Part III

Conduct of fiscal policy in the face of economic shocks

Please cite this as follows:

European Commission, 2018. The conduct of fiscal policy in the face of economic shocks, Report on Public Finances in EMU 2018, 71-104.

Contributors: P. Mohl, A. Poissonnier and W. van der Wielen (JRC), M. Lausegger (Box III.2.1), S. Barrios (JRC), M. Christl (JRC), A. Tumino (JRC) and W. van der Wielen (JRC) (Box III.2.2).

KEY FINDINGS

This part assesses the impact of economic shocks on the conduct of fiscal policy from two different perspectives. First, it empirically assesses the effect of economic shocks on the planned fiscal effort. Second, it provides new estimates of the impact of economic shocks on fiscal outcomes.

Member States often conduct fiscal policy without taking into account the uncertainty surrounding their fiscal forecast.

- We show that uncertain economic outcomes in the form of the forecast error of the fiscal effort have been an integral part of fiscal projections in the EU since 2000.

- Nevertheless, the results from panel regressions reveal that Member States frequently tend to adjust their planned fiscal effort only very late and asymmetrically to forecast errors, relaxing the fiscal effort in case of positive surprises and leaving it unchanged in case of negative ones.

Economic shocks can have a significant and lasting impact on fiscal positions, particularly on public debt in the EU.

- A negative productivity (supply) shock results in a temporary decline in the primary balance, which yields a progressive increase in the public debt-to-GDP ratio.

- A positive inflation (demand) shock has a positive but short-lived impact on the primary balance. At the same time, it inflates away public debt ratio temporarily.

- A positive sovereign interest rate (financial) shock causes a steady increase in the public debt ratio.

A limited learning in the form of disregarding past episodes of uncertainty can lead to insufficient fiscal buffers and jeopardise the sustainability of public finances in the EU.

- A sound approach to fiscal policy requires an adequate and timely reaction from Member States to uncertainty. In particular, a disregard of repeated or large-scale uncertainty, i.e. no learning from past episodes of uncertainty, can lead to insufficient fiscal buffers and jeopardise the sustainability of public finances.

- An appropriate policy response to uncertainty should include taking precautionary measures against the possibility of worse-than-expected outcomes. In addition, policies that foster economic resilience can reduce the likelihood of large negative macroeconomic shocks and limit their adverse consequences.

1. INTRODUCTION

Economic shocks are one element of the uncertainty inherent to economic developments. The recent economic and financial crisis illustrated the effect of unforeseen events on the economy. In the case of the Economic and Monetary Union (EMU), risk of contagion effects put into question the very viability of the euro-area project. ([56]) It does not, however, take the Great Recession to see that uncertainty, shocks and risks are an unavoidable feature of the economy. Indeed, the magnitude of forecast errors found in standard economic projections testify of the inevitability of such economic surprises.

Uncertainty is a broad concept and it can come from a variety of sources. There are multiple meanings and forms of uncertainty. Uncertainty can be broadly described as a situation where economic agents have limited knowledge to assess current and/or future events. ([57]) A canonical separation distinguishes between risk and uncertainty, ([58]) with the former being measurable/insurable and the latter being unmeasurable/uninsurable. It is difficult in practice, however, to disentangle these two concepts and, as a result, they are generally used interchangeably. ([59]) Uncertainty comes from a variety of sources, namely statistical sources (incomplete or inaccurate data), conceptual sources (inadequate or competing models) or structural sources (lack of knowledge about the true structure of the economy). ([60])

Uncertainty also affects fiscal policy. In the short and medium term, much of the uncertainty about fiscal policy comes from shocks to the macroeconomic environment and the impact of these on fiscal variables. ([61]) Therefore, fiscal plans should factor in the uncertainty surrounding fiscal projections. In the longer term, the main sources of budgetary uncertainty stem from potential growth, interest rate on public debt, health-care/ageing expenditure and contingent liabilities. ([62])

This part analyses the impact of economic shocks on planned fiscal efforts and fiscal outcomes. Chapter III.2. reviews how the EU fiscal governance framework deals with uncertainty. Chapter III.3. examines if and to what extent the design of the planned fiscal adjustment takes into account past forecast errors about fiscal outcomes. Chapter III.4. provides new estimates on how economic shocks translate into fiscal policy outcomes. Finally, Chapter III.5. concludes and discusses policy implications.

We focus on two issues related to fiscal uncertainty in our analysis. While uncertainty is inherently unobserved and difficult to quantify, several indicators have been used (see Box III.2.1 for an overview). Admittedly, we do not cover all dimensions of uncertainty in this analysis. In Chapter III.3., we characterise uncertainty about fiscal outcomes on the basis of forecast errors. In Chapter III.4., we take a model-based approach and show how exogenous shocks affect fiscal outcomes.

([56]) Buti and Padoan (2013).
([57]) Ellison and Williams (2012).
([58]) Knigth (1921).
([59]) Balta et al. (2013), Fernandez-Villaverde et al. (2015), Meinen and Roehe (2017); see Rossi et al. (2017) for one attempt to disentangle the two.
([60]) ECB (2016).
([61]) Belinga et al. (2014), Mourre and Princen (2015), Mourre et al. (2016); Fioramanti et al. (2016), Koester and Priesmeier (2017). See also Box III.2.2.
([62]) Auerbach (2014).

2. HOW DOES THE EU FISCAL GOVERNANCE FRAMEWORK DEAL WITH UNCERTAINTY?

The Stability and Growth Pact (SGP) accommodates uncertainty arising from statistical and conceptual sources. There are in particular two reasons why the EU fiscal governance framework acknowledges uncertainty. First, the data used in the assessment of compliance with the fiscal rules are frequently subject to revisions (statistical uncertainty). Second, some key concepts used in the fiscal surveillance process (e.g. the required fiscal effort) are unobserved and must be estimated using model techniques (conceptual uncertainty).

The following provisions of the fiscal governance framework cater for these two types of uncertainty in an asymmetric way. These provisions are meant to cater for negative shocks to avoid that a Member State is penalised by the rules.

Broad compliance margins: Since the 2011 SGP reform of the so-called "six-pack", the preventive arm of the SGP includes the concept of "non-significant deviation". Member States could be considered to be broadly compliant with EU fiscal rules if their required fiscal adjustment towards the medium-term budgetary objectives (MTO) deviates by less than 0.5% of GDP in one year or 0.25% of GDP on average over two years. ([63]) These tolerance margins accommodate uncertainty ex-post at the time of assessing compliance. Overall, they are designed to cater for statistical uncertainty that is not predictable but is consider as likely to occur given past experience.

Constrained judgement approach: A key input into the calculation of the structural balance is the estimate of the output gap, i.e. a numerical assessment of the current cyclical position of the economy. Output gap estimates are surrounded by uncertainty as potential growth, which is used to compute the output gap, is not directly observable. Furthermore, GDP data are frequently subject to revisions. The estimates of the output gap used in the surveillance process are calculated using a commonly agreed methodology based on a production function approach. ([64]) In 2016, the Economic and Financial Committee (EFC) endorsed the use of a "plausibility tool". This tool allows the Commission, under limited and specific circumstances, to exercise some "constrained judgement", i.e. to depart from the output gap estimates of the commonly agreed methodology in its assessment of the cyclical position of Member States when conducting its fiscal assessments.

Freezing principle: The required fiscal adjustment for year *t* is as a rule kept unchanged across forecast vintages, i.e. from the first ex-ante assessment (carried out in spring of year *t-1*) until the ex-post assessment (conducted in spring of the year *t+1*). This principle was designed to provide ex-ante guidance to Member States and to ensure predictability of assessments. However, it comes at a price of non-adaptability to changing economic conditions. For instance, if the economic conditions turn out to be less favourable than expected (i.e. a downward revision of the output gap), the frozen requirement would ask for a too sizeable fiscal adjustment. Against this background, it was agreed to reset, or "unfreeze", the requirements under certain conditions. ([65])

Unusual event clauses and general escape clause: The size or the pace of the required fiscal adjustment can be modified in exceptional cases. The SGP defines two types of events. First "unusual events outside the control of the Member States concerned, which have a major impact on its financial position" (the so-called "unusual event clause"). These events refer to severe asymmetric

([63]) In the preventive arm of the SGP, the required fiscal adjustment is measured by the structural balance and the expenditure benchmark.

([64]) This approach was adopted by the ECOFIN Council following approval from the Economic Policy Committee (EPC). The EPC has a dedicated working group (the Output Gap Working Group (OGWG), which meets regularly to discuss the operational effectiveness and relevance of the existing production function methodology (Havik et al., 2014).

([65]) First, if the most recent forecast/data signal a worsening of the economic situation so that the Member State's output gap would decline below -3% of GDP or the real growth rate would become negative, the required fiscal adjustment based on the most recent forecast/data prevail over the frozen requirement to avoid pro-cyclical fiscal policy in particularly unfavourable economic conditions. Second, if the most recent forecast/data indicate that the frozen requirement would lead to an overachievement of the MTO due to a better starting position, the requirement based on the most recent forecast/data prevail over the frozen requirement.

shock affecting a specific Member State, such as the earthquake in Italy in 2017 or the terrorist attacks in Belgium in 2016. Second, periods of "severe economic downturn for the euro area or the Union as a whole provided this does not endanger fiscal sustainability in the medium term" (the so-called "general escape clause"). In these cases the required fiscal adjustment under the preventive arm of the SGP can be lowered or the deadline for correction of the excessive deficit can be extended.

Opening of an excessive deficit procedure: Various steps are taken under the corrective arm of the SGP when a Member State's deficit or debt ratio is judged to be excessive, i.e. if the general government deficit exceeds 3% of GDP or the debt ratio is higher than 60% of GDP and not sufficiently diminishing towards that level. Exceeding the reference values does not, however, automatically lead to an opening of an excessive deficit procedure (EDP). In particular, an EDP is typically not opened in case of a "small and temporary" or "exceptional" breach of the deficit and debt criterion. In addition, a range of other "relevant factors" (e.g. on the medium-term economic, budgetary and debt position) have to be taken into account in an overall assessment before opening an EDP.

Box III.2.1: Uncertainty: Different measures and focus

While uncertainty is inherently unobserved and difficult to quantify, there is no consensus on how to measure it. ([1])

First, dispersion indicators focus on the dispersion across economic analysts or agents (forecasters, survey respondents, firms). Such indicators assume that a high (low) dispersion indicates a high (low) level of uncertainty. ([2]) While dispersion indicators tend to be based on a large number of observations, some caveats remain. First, agents' opinions may display systematic biases due to financial incentives. ([3]) Second, dispersions across respondents may be explained by differences in available information or in their implications. ([4]) On specific indicators, forecasters do not make predictions simultaneously, therefore dispersion might be caused by time lags between surveys. In addition, firm heterogeneity may be linked to predictable changes, for instance linked to structural evolution of the economy.

Second, stock market volatility is often used as an uncertainty measure. Financial-market data are available at high frequency. Within a certain period one can measure their volatility. Such measures are used to proxy uncertainty, at the same time, it cannot be ruled out that these indicators change for reasons other than uncertainty (e.g. changes in risk aversion or economic confidence). ([5])

Third, forecast errors measures are based on the difference between forecast and outturn data. They assume that a low (high) deviation between forecast and outturn data, e.g. of macro-economic variables ([6]) or financial markets valuations, ([7]) is a sign for a low (high) level of uncertainty. It is possible to aggregate the forecast errors for many variables. ([8])

Fourth, news-based measures count words related to uncertainty in news reports. The more often these words occur, the higher is the degree of uncertainty. ([9]) The main caveats with news-based measures are potential biases due to the subjectivity involved in its execution (e.g. choice of newspapers, search words) as well as the fact that they do not differentiate between national and international uncertainty (e.g. German newspapers writing about Brexit is counted towards Germany's uncertainty). Furthermore, there are limitations regarding data availability, especially for smaller countries.

