57	-0,01	0,00	-0,01
SE	0,59	0,55	0,55	0,57	0,04	0,00	0,02
UK	0,59	0,55	0,53	0,54	0,04	-0,02	-0,01
EU	0,56	0,55	0,55	0,55	0,01	0,00	0,00

Note: EU refers to the EU Member States at the time of our analysis. Counterfactual revisions of the semi-elasticities are computed by either taking the period covering both vintages for the weights or by excluding capital transfers from public expenditure (D9p). Such changes in the methodology would have resulted in minor differences in the semi-elasticities, with the largest effects on EE, IE, and ES. EU calculations are based on elasticities and weights of the Union as if it was a country of its own.
Source: AMECO (2018 Spring vintage), Mourre et al. (2014) and authors' calculations

Table V.2. **Estimation of semi-elasticity models against structural indicators**

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Baseline specification										
Unemployment exp. / GDP	7.026***	5.581***	5.731***	6.056***	6.229***	6.157***	6.319***	6.185***	4.682***	5.872***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other exp. / GDP	0.867***	0.880***	0.888***	0.897***	0.911***	0.905***	0.923***	0.887***	0.743***	0.878***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
non tax rev. / GDP	-0.803***	-0.846***	-0.845***	-0.858***	-0.883***	-0.879***	-0.902***	-0.860***	-0.792***	-0.862***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Economic fundamentals										
Income per capita (average)		0.000846								
		(0.172)								
Income per capita (end value)			0.000657							
			(0.207)							
GDP Member State / GDP EU				0.00113						
				(0.522)						
Economic volatility (stdev OG)					-0.000370					
					(0.893)					
Economic volatility (stdev GDP growth)						-0.000630				
						(0.659)				
wage / value added							0.000201			
							(0.800)			
Fiscal and tax policy										
debt / GDP								0.000131		
								(0.444)		
PIT top rate									0.00185***	
									(0.002)	
CIT top rate										0.00125*
										(0.086)

Vintage dummies										
Vintage 2005	0	0	0	0	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Vintage 2013	-0.00803	-0.00692	-0.00551	-0.00560	-0.00515	-0.00467	-0.00273	-0.00583	0.00593	0.00336
	(0.212)	(0.291)	(0.367)	(0.366)	(0.488)	(0.472)	(0.633)	(0.344)	(0.422)	(0.717)
Vintage 2014	0.0385***	0.0396***	0.0408***	0.0410***	0.0414***	0.0419***	0.0436***	0.0407***	0.0525***	0.0499***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Vintage 2018	0.0376***	0.0379***	0.0387***	0.0402***	0.0408***	0.0410***	0.0414***	0.0381***	0.0541***	0.0520***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.0457	0.0363	0.0344	0.0393	0.0371	0.0425	0.0188	0.0401	0.0369	0.0137
	(0.257)	(0.223)	(0.246)	(0.235)	(0.319)	(0.273)	(0.673)	(0.206)	(0.169)	(0.729)
Observations	111	111	111	111	111	111	106	111	111	111
Country fixed effects	Yes	No	No	No	No	No	No	No	No	No
Vintage fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2 within	0.660	0.659	0.656	0.657	0.655	0.653	0.685	0.654	0.650	0.668
R2 between	0.831	0.860	0.857	0.847	0.845	0.848	0.849	0.848	0.883	0.841
R2 overall	0.801	0.825	0.822	0.814	0.812	0.814	0.821	0.815	0.844	0.811

Note: p-values in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Source: authors' calculations

Table V.3. **Estimation of semi-elasticity models against tentative geographical typologies**

	(a)	(b)	(c)	(d)	(e)	(f)
Baseline specification						
Unemployment exp. / GDP	7.026***	5.537***	6.289***	5.434***	5.907***	6.271***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other exp. / GDP	0.867***	0.863***	0.911***	0.862***	0.906***	0.918***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
non tax rev. / GDP	-0.803***	-0.848***	-0.881***	-0.826***	-0.872***	-0.886***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Peer effect						
Weighted neighbours' semi-elasticity		0.193**				
		(0.027)				
Geographical groups						
Euro area (time varying)			-0.000982			
			(0.923)			
Joined EU no sooner than 2004				-0.0261*		
				(0.085)		
Lower income Europe					-0.0254**	
					(0.050)	
Programme countries						0.00553
						(0.708)
Vintage dummies						
Vintage 2005	0	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)	(.)
Vintage 2013	-0.00803	-0.00519	-0.00556	-0.00471	-0.00501	-0.00565
	(0.212)	(0.398)	(0.337)	(0.443)	(0.424)	(0.366)
Vintage 2014	0.0385***	0.0341***	0.0410***	0.0418***	0.0415***	0.0409***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Vintage 2018	0.0376***	0.0357***	0.0405***	0.0408***	0.0408***	0.0403***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.0457	-0.0331	0.0362	0.0753**	0.0459	0.0317
	(0.257)	(0.500)	(0.254)	(0.050)	(0.174)	(0.301)
Observations	111	111	111	111	111	111
Country fixed effects	Yes	No	No	No	No	No
Vintage fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R2 within	0.660	0.660	0.656	0.653	0.655	0.656
R2 between	0.831	0.868	0.843	0.863	0.857	0.844
R2 overall	0.801	0.832	0.811	0.826	0.822	0.812

Note: p-values in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Source: authors' calculations

EUROPEAN ECONOMY DISCUSSION PAPERS

European Economy Discussion Papers can be accessed and downloaded free of charge from the following address:
https://ec.europa.eu/info/publications/economic-and-financial-affairs-publications_en?field_eurovoc_taxonomy_target_id_selective=All&field_core_nal_countries_tid_selective=All&field_core_date_published_value[value][year]=All&field_core_tags_tid_i18n=22617.

Titles published before July 2015 under the Economic Papers series can be accessed and downloaded free of charge from:
http://ec.europa.eu/economy_finance/publications/economic_paper/index_en.htm.

GETTING IN TOUCH WITH THE EU

In person
All over the European Union there are hundreds of Europe Direct Information Centres. You can find the address of the centre nearest you at: http://europa.eu/contact.

On the phone or by e-mail
Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
- at the following standard number: +32 22999696 or
- by electronic mail via: http://europa.eu/contact.

FINDING INFORMATION ABOUT THE EU

Online
Information about the European Union in all the official languages of the EU is available on the Europa website at: http://europa.eu.

EU Publications
You can download or order free and priced EU publications from EU Bookshop at: http://publications.europa.eu/bookshop. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see http://europa.eu/contact).

EU law and related documents
For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex at: http://eur-lex.europa.eu.

Open data from the EU
The EU Open Data Portal (http://data.europa.eu/euodp/en/data) provides access to datasets from the EU. Data can be downloaded and reused for free, both for commercial and non-commercial purposes.

Publications Office
of the European Union