Finally, to encompass all dimensions, some authors build synthetic indicators combining different measures. ([10])

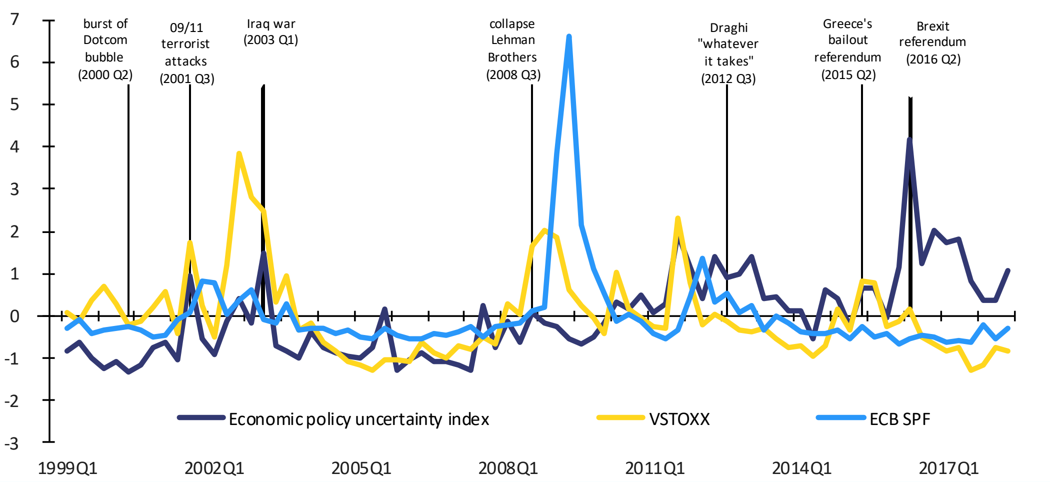
We exemplify uncertainty measures using four indicators for the EU (Graph 1). We consider the dispersion of forecasters' opinion (ECB SPF), the volatility on the financial market (VSTOXX) and the Economic Policy Uncertainty (EPU).

([1]) For descriptions of uncertainty indicators see also Vašíček (2018), Meinen and Roehe (2017) or Jurado et al. (2015).
([2]) Bloom et al. (2018), Bachmann et al. (2013), Abel et al. (2016).
([3]) Jurado et al. (2015).
([4]) Diether et al. (2002), Mankiw et al. (2003), Vašíček (2018).
([5]) Bekaert et al. (2013).
([6]) Klomp and de Haan (2009), Mohl and Sondermann (2013), Auerbach (2014), Abel et al. (2016), Rossi and Sekhposyan (2017).
([7]) Brown et al. (1988).
([8]) Jurado et al. (2015).
([9]) Baker et al. (2016).
([10]) ECB (2016).

(Continued on the next page)

Box (continued)

Graph 1: **Evolution of uncertainty indicators for the EU in comparison**



Source: ECB, European Commission, Baker, Bloom and Davis, Bloomberg.

Uncertainty indicators show marked differences depending on their focus: economic, financial or political uncertainty (Graph 1, Table 1). ([11]) Such uncertainty measures spike at different points in time and exhibit low correlations. The correlation is even negative between the EPU and the dispersion of macroeconomic forecast (-0.08) and it only reaches a level of close to 0.3 between the ECB SPF and the VSTOXX.

The VSTOXX and the bond spreads measure specifically financial markets uncertainty. The VSTOXX increased significantly in reaction to the 9/11 terror attacks, the 2003 Iraq war, and the collapse of Lehman Brothers. It decreased progressively after ECB President Mario Draghi's statement in July 2012 and increased again in 2015 in the context of Greece's bailout referendum.

The Economic Policy Uncertainty (EPU) index focuses on events of a political nature. The EPU index showed significant increases in reaction to the 9/11 terrorist attacks or the Iraq invasion; two events which also triggered reaction in the financial uncertainty indicators. By contrast, the EPU index did not spike following the fall of Lehman Brothers but it increased following the Brexit referendum, while the measures of financial market and macro-economic uncertainty (e.g. dispersion of indicators) remained at low levels.

Dispersion in the ECB Survey of Professional Forecasts (SPF) primarily measures macroeconomic uncertainty. This indicator shows a spike of uncertainty right after the collapse of Lehman Brothers. The delay compared to the financial indicators around 2009 and 20012 reflects a difference in their nature: the measure of macroeconomic uncertainty peaked after that of financial uncertainty because risks were first observed on the financial market and their materialisation fuelled the risk of contagion to the real economy. The recent referendums on the UK's membership of the EU and Greece's bailout were accompanied by increases in measures of political risk but did not trigger sizeable reactions in measures of macroeconomic uncertainty.

([11]) For the dispersion of indicators we take data from the ECB's Survey of Professional Forecasters (SPF) and estimate the cross-sectional variance of 1-year rolling forward forecast point predictions of Eurozone GDP growth (Abel et al., 2016). In terms of financial-markets measures, we use the VSTOXX, which measures the volatility of the EURO STOXX 50, as well as the bond spread between the German and Greek 10-year government bonds. Finally, the news-based measure is shown by the Economic Policy Uncertainty index, which is applied to Europe (Baker et al., 2016).

(Continued on the next page)

Box (continued)

Table 1: **Uncertainty measures at a glance**

Measure type	Description	Area	Variables analysed	Author
Dispersion indicators	Uses disagreement as a proxy for uncertainty assuming that episodes characterised by high (low) disagreement are indicative of a high (low) level of ex ante uncertainty shared by respondents	Economic	Forecast of output growth, inflation, unemployment	Zarnowitz and Lambros (1987), Lahiri and Sheng (2010), Abel et al. (2016)
		Economic	Business expectations	Bachmann et al. (2013)
		Economic	Business and consumer surveys	Vašíček (2018), Balta et al. (2013)
	Uses dispersion as a proxy for uncertainty assuming that episodes characterised by high (low) dispersion are indicative of a high (low) level of uncertainty	Economic	Firm-level or industry-level sales and productivity	Bloom et al. (2018)
Stock market volatility	Uses stock market volatility indexes as a proxy for uncertainty	Financial markets	Stock market volatility index (VXO, VIX)	Bloom (2009), Bekeart et al. (2013)
Forecast errors	Assumes that episodes associated with low (high) ex post forecast errors are indicative of a low (high) level of ex ante uncertainty.	Economic	Forecast error of output growth, inflation, unemployment	Abel et al. (2016)
		Economic	Inflation, unemployment rate, output growth	Rossi and Sekhposyan (2017)
		Policy	Fiscal, monetary, trade policies	Klomp and de Haan (2009)
		Economic	Fiscal balance	Auerbach (2014)
		Economic	132 macroeconomic series	Jurado et al. (2015)
News-based measures	Evaluates the frequency of articles in countries' leading newspapers that contain words related to uncertainty. The higher the frequency, the higher the uncertainty	Policy	Newspaper articles	Baker et al. (2016)
	Link news reports from politicians' statements to sovereign bond spreads in the EU	Policy	Sovereign bond spreads	Mohl and Sondermann (2013)

Source: Commission services.

Box III.2.2: New approaches to quantify the fiscal impact of unemployment changes with EUROMOD

This box presents novel approaches to quantify the expected fiscal impact of changes in unemployment to be developed by the Joint Research Centre (JRC) of the European Commission.

Large unemployment fluctuations can have a significant budgetary impact as recently evidenced by the Great Recession. For instance, unemployment spending rose by more than 70% in Bulgaria, Estonia, Ireland, Spain, Slovenia and Slovakia, between 2007 and 2011, against an EU average increase of around 30%. ([1]) In the case of Spain, the sharp increase in unemployment spending represented a significant share of public expenditure slippages during the post-crisis period, despite the implementation of measures aimed at increasing incentives for job seekers and the transition of long-term unemployed to alternative social support schemes. ([2])

The identification of the budgetary effects of unemployment changes is a challenging task. At macro level, they are often assessed based on assumptions on the magnitude of the elasticity of the unemployment expenditures with respect to the number of unemployed or the unemployment rate. However, such an approach fails to capture factors linked to the heterogeneity of workers, which matters for at least two reasons: (i) the eligibility for and size of unemployment benefits depend on workers' characteristics (e.g. previous wage, working history, family circumstances); and (ii) the likelihood to find a job also depends on workers' characteristics (in particular, skills, gender, marital status). ([3])

The JRC is exploring innovative approaches to quantify the budgetary costs of changes in unemployment based on micro data using the microsimulation model EUROMOD. Common characteristics across the approaches are the interaction of a macro-model to determine the macroeconomic situation and a micro-simulation model, accounting for policy changes and incorporating workers heterogeneity. The main steps are summarised in Graph 1.

First, a macro-model has to be set up. Both the use of a macro-model providing GDP and unemployment forecasts or of empirical relationships between GDP and unemployment (e.g. Okun's law) could be used to derive the level of unemployment corresponding to a certain GDP level.

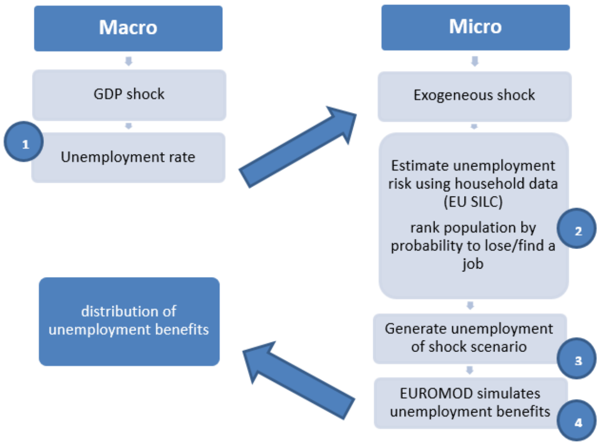
Second, survey micro-data are used to determine unemployment risk. The analysis employs individual level data from the European Statistics on Income and Living Conditions (EU-SILC) to estimate an unemployment risk for each respondent active on the labour market. The estimation is performed separately for each EU Member States using 2015 SILC data. ([4]) Subsequently, EU-SILC respondents are sorted according to their predicted unemployment probability. ([5])

([1]) Based on Eurostat data.
([2]) Martí and Pérez (2015).
([3]) Blundell and Stoker (2005).
([4]) The number of observations varies from more than 4,300 in Luxembourg to just above 20,000 in Italy. A probit regression is used, with dependent variable equal to 1 if the respondent is unemployed. Demographic characteristics and income circumstances are used as regressors. In order to avoid deterministic behaviours, the fitted values of the probit are complemented by a random component before computing the unemployment probabilities. Intuitively, this operation avoids that all the individuals with characteristics strongly associated with being unemployed, for example having a low education level, are automatically identified as those with the highest unemployment risk.
([5]) This approach follows the work by Jara et al. (2015). The matching process that generates employment relationships, i.e. between workers and vacancies, has been documented extensively. For a broad overview of the literature concerning the matching function see Petrolongo and Pissarides (2001). More recently, Elsby et al. (2015) also provided an overview of the extensive research with respect to the resulting relationship between unemployment and the job vacancy rate, i.e. the Beveridge curve.

(Continued on the next page)

Box (continued)

Graph 1: **Schematic representation of the approach**



Source: Commission services.

Third, the target number of unemployed derived in step 1 is recreated in the EU-SILC data. The JRC is testing two different approaches in order to accomplish this:

- The first approach recreates the targeted number of unemployed by first drawing observations from individuals currently unemployed according to their unemployment risk (as estimated in step 2). If, by doing so, the target number of unemployed has not been reached, the model draws from the set of employed people, starting from those with higher unemployment risks. In addition, the selection can account for country- and unemployment-rate-specific benefit coverage rates, estimated using data from the EU Labour Force Survey. While the method replicates the targeted number of unemployed, it fails to simulate the duration of the unemployment spells.

- In the second approach, the JRC is exploring the possibility of targeting not the number of unemployed, but rather the total sum of months spent in unemployment. In this case, using country level panel data from aggregated EU-SILC micro data, an empirical correlation can be determined between levels of unemployment and total duration of unemployment spells. The second approach selects among the observed unemployed and next the respondents in employment, until the desired number of months spent in unemployment in one year is reached for the entire economy.

Fourth, the microsimulation model EUROMOD is used to simulate unemployment benefits for the new stock of unemployed. Individual unemployment payments are aggregated at the country level to analyse the budgetary impact of the changes in unemployment. (6) Given this objective, the JRC is also considering to reweight the data as an alternative to introduce unemployment shock into EU-SILC data. A macro model could for example provide information on changes in unemployment by skill group. In that case, the survey weights of the unemployed could be changed accordingly, allowing matching the targeted number of unemployed and, with the help of EUROMOD, simulating the budgetary cost of the unemployment changes. Finally, given a probability distribution of shocks to GDP, model simulations can be repeated in order to construct confidence bounds or fan charts of the simulated distribution of fiscal

(6) EUROMOD is a tax/social benefits calculator designed to provide results which are representative at country-level and validated against aggregate national statistics. EUROMOD codifies direct taxes and social benefits in all EU countries. For this, it relies on detailed micro data from the EU-SILC survey, including information on socio-demographic characteristics and financial circumstances. The EUROMOD model is therefore a tool suitable for the quantification of the fiscal impact of unemployment changes.

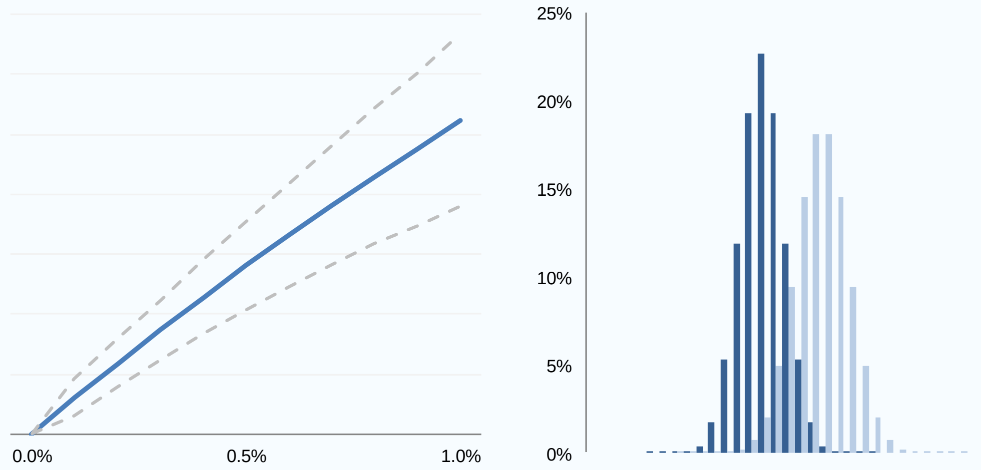
(Continued on the next page)

Box (continued)

outcomes. ([7]) Graph 2 illustrates the expected change in unemployment spending (EUR) as a function of the change in the unemployment rate in a stylised hypothetical simulation.

The proposed approach has three key advantages. The first advantage is to have a measure of the budgetary cost of unemployment which changes with legislation reforms and allows distinguishing the impact of the reforms from the impact of unemployment developments. Second, the measure is micro-based and reflects the heterogeneity of the unemployed and possibly the cost asymmetry in the different phases of the cycle. This heterogeneity could have non-negligible fiscal consequences if different workers are entitled to different unemployment insurance coverage and/or given that the change in their employment status or income level may have implications for their entitlement to other social benefits. Third, the proposed methodology enables "almost" real-time application, since it only requires measures of current unemployment for its application.

Graph 2: **Hypothetical fan chart**



Note: Change in unemployment spending as a function of the change in the unemployment rate (pp. change). On the right graph, dark (light) bars show an increase in the unemployment rate of 0.4 (0.8) pp.
Source: Commission services.

Some caveats remain/require further investigation. First, although the proposed methodology captures heterogeneity in unemployed characteristics through the estimated unemployment risk, it is invariant to the type of shock. A five percent unemployment shock originated by aggregated demand will generate the same pool of unemployed as an aggregated supply shock of the same size. A possible way to overcome this limitation is to use additional information on the type of shock in the selection process. For example, different types of shock may influence high and low skilled workers or some industries in a different way. Second, the time lag with whom EU-SILC is made available is dealt with by EUROMOD with the use of uprating factors for monetary variables, which are only an approximation of monetary update over time.

([7]) The initial distributional characteristics of the macroeconomic shocks can be obtained from a consistent macro model or using estimations as commonly used for the stochastic debt projections in the Commission's Fiscal Sustainability Reports. The methodology has also been followed by the IMF and the World Bank in its fiscal policy analyses, see e.g. Celasun et al. (2007) and Budina and van Wijnbergen (2008).

3. DO MEMBER STATES REACT TO UNCERTAIN OUTCOMES?

3.1. INTRODUCTION

In this Chapter, we assess if and under which conditions Member States adjust their fiscal plans to periods of uncertainty, i.e. if they learn from past episodes of uncertainty. Since uncertainty is an inevitable part of economic life, a sound approach to fiscal policy does not necessarily require Member States to react to uncertainty. However, a myopic disregard of repeated or large-scale uncertainty, i.e. no learning from past episodes of uncertainty, can do serious damage to a Member State's public finances.

The remainder of this Chapter is structured as follows. Section III.3.2. presents some stylised facts about the uncertainty measure used here. Section III.3.3. explains the empirical strategy. Finally, Section III.3.4. presents the main findings.

3.2. STYLISED FACTS: FISCAL FORECAST ERRORS CAN BECOME SIZEABLE

We measure uncertainty as the forecast error of the fiscal effort, a key indicator of the SGP. The fiscal effort is the component of fiscal policy that depends most on the decision of policymakers. It is measured as the change in the structural balance. ([66]) The structural balance adjusts the overall government balance for the impact of the economic cycle as well as for certain one-off revenues (e.g. sales of telecommunication licences) and one-off capital transfers (e.g. financial assistance to the banking sector). The forecast error of the fiscal effort for year *t* is defined as the difference between the one-year ahead forecast for year *t* made in autumn of year *t-1* and the "realised" (outturn) value for year *t* observed in spring of year *t+1*. As a result, a positive (negative) forecast error points to a negative (positive) surprise. The use of the autumn forecast allows us to take into account Member States' draft budgetary plans.

The forecast error is based on Commission forecast reports. We compute the forecast errors for Member States using real-time data from Commission forecast vintages between autumn 2000 and spring 2018. Commission forecasts appear to represent an unbiased forecast using all the available information, therefore capturing the "intrinsic" uncertainty. ([67]) By contrast, forecasts produced by domestic authorities may be overly optimistic in order to avoid potential procedural consequences in case of non-compliance with the targets. ([68])

Our results show that the forecast error of the fiscal effort can be sizeable even for the EU28 on average (Graph III.3.1). In the early 2000s, the forecast error of the fiscal effort for the EU28 points to negative surprises, i.e. the fiscal effort turned out to be smaller than expected resulting in a positive forecast error. The negative surprises were highest during the Great Recession in 2008 and 2009, when the fiscal effort turned out to be more than 1 pp. smaller than expected. Such a figure can be considered very large, as the SGP defines a deviation of the fiscal effort on the adjustment path towards the MTO as "significant" if it exceeds 0.5% of GDP in one year or 0.25% of GDP on average in two years. In the last three years, the EU28 showed positive surprises (i.e. negative forecast errors), which were, however, rather small.

Sizeable forecast errors of the fiscal effort have not only occurred in times of deep crisis (Graph III.3.2). It is true that the forecast errors were particularly high during the Great Recession and the European debt crisis (i.e. between 2008 and 2013). During this period, more than 70% of the forecast errors exceeded 0.5 pp. (see red Kernel distribution in Graph III.3.2). In addition, the forecast errors were characterised more often by negative surprises (explaining the right-skewed distribution). However, in non-crisis times sizeable

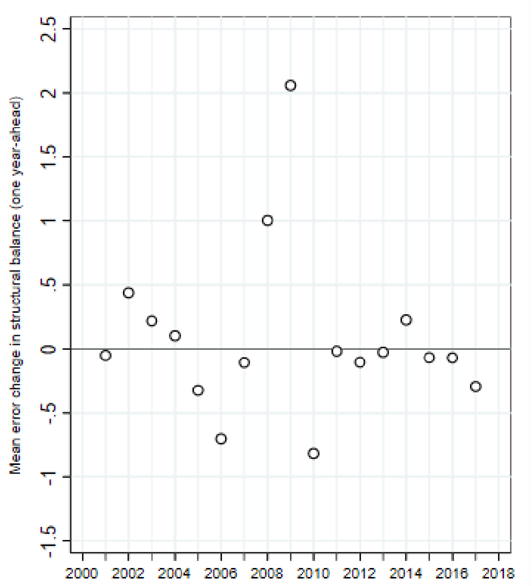
([66]) The preventive arm of the SGP uses a second measure for the fiscal effort, namely the expenditure benchmark.

([67]) González Cabanillas and Terzi (2012) and Fioramanti et al. (2016) for GDP and Mourre et al. (2016) for tax revenues. We ran tests for bias in the Commission's projections, by simply regressing the forecast error on a constant and testing if this constant is statistically different from zero. Our findings show that the forecast of the fiscal effort does not show a bias for country aggregates (EU, euro area, CEEC) and for 25 out of 28 Member States. Only for Croatia, Denmark and Sweden do we find a tendency to underestimate the fiscal effort. For Croatia, the number of observations is limited, since it only joined the EU in 2013. The results broadly confirm similar tests conducted in 2012 (González Cabanillas and Terzi, 2012).

([68]) Frankel and Schreger (2013).

forecast errors (exceeding 0.5%) occurred in around 50% of cases (see green Kernel distribution in Graph III.3.2).

Graph III.3.1: **Mean error of the fiscal effort (EU28 average)**

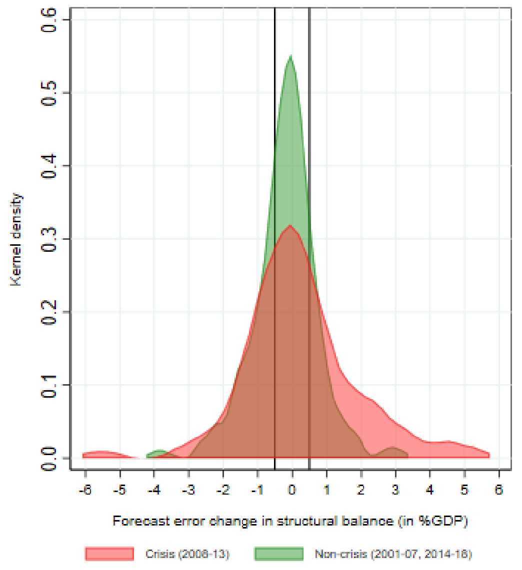


Note: The forecast errors are defined as the difference between the forecast from autumn for year t+1 and the realised value in spring for year t-1. A positive (negative) forecast error corresponds to a negative (positive) surprise. The calculations are based on real-time data from Commission forecast vintages from 2000-2018. For data availability reasons, the cyclically-adjusted balance is used before 2006 instead of the structural balance. EU28 aggregate is calculated based on non-weighted averages.
Source: Commission services.

The forecast error of the fiscal effort was non-negligible for many Member States. For the EU as a whole, positive and negative one-year ahead forecast errors offset each other over the period 2000 to 2018, resulting in a mean error close to zero. However, at country-level the forecast error seems to be more persistent. Over the period 2000 to 2018, on average around 20 (15) percent of the Member States overestimated the fiscal effort by on average 0.25 (0.5) pp. (Graph III.3.3). The mean error represents only a rough indicator of the forecast quality, since positive and negative errors can offset each other, thereby limiting the size of the error. As a consequence, we also calculate the mean absolute error. ([69]) We find that in more than 80% of Member States, the mean absolute error exceeds 1 pp. over the period 2000 to 2018 (Graph III.3.4).

([69]) The mean absolute error (MAE) measures the average absolute difference between the forecast and the outturn.

Graph III.3.2: **Distribution of forecast errors of the fiscal effort (EU28 Member States)**

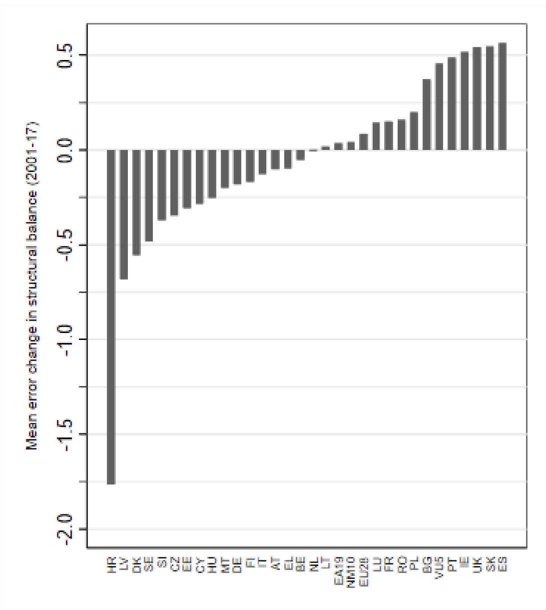


Note: The forecast errors are defined as the difference between the forecast from autumn for year t+1 and the realised value in spring for year t-1. A positive (negative) forecast error corresponds to a negative (positive) surprise. The calculations are based on real-time data from Commission forecast vintages from 2000-2018. For data availability reasons, the cyclically-adjusted balance is used before 2006 instead of the structural balance.
Source: Commission services.

3.3. EMPIRICAL STRATEGY

We analyse Member States' reaction to uncertainty in three steps using a panel data approach (Graph III.3.5, Box III.3.1). As a first step, the key drivers of the planned fiscal adjustment are determined in a baseline model using a classical fiscal reaction function approach. In a second step, we augment the baseline specification with the forecast error of the fiscal effort, in order to get a first rough idea of whether Member States learn from past forecast errors/uncertainty (i.e. a "learning effect"). In a third step, we refine our test of the learning effect. Since forecast errors are an unavoidable part of fiscal projections, we do not expect Member States to react to all kinds of uncertainty. However, a myopic disregard of repeated errors or large-scale uncertainty can do serious damage to a Member State's public finances. Therefore, we use a panel interaction model to find the conditions under which the forecast error becomes important (see Box III.3.1 for a more detailed description of the empirical strategy). The analysis concentrates on all Member States using real-time data from Commission forecast reports between autumn 2000 and spring 2018.

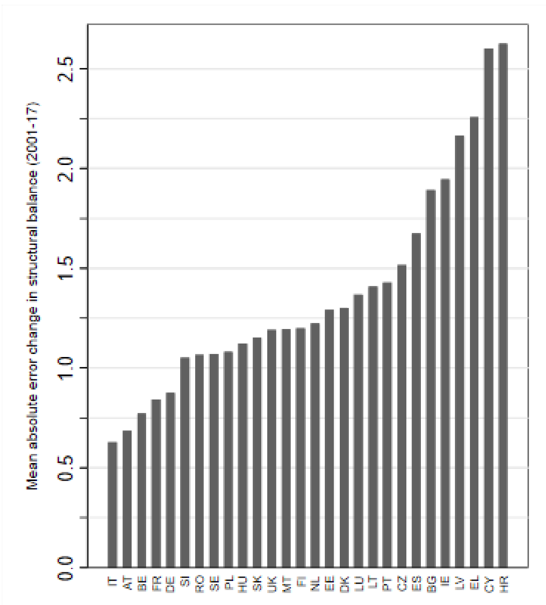
Graph III.3.3: **Mean error of fiscal effort by country (one-year ahead)**



Note: The one-year ahead forecast error is defined as the difference between the forecast from autumn for year t+1 and the realised value in spring for year t-1. A positive (negative) forecast error corresponds to a negative (positive) surprise. The calculations are based on real-time data from the Commission autumn forecasts using forecast vintages from 2000-2018. For data availability reasons, the cyclically-adjusted balance is used before 2006 instead of the structural balance. EU28 aggregate calculated based on non-weighted averages.
Source: European Commission forecast across different vintages.

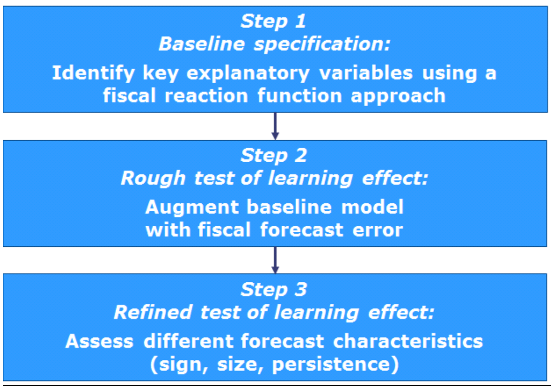
The dependent variable is defined as the planned fiscal effort for the year ahead and, in line with the academic literature, we control for a number of factors. The dependent variable measures the fiscal effort (the change in the structural balance) planned for the next year, according to Commission forecasts. The independent variables are selected in line with the academic literature. ([70]) We control for the economic cycle, as measured by the change in the output gap, and we use the debt-to-GDP ratio to take account of governments' budget constraints. The remaining independent variables include other macroeconomic indicators (current account balance), political-economic variables (the percentage share of months of a given year before an election), demographic factors (old age dependency ratio) and institutional factors (Member States in EDP, achievement of the MTO). Since the impact of the macroeconomic and demographic variables does not affect the fiscal effort immediately, they are included with a lag of one year.

Graph III.3.4: **Mean absolute error of fiscal effort by country (one-year ahead)**



Note: The one-year ahead forecast error is defined as the difference between the forecast from autumn for year t+1 and the realised value in spring for year t-1. A positive (negative) forecast error corresponds to a negative (positive) surprise. The calculations are based on real-time data from the Commission autumn forecasts using forecast vintages from 2000-2018. For data availability reasons, the cyclically-adjusted balance is used before 2006 instead of the structural balance.
Source: European Commission forecast across different vintages.

Graph III.3.5: **Estimation strategy: Do Member States react to unexpected fiscal outcomes (learning effect)?**



Source: Commission services.

([70]) Bohn (1998), Checherita-Westphal and Žďárek (2017), Combes et al. (2017), European Commission (2011).

Box III.3.1: **Estimation strategy: Do Member States learn from past episodes of uncertainty?**

This box provides more details on the estimation strategy, which is conducted in three steps. The key purpose of the empirical approach is to find if Member States react to uncertainty, i.e. if they show a learning effect with regards to past uncertainty:

As a first step, the key drivers of the expected fiscal adjustment are determined in a baseline specification, which can be expressed as follows:

$$\Delta\, SB_{\mathrm{i,t+1,j}} = \beta_1 \Delta\, \mathrm{OG}_{\mathrm{i,t,j}} + \beta_2 \text{public debt}_{\mathrm{i,t-1,j}} + \beta_3 X_{i,t,j} + \vartheta_{\mathrm{t}} + \theta_{\mathrm{i}} + \varepsilon_{\mathrm{i,t}} \quad (1)$$

where *i* refers to the Member State, *t* to the year of the observed value and *j* to the Commission forecast vintage. For instance, the variable $\textit{public debt}_{BE,2019,AF2018}$ stands for the public debt ratio of Belgium (*i*) in 2019 (*t*) as published in the Commission 2018 autumn forecast report (*j*). The dependent variable is the expected change in the structural balance. The independent variables are selected in line with the large fiscal reaction function literature and include an indicator for the economic cycle (change in the output gap) and the budget constraint (public debt). Additional control variables are presented in the main text above and summarised in the vector *X*. Furthermore, the specification includes year- (ϑ) and country-fixed effects (θ), while ε represents an error term.

In a second step, the baseline specification is augmented with the forecast error presented above to get a rough idea of the impact of a possible learning effect from the past. The augmented baseline specification looks as follows:

$$\Delta SB_{\mathrm{i,t+1,j}} = \beta_1 \Delta \mathrm{OG}_{i,t,j} + \beta_2 \text{public debt}_{i,t-1,j} + \beta_3 X_{i,t,j} + \sum_{k=1}^{3} \beta_{\mathrm{k+3}}\, err(\Delta SB_{t-k}) + \vartheta_{\mathrm{t}} + \theta_{\mathrm{i}} + \varepsilon_{\mathrm{i,t}} \quad (2)$$

where *err(ΔSB)* stands for the one-year ahead forecast error of the fiscal effort as measured by the change in the structural balance. This means that a positive (negative) forecast error indicates that the outcome is worse (better) than expected. We also test for the lagged impact of the forecast errors by using the forecast errors of the previous three years. ([1]) In terms of our main hypotheses, we would find evidence for a learning effect from the past if the coefficient of the forecast error is positive and statistically different from zero, meaning that a marginal increase in the fiscal error (i.e. an overestimation of the fiscal effort) leads, ceteris paribus, to a tightening of the fiscal adjustment.

In a third step, we revise the specification to find out under which conditions Member States react to negative or positive surprises. We estimate the following interaction model:

$$\Delta SB_{\mathrm{i,t+1,j}} = \beta_1 \Delta \mathrm{OG}_{i,t,j} + \beta_2 \text{public debt}_{i,t-1,j} + \beta_3 X_{i,t,j} + \beta_4 err\left(\Delta \mathrm{SB}_{i,t-1,j}\right) + \beta_5 D_{\mathrm{i,t,j}} + \beta_6 err\left(\Delta \mathrm{SB}_{i,t-1,j}\right) * D_{\mathrm{i,t,j}} + \vartheta_{\mathrm{t}} + \theta_{\mathrm{i}} + \varepsilon_{\mathrm{i,t}} \quad (3)$$

where *D* represents a dummy variable that is equal to one if the forecast error is positive and/or sizeable and/or persistent. We first assess cases of negative surprises (i.e. positive forecast errors), since they can be considered particularly damaging for the sustainability of public finances. We also test the impact of positive surprises (i.e. negative forecast errors). To find out if these elements have an impact on the expected fiscal effort, the dummy variable is interacted with the forecast error. We can then derive the marginal effect, which measures how a marginal change of the forecast error effects the fiscal effort as follows:

$$\frac{\partial\, SB}{\partial\ \mathrm{err}\ (\Delta SB)} = \beta_4 + \beta_6\, D_{\mathrm{i,t,j}} \quad (4)$$

([1]) Due to multicollinearity the coefficients and standard errors of the forecast error cannot be interpreted if the variable is included into the regression with several lags. As a consequence, we calculate the joint sum of forecast errors coefficients and use a simple Wald test to check whether this short-term elasticity is significant.

(Continued on the next page)

Box (continued)

The equation shows that the marginal effect depends on the value of the dummy variable D. The marginal effect is defined as $\beta_4 + \beta_6$ if the dummy variable is equal to 1 (e.g. forecast error shows a negative surprise), whereas it simplifies to β_4 if the dummy variable is 0 (e.g. forecast error shows a positive surprise). ([2]) In addition, the standard errors for both events can to be calculated based on the variance-covariance matrix.

We apply different estimation techniques. In terms of the estimation approach, we apply three different techniques. We first estimate the model with simple LSDV estimations using White heteroscedasticity robust standard errors. ([3]) In addition, we provide further evidence by running first-difference and system-GMM regressions in order to control for endogeneity. ([4]) We consider the forecast error and the output gap to be endogenous. Due to the small sample size, the set of internal instrumental variables is restricted to up to 2 lags and the matrix of instruments is then "collapsed". ([5]) We test the validity of the GMM specification with AR(1,2) and Hansen tests.

([2]) For the specification and interpretation of interaction terms see Brambor et al. (2006); Braumoeller (2004).
([3]) White (1980).
([4]) Blundell and Bond (1998).
([5]) The standard errors are corrected following Windmeijer (2005).

3.4. MAIN RESULTS

Based on simple correlations, we find a positive but very weak relationship between the planned fiscal effort and the forecast error of the fiscal effort (Graph III.3.6). Linking the forecast error of the fiscal effort with the planned fiscal effort reveals a rather weak relationship for both euro area (light blue) and other Member States (light and dark blue). The correlation remains weak when the forecast error is used with a lag of two or three years. ([71]) However, as correlation does not imply causality, further analysis needs to be undertaken in a regression framework.

Our baseline model largely confirms the findings of the fiscal reaction function literature (Table III.3.1). We find strong evidence of pro-cyclical fiscal policy, as shown by the negative and significant coefficient of the change in the output gap. In addition, an increase of the debt-to-GDP ratio tends to lead to a fiscal tightening. Moreover, election years appear to be significantly linked with a loosening of the fiscal adjustment. The initial years of the Great Recession (2018-09) appear to have resulted in a significant loosening of the fiscal adjustment. Finally, Member States that have overachieved their MTOs seem to set looser fiscal adjustment plans, while Member States in EDP seem to set a tighter fiscal adjustment plan. The findings are robust to the estimators used (columns 1-3). ([72])

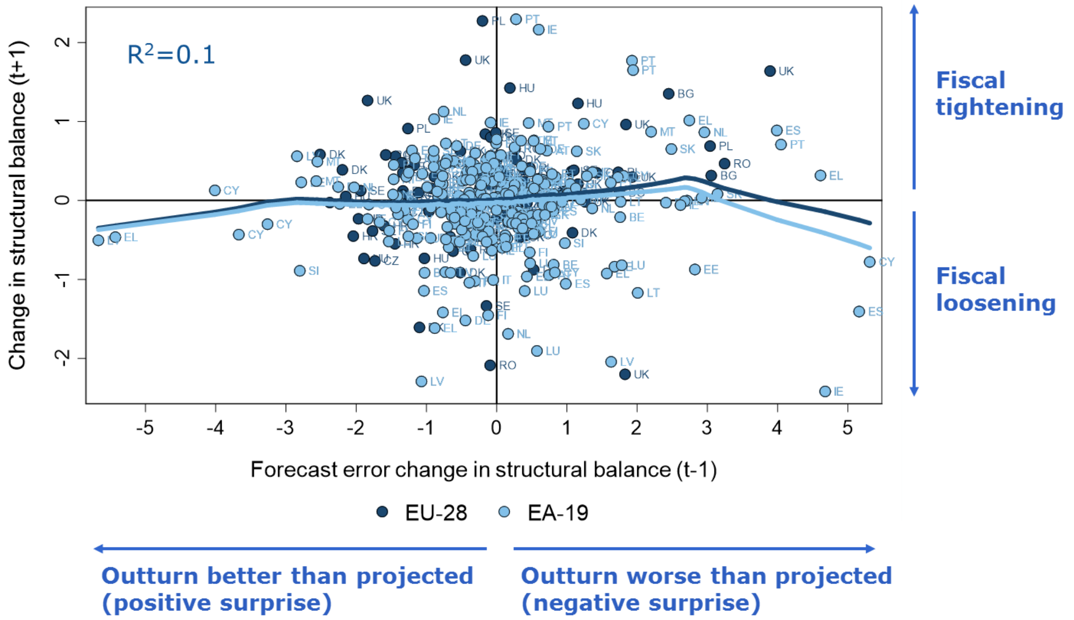
A rough first assessment using the augmented baseline model indicates no significant learning effect (Table III.3.1). To get a rough first idea if Member States learn from past episodes of uncertainty, we augment the model with the forecast error of the fiscal effort. Since the consequences of increased uncertainty may only kick in after repeated forecast errors have occurred, we assess the impact of time lags in greater detail. We run our empirical analyses by adding the lagged forecast error in a stepwise fashion, beginning with a lag of one year (column 2) and ending up with specifications comprising the forecast error with a lag of up to two (column 3) and three years (column 4). The results indicate that an increase (decrease) in the forecast error, corresponding to a negative (positive) surprise, does not have a statistically significant impact. The findings of the other independent variables remain broadly unchanged.

Robustness tests broadly confirm the main findings (Table III.3.1). First, we shorten the sample to re-run the regressions for the time period since 2005 (columns 5-7). The reason for it is that the structural balance has been used in fiscal surveillance only since 2005, while the cyclically-

([71]) These results are not shown here but are available upon request to the authors.

([72]) We also tested for a broad range of additional independent variables (such as the current account balance, openness, ageing), which, however, turned out to be not statistically significant.

Graph III.3.6: **Correlation between forecast error and planned fiscal adjustment**



Note: The graph shows simple correlations between the planned fiscal effort (as measured by the change in the structural balance) for the year ahead (y-axes) and the one-year ahead forecast error of the fiscal effort (x-axes). The sample covers 28 Member States, which are highlighted in light blue (euro area Member States) and dark blue (other Member States). The fit is illustrated using a locally-weighted scatterplot (non-parametric regression), which has the main advantage of not requiring the specification of a global functional form to fit a model and calculated for euro area (light blue line) and other Member States (dark blue line).
Source: Commission services.

adjusted balance was used before.(73) Second, we assess the sensitivity of our findings by using different estimation techniques (columns 8 and 9). Overall, our key findings do not change much in both cases.

We revise our empirical strategy to find out if Member States learn from past episodes of uncertainty. A myopic disregard of repeated or large-scale uncertainty can do serious damage to the public finances. In order to take this factor into account, we assess the sign, size and persistence of the forecast error in greater detail. We assess negative surprises (i.e. positive forecast errors) and positive ones (i.e. negative forecast errors). We also test if large or very large negative or positive surprises (0.25 pp. or 0.5 pp. of GDP) had an impact. Finally, we test if repeated (large) negative or positive surprises had an impact on Member States' planned fiscal effort.

Our findings of the refined test of the learning effect can be summarised as follows (Table III.3.2):

- ***Sign of the forecast error***: Our results show that neither negative (i.e. a *positive* forecast error) nor positive surprises of the fiscal forecast (i.e. a *negative* forecast error) do have a statistically significant impact on the planned fiscal effort.

- ***Size of the forecast error***: Similarly, *large* or *very large* negative surprises do not cause a significant effect on the planned fiscal effort if they occur only once. This finding holds irrespective of the sign (positive or negative) and the size (0.25 pp. or 0.5 pp. of GDP) of the forecast error. Similarly, the occurrence of one (very) large forecast error in the past (up to three years) have no statistically significant impact on the planned fiscal effort.

(73) The structural balance corresponds to the cyclically-adjusted balance excluding one-offs and certain temporary measures.

Table III.3.1: **Regression results (augmented) baseline model**

Dependent variable:	Baseline	Augmented baseline model			Robustness				
structural balance	model	with forecast error			shorter sample (since 2005)			estimation technique	
Estimator	FDGMM	FDGMM			FDGMM			LSDV	SYSGMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Output gap (t)	-0.434***	-0.369***	-0.298***	-0.294***	-0.378***	-0.301***	-0.290***	-0.293***	-0.386***
	(-3.732)	(-3.322)	(-3.698)	(-3.170)	(-3.403)	(-3.407)	(-3.112)	(-4.685)	(-3.436)
Public debt (t-1)	0.006***	0.005***	0.005***	0.006***	0.005***	0.005***	0.006***	0.009***	0.005**
	(3.255)	(2.698)	(2.644)	(3.382)	(2.634)	(2.619)	(3.293)	(2.851)	(2.329)
Election year (t)	-0.001*	-0.002**	-0.002***	-0.002***	-0.002**	-0.002***	-0.003***	-0.000	-0.002*
	(-1.852)	(-2.030)	(-2.819)	(-4.025)	(-2.253)	(-2.679)	(-4.025)	(-1.438)	(-1.946)
Crisis dummy (2008-09)	-0.119*	-0.602*	-0.567**	-0.511*	-1.020***	-0.909***	-0.934***	-0.104	-0.603*
	(-1.842)	(-1.777)	(-2.169)	(-1.785)	(-3.254)	(-4.051)	(-4.046)	(-0.693)	(-1.741)
MTO overachievement (t)	-0.263***	-0.292***	-0.296***	-0.245**	-0.308***	-0.317***	-0.257**	-0.281***	-0.278***
	(-3.829)	(-4.253)	(-4.215)	(-2.509)	(-3.972)	(-3.990)	(-2.496)	(-3.096)	(-4.083)
EDP (t)	0.245***	0.259***	0.296***	0.347***	0.256**	0.289***	0.343***	0.188*	0.280***
	(2.637)	(2.740)	(3.238)	(3.665)	(2.284)	(2.688)	(3.018)	(1.866)	(3.203)
Forecast error ΔSB (t-1)		0.103	0.126	0.088	0.083	0.098	0.074	0.167	0.111
		(1.379)	(1.226)	(1.595)	(0.819)	(1.352)	(0.897)	(0.597)	(1.393)
Forecast error ΔSB (t-2)			0.065	0.139		0.072	0.138		
			(0.883)	(0.525)		(0.747)	(0.796)		
Forecast error ΔSB (t-3)				0.2			0.206		
				(0.949)			(0.853)		
# observations	455	399	371	343	339	326	313	399	399
R-squared								0.49	
Wald time/country dummies (p-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 / 0.01	0.00
Forecast error ΔSB (size)		0.10	0.19	0.43	0.08	0.17	0.42	0.17	0.11
Forecast error ΔSB (p-value)		0.17	0.38	0.60	0.41	0.46	0.37	0.55	0.16
AR(1) (p-value)	0.01	0.00	0.00	0.00	0.01	0.01	0.00		0.00
AR(2) (p-value)	0.32	0.32	0.08	0.39	0.73	0.30	0.45		0.33
Hansen (p-value)	0.76	0.66	0.83	0.95	0.94	0.75	0.99		0.66
# instruments	25	25	26	27	21	23	25		25

Note: The Forecast error is defined as the difference between the forecast from autumn for the year ahead and the realised outturn from spring for the previous year. Estimations are based on least square dummy variable estimator using heteroskedasticity-robust standard errors (LSDV). In addition, the use of first-difference GMM (FDGMM) and system-GMM (SYSGMM) estimators follows Blundell and Bond (1998), where we consider the output gap and the forecast error variables to be endogenous. Due to the small sample size, the set of internal instrumental variables is restricted to up to 1 lag and the matrix of instruments is then "collapsed". The standard errors are corrected following Windmeijer (2005). AR(1,2) and Hansen tests confirm the validity of the GMM specifications (Roodman, 2009a, b). Note that the coefficients and standard errors of the forecast error cannot be interpreted if the variable is included in the regression with several lags (column 3, 4, 6, 7). As a consequence, we report the size of forecast errors coefficients (row "forecast error ΔSB (size)") We then use a simple Wald test to check whether this short-term elasticity is statistically different from zero ("forecast error ΔSB (p-value)"). ***, ** and * denote, respectively, statistical significance at 1, 5 and 10%.
Source: Commission services.

- ***Persistence of forecast errors***: We assess up to three lags to assess the impact of persistent forecast errors. We find evidence that persistent forecast errors have an impact on the planned fiscal effort. The strength of the impact depends, however, on the size of the forecast error: Overall, we find only a weak impact in case of negative surprises, but a strong one for positive ones. To be more precise, in case of negative surprises (Table III.3.2, panel A), only a *repeated and very large negative* surprise (i.e. exceeding 0.5 pp. of GDP) leads to a statistically significant impact in the form of a fiscal tightening. It is important to note, however, that this is a rather rare event that only occurs in around 3% of all observations since 2000 (13 out of 399). The main result is only valid in case of three very large negative surprises that are repeated in a row. By contrast, we cannot find significant results if the very large negative surprise occurred only two years in a row or in two out of three years.

At the same time, repeated positive surprises have a rather strong impact, resulting in a fiscal loosening (Table III.3.2, panel B).

Table III.3.2: **Regression results conditional on forecast characteristics**

A. Negative surprises		Qualitative assessment	Quantitative assessment: Marginal effect – Size	Marginal effect – p-value	# obs.
Sign	Negative surprise	No impact	0.06	0.51	226
Size	Large negative surprise	No impact	0.03	0.70	155
	Very large negative surprise	No impact	0.00	0.69	112
Per-sistence	Repeated neg. surprise	No impact	0.15	0.21	100
	Repeated large neg. surprise	No impact	0.16	0.13	45
	Repeated very large neg. surprise:				
	• 2 years in a row	No impact	0.19	0.50	43
	• 2 out of 3 years	No impact	0.17	0.14	108
	• 3 years in a row	Impact: fiscal tightening	0.23**	0.05	21

B. Positive surprises		Qualitative assessment	Quantitative assessment: Marginal effect – Size	Marginal effect – p-value	# obs.
Sign	Positive surprise	No impact	-0.06	0.59	173
Size	Large positive surprise	No impact	-0.03	0.82	118
	Very large positive surprise	No impact	-0.24	0.25	75
Per-sistence	Repeated pos. surprise	Impact: fiscal loosening	-0.63***	0.00	32
	Repeated large pos. surprise		-0.54***	0.01	8
	Repeated very large pos. surprise:				
	• 2 years in a row		-0.22**	0.04	19
	• 2 out of 3 years		-0.15***	0.00	44
	• 3 years in a row		-0.21*	0.10	1

Note: Forecast errors of the fiscal effort (i.e. the change in the structural balance) are considered to be large (very large) if they exceed 0.25(0.5) pp. The column "qualitative assessment" summarises the quantitative assessments in a (hopefully) simpler manner. The columns "quantitative assessment" show the size and significance level of the marginal effect, which measures the impact of a marginal increase of the forecast error if the forecast characteristic (sign, size, persistence) is fulfilled (see equation (4) in Box III.3.1, see below an example). The findings are based on the same sample and estimations techniques as described in the note of Table III.3.1. The total number of observations in the panel is 399, while "# obs." reports the number of observations of the investigated forecast characteristics, e.g. in 175 out of 399 cases we observed a negative surprise. Example of the quantitative assessment: A negative surprise tends to have a small positive impact on the planned fiscal adjustment (the size of the coefficient is 0.06), which is, however, not statistically significant at the 10% level (p-value of 0.51). ***, ** and * denote, respectively, statistical significance at 1, 5 and 10%.
Source: Commission services.

4. HOW DO ECONOMIC SHOCKS AFFECT FISCAL OUTCOMES?

4.1. INTRODUCTION

Fiscal shocks can have a sizeable impact on the real economy. A large literature analyses the short-term effects of fiscal shocks on output. ([74]) Their impact is captured by the fiscal multiplier, which is typically defined as the percentage change in real GDP resulting from a fiscal shock of 1% of GDP. While there is general agreement that fiscal consolidation has a negative effect on GDP in the short-run, the size of its impact depends on several factors. On average, public spending multipliers are estimated as being between 0.75 and 1. Tax multipliers tend to be several tenths of a percent lower, although this depends on the type of tax shock considered. For instance, recent findings suggest that multipliers for tax rate adjustments are larger (compared to average tax multipliers), while those for tax base changes are smaller and possibly insignificant. ([75]) Moreover, anticipated tax cuts give rise to contractions upon announcement before the medium-term impact of their implementation materialises. Overall, fiscal multipliers tend to be larger during (deep) recessions, when monetary policy is constrained, or in periods of financial stress. At the same time, they tend to be smaller if fiscal sustainability concerns exist or if fiscal consolidation is credibly implemented. The recessionary effect of an expenditure-based fiscal consolidation is more pronounced if it relies on productive spending. ([76])

In this Chapter, we take the opposite perspective and analyse the effect of economic shocks on fiscal variables. Economic shocks can alter fiscal outcomes (reduce/improve revenue or increase/reduce spending in bad/good times) and in bad times limit the capacity of governments to conduct their policies as planned. In undertaking our analysis, we use a standard tool in macroeconomics that is particularly suited to capturing interdependences across variables: a panel vector autoregressive model (VAR). We find that economic shocks can, in particular, result in debt accumulation and pose a risk to the sustainability of public finances.

The remainder of this Chapter is structured as follows. Section III.4.2. describes the methodology ([77]) and data used for this analysis. Section III.4.3. presents our results.

4.2. METHODOLOGY AND DATA

VAR models have been frequently used to analyse the effect of fiscal policy shocks on the rest of the economy. VAR models including fiscal policy variables have been used to analyse the effect on output of spending and revenue shocks, ([78]) and to estimate the effect of fiscal shocks on prices. ([79]) In light of the Great Recession and the ensuing debt crisis, fiscal VAR models have been developed further with a view to gauging output multipliers. Some new approaches use sign restrictions to identify government expenditure and revenue shocks, ([80]) while others explore the non-linearity of the output effects of spending shocks over the business cycle. ([81]) Although non-fiscal shocks have been often studied, ([82]) the impact of non-fiscal economic

([74]) Alesina et al. (2012).
([75]) Dabla-Norris and Lima (2018).
([76]) A more extensive discussion of the size of fiscal multipliers is provided in European Commission (2012), Gechert (2015) and Kilponen et al. (2015). For another approach based on structural models, see Coenen et al. (2012).

([77]) Box III.4.1 provides more technical elements on the methodology.
([78]) Blanchard and Perotti (2002), Romer and Romer (2009, 2010), Caldara and Kamps (2017). Favero and Giavazzi (2007) and Chung and Leeper (2007) consider the effect of the debt level on fiscal multipliers. Mertens and Ravn (2010, 2012) expand the early fiscal VAR analyses to fully account for the reality that fiscal shocks are often anticipated. In those cases, standard SVAR estimates may, for instance, lead to upward biases in consumption and wage responses to spending shocks. Therefore, using assumptions regarding the anticipation horizon and the anticipation rate of government spending shocks, they implement an augmented SVAR estimator applicable to anticipated fiscal shocks.
([79]) Canova and Pappa (2007).
([80]) Mountford and Uhlig (2009), rather than using zero-restrictions on the correlation of revenues and expenditures, they employ restrictions on the sign of the responses of the endogenous variables to the fiscal shock.
([81]) Auerbach and Gorodnichenko (2012). They follow the example of regime-switching models for monetary policy (Sims and Zha, 2006).
([82]) Some examples include: Blanchard and Quah (1989), who disentangle supply and demand shocks using long-run restrictions in a seminal paper; Christiano et al. (1999), who review the identification of monetary policy shocks; Iacoviello (2000), who considers the effect of house prices

shocks on fiscal variables has been less investigated.

Our baseline model is a panel VAR with fiscal and standard macroeconomic variables. We use real quarterly GDP (y^c), inflation (π^c), the nominal interest rate on sovereign debt (i^c), primary expenditure of the general government (g^c) and revenue of the general government (t^c) in country c:

$$X_t^c = \sum_{i=1}^{l} A_i X_{t-i}^c + U_t^c$$

with $X_t^c = [\Delta y_t^c, \Delta\pi_t^c, \Delta i_t^c, \Delta g_t^c, \Delta t_t^c]'$, A_i 5x5 matrices and U_t^c a vector of unstructured residuals. ([83])

We mostly use data from Eurostat since 2000 for a sample of 28 Member States. While the primary source of data is Eurostat, ([84]) some data were complemented using other sources (OECD, Insee, ONS, Bloomberg). All data are seasonally adjusted. ([85]) For most Member States, the data required for the VAR estimation start in around 2000. The time sample is longer for six Member States. ([86])

We are interested in the impact of three types of economic shocks on fiscal outcomes. We identify shocks to productivity (*supply shocks*), which drive the output trend, shocks to inflation (*demand shocks*), which generate cyclical fluctuations in the economy, and sovereign interest rate shocks, i.e. shocks to the effective interest rate paid on public debt (*financial shocks*). We also identify two fiscal shocks on public revenue and primary expenditure, respectively. We assess how these shocks impact key fiscal variables, namely revenues, primary expenditure, primary balance and public debt.

To allow for an economic interpretation of the shocks, we impose several identifying assumptions (Table III.4.1). The components of U_t may be instantaneously correlated, i.e. in any given period several shocks can affect each variable (e.g. the interest paid on public debt can respond to a financial shock and at the same time to fiscal policy measures captured by fiscal shocks). Therefore, the residuals in U, prior to structuration, are impossible to interpret in economic terms. We address this problem by imposing the following identifying assumptions (see Box III.4.1 for further details):

The identification of fiscal shocks builds on a standard strategy used in this literature. ([87]) To identify the fiscal shocks, elasticities of public spending and revenue to inflation and interest rates are calibrated. Blanchard and Perotti, who initiated this approach, based their calibration on previous work conducted by the OECD, ([88]) adjusting work based on annual data for their quarterly model. For the present study, we follow the same strategy and build on the latest update of this work on fiscal elasticities. ([89])

The identification is completed using long-term restrictions that are compatible with a neo-Keynesian model. The identification assumes that inflation shocks have no long-term impact on the level of output. This is a standard assumption, compatible with money neutrality in the long-run and by which the inflation shock we identify is a cyclical demand shock. We also assume that both productivity and inflation shocks have no long-term effect on the effective interest rate paid on public debt. The corollary of these assumptions is that the non-stationary part of sovereign interest rates is not linked to economic fundamentals (supply and demand) but to financial market behaviour. Finally, we assume that in the long run, revenue and expenditure follow GDP developments and, therefore, that productivity shocks leave the revenue- and expenditure-to-GDP ratios unchanged.

shocks; or Barsky and Kilian (2004), who dedicate a section of their review of oil price shocks to structural VARs.

([83]) We take these variables in first difference because we cannot reject the hypothesis of non-stationarity for each of them, based on a Lagrange multiplier test (Hadri, 2000).

([84]) We use quarterly national accounts, government non-financial accounts, sector accounts and Maastricht convergence interest rate.

([85]) Data are seasonally-adjusted either by the data provider or by ourselves using JDemetra+ and the TramoSeats routine.

([86]) The starting year goes back to the mid-1990s for Belgium, Spain, Sweden, the UK and France.

([87]) Blanchard and Perotti (2002), Perotti (2005).

([88]) Giorno et al. (1995), van den Noord (2000).

([89]) Price et al. (2014), see also Part II.2 of this report.

Table III.4.1: **Identifying assumptions of the panel VAR**

Shock \ Outcome	GDP	Inflation	Effective interest rate	Primary expenditure	Revenue
Productivity			No LT effect	Same LT effect as on GDP	Same LT effect as on GDP
Inflation	No LT effect		No LT effect	Calibrated ST elasticity	Calibrated ST elasticity
Effective interest rate				Calibrated ST elasticity	Calibrated ST elasticity
Primary expenditure					
Revenue				No effect within the same quarter	

Note: LT=long term, ST=short term, i.e. within the same quarter.
Source: Commission services.

4.3. RESULTS

Main results

The effect of economic shocks on government revenues, expenditure and the primary deficit is often short lived or rather small (Graph III.4.1).

- **A negative productivity shock leads to a temporary deterioration of the primary balance**. We consider a one percentage point (pp.) decrease in productivity that gradually increases to a 1.9 pps. decline in GDP. Such a shock has, by assumption, no long-run impact on the expenditure- and revenue-to-GDP ratios. As a result, revenues and expenditure (expressed in monetary terms) decline in the long run in the same proportion as GDP following the decrease in productivity. In the short term, both the revenue- and primary-expenditure-to-GDP ratios decline (the effect on expenditure is, however, not statistically significant). As a result, the government primary balance declines slightly by around -0.1 pp. of GDP in the first quarters (this is statistically significant at the 68% threshold only).

- **A positive inflation shock has a short-lived positive impact on the primary balance**. In the short term, a one pp. increase in the inflation rate has a positive effect on the primary balance (+0.4 pp. of GDP upon impact). This effect reflects the fact that higher prices result in a higher tax base and mechanically higher tax revenue, while expenditure are at best indexed on inflation with a delay. This effect rapidly declines and turns negative (but not statistically significant) in the long term (-0.1 pp. of GDP). This development can be explained by the increase in the spending-to-GDP ratio (close to 0.2 pp. of GDP), which more than offsets the slight increase in the revenue-to-GDP ratio (0.1 pp.). ([90]) The long-term effect is entirely due to the reaction of real spending and revenue, since the inflation shock has by assumption no long-term impact on GDP. ([91])

- **A positive sovereign interest rate shock increases (primary) spending and revenue**. We consider a 1 pp. increase of the interest rate paid on sovereign debt. Because of debt rollover, such a shock will have a smaller impact on the effective interest rate. ([92]) Furthermore, this shock does not fully disappear in the long run and the effective interest rate increases only marginally in the long run. As regards the primary balance, in the short term the primary expenditure-to-GDP ratio overshoots while the revenue-to-GDP ratio first declines upon impact, which has a negative but negligible effect on the primary balance. In the long run, both revenue and expenditure ratios very slightly increase.

([90]) Both effects are only statistically significant at the 68% level.
([91]) See the explanation on long-term restrictions above and Box III.4.1. While the inflation shock does not cause a long-term impact on GDP, it has a transitory recessionary effect on GDP of around -0.1% in the first year.
([92]) The average maturity of public debt in the EU in 2017 is 47 quarters, 2.1% of debt is rolled over each quarter and therefore, a 1 pp. increase in the market rate corresponds to a 0.02 pp. increase in the effective interest rate paid on the overall stock of debt.

However, all three shocks have a persistent impact on public debt, demonstrating the long-term risks they pose for fiscal policy (Graph III.4.2).

- Following a 1 pp. negative ***productivity shock***, the debt-to-GDP ratio increases by 3 pps. in the first three years following the shock and continues to increase thereafter, although at a slower pace. This finding can be explained by the impact of the productivity shock on the primary balance in the transition and the resulting increase on the debt burden (i.e., the so-called snowball effect).

- Following an ***inflation shock***, the primary balance tends to increase temporarily and the increase in the price level inflates away the debt stock, thus lowering the debt burden in real terms in the short term. This effect is, however, temporary and after 2 to 3 years the debt ratio reaches a level around 1 pp. of GDP lower before inching up again. Eventually, the effect on the debt-to-GDP ratio turns positive, in line with the decline of the primary balance in the long run.

- The ***sovereign interest rate shock***, despite a negligible effect on the budget balance, increases the debt burden and, therefore, debt accumulation. This is due to a small long-term increase of the interest rate, which puts the debt-to-GDP ratio on an increasing trend that totals more than 0.3 pp. in 5 years.

Robustness

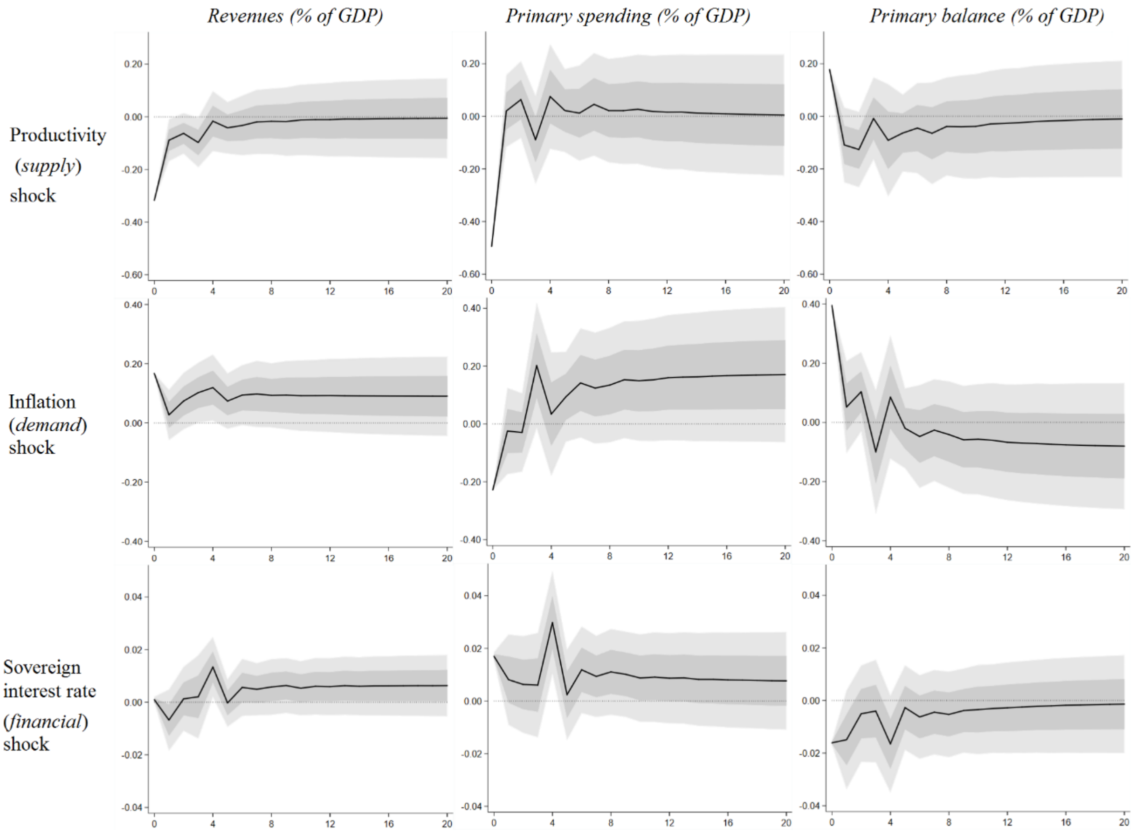
Our results are robust to various empirical tests. The results presented above are based on a GMM estimator. ([93]) A least square dummy variable estimator ([94]) provides comparable results. While our baseline estimation covers all 28 Member States, similar results are obtained for the EU15, the euro area and the Central and Eastern European countries. ([95]) Also, using minimum and maximum values estimated across Member States for the calibration of fiscal elasticities leaves the results essentially unchanged.

Controlling for the effect of public debt on the short-term dynamics does not change the main findings. We introduced the debt-to-GDP ratio as an exogenous regressor in our model. ([96]) Contrary to previous findings for the US, this variable does not improve our model in a statistically significant manner, nor does it modify the impulse responses.

A structuration approach using only the short-term elasticities of expenditure and revenue to output does not change the main findings. This approach corresponds to the well-established approach by Blanchard and Perotti, which does not impose long-term restrictions on the ratios of expenditure and revenue to GDP. With our data, this approach implies long-term decreases in the revenue- and expenditure-to-GDP ratios following productivity increases, which is at odds with the stability of such ratios in the data. However, apart from correcting these long-term effects, our structuration yields very similar results.

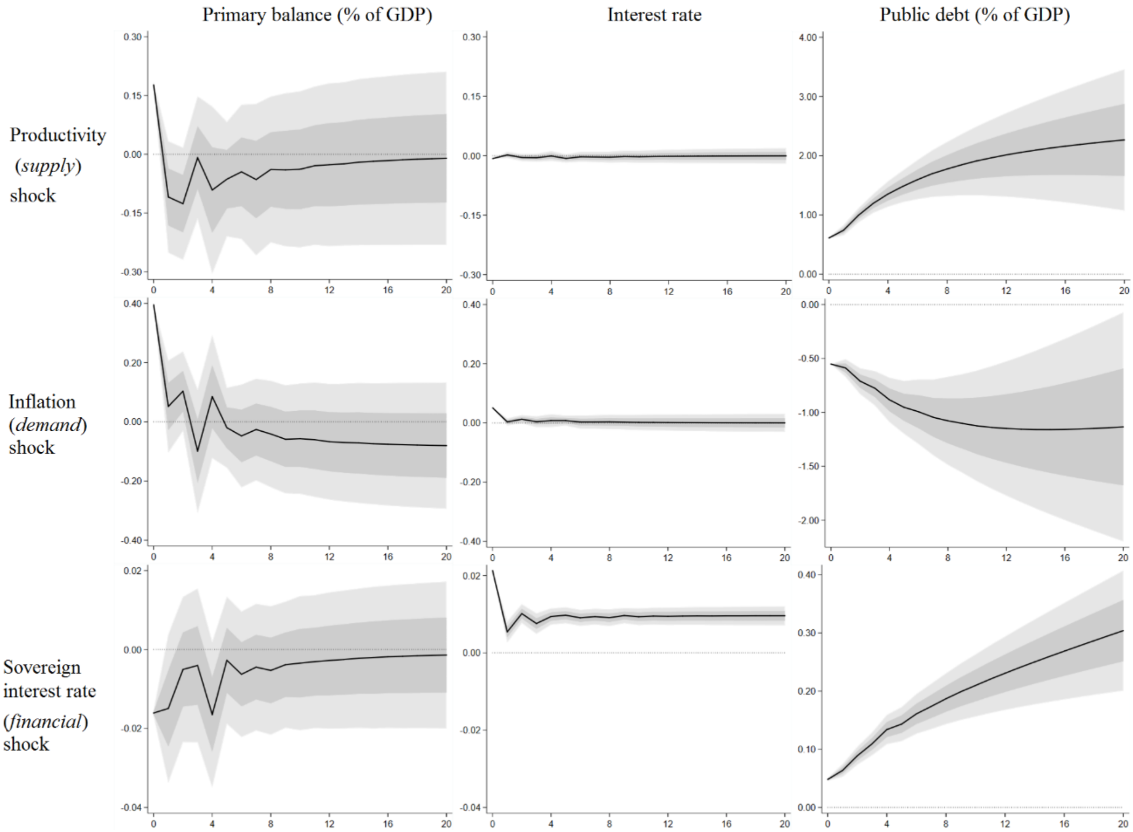
([93]) Abrigo and Love (2016).
([94]) Cagala and Glogowsky (2014).
([95]) The EU15 differs from the other subsamples on the reaction of interest rate to shocks.
([96]) Favero and Giavazzi (2007 and 2009), Cherif and Hasanov (2018).

Graph III.4.1: **Effects of economic shocks on public deficit**



Note: Shaded areas correspond to the 95% and 68% confidence bands. To compute these impulse responses, we need to calibrate the shares of the primary expenditure-to-GDP and revenue-to-GDP ratios at date 0. These are initialised on the EU average at the end of our sample. Confidence intervals are computed based on Monte Carlo simulations.
Source: Commission services.

Graph III.4.2: **Effects of economic shocks on public debt**



Note: Shaded areas correspond to the 95% and 68% confidence bands. To compute these impulse responses, we need to calibrate the shares of debt-to-GDP, primary-expenditure-to-GDP, revenue-to-GDP and the effective interest rate paid on public debt at date 0. These are initialised on the EU average at the end of our sample. The response of debt is shown in deviation from the trajectory computed under a "no shock" assumption. Confidence intervals are computed based on Monte Carlo simulations.
Source: Commission services.

Box III.4.1: **Structuration of the panel VAR model**

1. Model structuration

Based on panel data, we estimate the following VAR model $X_t=A(L)\,X_{(t-1)}+U_t$ where $X_t=[\Delta y_t, \Delta\pi_t, \Delta i_t, \Delta g_t, \Delta t_t]'$ is our vector of endogenous variables, (1) $A(L)$ is a lag polynomial of order 4 and $U_t = [u_t^y, u_t^\pi, u_t^i, u_t^g, u_t^t]'$ are the unstructured residuals associated with each of the variables. We estimate the structured shocks (e^y, e^π, e^i, e^g, e^t), which are uncorrelated with each other and economically interpretable. (2)

The structuring equations linking the residuals to the structured shocks are:

$$u_t^y = \beta_{y\pi} e_t^\pi + \beta_{yi} e_t^i + \beta_{yg} e_t^g + \beta_{yt} e_t^t + e_t^y \quad (1)$$

$$u_t^\pi = \beta_{\pi y} e_t^y + \beta_{\pi i} e_t^i + \beta_{\pi g} e_t^g + \beta_{\pi t} e_t^t + e_t^\pi \quad (2)$$

$$u_t^i = \beta_{iy} e_t^y + \beta_{i\pi} e_t^\pi + \beta_{ig} e_t^g + \beta_{it} e_t^t + e_t^i \quad (3)$$

$$u_t^g = \beta_{gy}\, e_t^y + \alpha_{g\pi} u_t^\pi + \alpha_{gi} u_t^i + \beta_{gt} e_t^t + e_t^g \quad (4)$$

$$u_t^t = \beta_{ty}\, e_t^y + \alpha_{t\pi} u_t^\pi + \alpha_{ti} u_t^i + \beta_{tg} e_t^g + e_t^t \quad (5)$$

or in matrix notation:

$$(I - M_\alpha)U = M_\beta E$$

The Blanchard and Perotti approach relies on calibrating, in Equations (4) and (5), the elasticities of the fiscal variables to economic variables (α) gathered in matrix M_α. The coefficients β of matrix M_β are then estimated based on simple regressions and our long-term restrictions.

2. Calibration of the fiscal elasticities (matrix M_α)

We calibrate the elasticities of public revenue and expenditure to inflation and sovereign interest rate from Equations (4) and (5). (3)

On the revenue side, the elasticity to prices can be deducted from the elasticity to output. (4) In this respect, seminal papers build on work from the 1990s and early 2000s, (5) which compute the semi-elasticities of public revenue and expenditure to output for OECD countries on an annual basis. This work has been updated more recently. (6) In our VAR, we build on the latest update using ESA2010 data. (7) The price elasticity of revenue is $\alpha_{t\pi}$=0.14.

On the expenditure side, most items are not indexed contemporaneously to prices. Therefore, the elasticities of those expenditure items (in real terms) to prices is -1. Some items, accounting for 20% to 30% of primary expenditures in the EU28 since 2001, are purchased at market prices and, therefore, have an elasticity of 0 to prices in real terms. We calibrate the price elasticity of expenditure to: $\alpha_{g\pi}$=-0.75. This is consistent with the value retained by Perotti (8) (-0.5), who uses a definition of expenditure excluding transfers.

(1) y,π,i,g,t are, respectively, real GDP, inflation from the GDP deflator, the effective interest rate paid on public debt, primary expenditure (deflated using the GDP deflator) and public revenues (deflated using the GDP deflator). All variables expect for the interest rate are taken in logs.
(2) Perotti (2005).
(3) Blanchard and Perotti (2002). In contrast to the approach they initiated, we do not calibrate the short-term elasticity of revenue and expenditure to output, but estimate β_{gy} , β_{ty} based on long-term restrictions.
(4) Perotti (2005).
(5) Giorno et al. (1995), van den Noord (2000).
(6) Mourre et al. (2014), Price et al. (2015).
(7) Lausegger et al. (forthcoming) and Part II.2 of this report.
(8) Perotti (2005).

(Continued on the next page)

Box (continued)

We set the fiscal elasticity to the interest rate to zero. ([9]) In addition to the arguments previously presented, we add that the interest rate is set as a reference for contracts that will bring dividends or call for payments in future periods. Current payments and capital income are, therefore, indexed on past interest rates depending on the structure and maturity of the portfolio considered. Therefore, the contemporaneous elasticity to interest rate should be zero. This is true for non-tax revenue (10% of government revenues) and interest payments (excluded from total primary expenditures), but also for taxes based on such gains (included in other tax revenues).

3. Long-term restrictions

By imposing long-term restrictions, we can isolate combinations of the unstructured residuals (u^y, u^π, u^i, u^g, u^t) that are orthogonal to some of the economic shocks (e^y, e^π, e^i, e^g, e^t). We can then exploit those orthogonalities to isolate each economic shock. Identifying the long-term restrictions requires the specification of the cumulated impulse-response function (IRF) to a shock E_0:

$$\left(\sum_{i=0}^{\infty} A(1)^i\right)(I - M_\alpha)^{-1} M_\beta E_0 = \underbrace{(I - A(1))^{-1}(I - M_\alpha)^{-1}}_{M} M_\beta E_0$$

Matrix M is computable based on the estimation output (matrix A) and the calibration of matrix M_α. ([10])

The fact that inflation shocks ($E_0 = [0,1,0,0,0]$) have no long-term impact on output implies that:

$$M[1,1]\beta_{y\pi} + M[1,2] + M[1,3]\beta_{i\pi} = 0$$

From Equations (1), (2) and (3), we can infer a combination of the residuals which is orthogonal to the inflation shock:

$$M[1,1]u_t^y + M[1,2]u_t^\pi + M[1,3]u_t^i = combination(\, e_t^y, e_t^i, e_t^g, e_t^t)$$

In a similar fashion, the fact that inflation and productivity shocks ($E_0 = [0,1,0,0,0]\ or\ [1,0,0,0,0]$) have no long-term impact on interest rate gives a combination of the residuals orthogonal to the inflation and productivity shocks.

In addition, the long-term restrictions on the revenue- and primary-expenditure-to-GDP ratios give two combinations orthogonal to the productivity shock.

Having calibrated the fiscal elasticities (M_α), we can isolate two final combinations of the unstructured residuals orthogonal to the inflation or the sovereign interest rate shock.

$$\hat{u}_t^g = u_t^g - \alpha_{g\pi} u_t^\pi - \alpha_{gi} u_t^i = \beta_{gy}\, e_t^y + \beta_{gt} e_t^t + e_t^g \quad (4')$$

$$\hat{u}_t^t = u_t^t - \alpha_{t\pi} u_t^\pi - \alpha_{ti} u_t^i = \beta_{ty}\, e_t^y + \beta_{tg} e_t^g + e_t^t \quad (5')$$

From regressions of the unstructured residuals on those combinations, we can sequentially isolate the economic shock e_t^π, then e_t^y and finally e_t^i. Once the shocks are isolated, the β coefficient can be directly estimated or inferred from the previous regressions. To identify e^g and e^t we can impose either β_{gt} or $\beta_{tg} = 0$. In practice, this last choice has no effect on our identification of non-fiscal shocks.

([9]) Perotti (2005).
([10]) Because the eigenvalues of our estimated VAR are smaller than one in modulus, the following applies $\sum_{i=0}^{\infty} A(1)^i = (I - A(1))^{-1}$ and M is easily computable.

5. CONCLUSIONS

Economic shocks are inherent features of the macroeconomic environment and can affect fiscal policy. We consider two sides of this broad issue in the present study. We first look at how policymakers account for fiscal forecast errors in their fiscal planning. We then identify how economic shocks can affect fiscal outcomes.

The EU fiscal governance framework avoids penalising Member States because of uncertainty. There are several provisions of the SGP that can lower the required fiscal adjustment in case of negative economic shocks. These clauses cater, in particular, for two sources of uncertainty inherent to numerical fiscal rules. First, the data used in the assessment of compliance with the fiscal rules are subject to revisions (statistical uncertainty). Second, key concepts used in the fiscal governance framework cannot be directly observed (conceptual uncertainty).

Economic shocks can have a significant and lasting impact on fiscal policies in the EU, according to new VAR estimations. We find that a negative shock on productivity leads to a temporary decline in the primary balance and a persistent increase in public debt. A positive inflation shock has a weak negative impact on the primary balance, but it generates a temporary decline in public debt ratio. Finally, a positive shock to the effective interest rate paid on public debt leads to a steady increase of public debt, due to the higher interest payments.

Member States, however, often conduct fiscal policy without taking into account the uncertainty surrounding their fiscal forecast. We show that uncertain economic outcomes in the form of the forecast error of the fiscal effort have been an integral part of fiscal projections in the EU since 2000. Nevertheless, the results from panel regressions reveal that Member States frequently do not adjust their planned fiscal effort to economic shocks. We find that Member States only very late and asymmetrically to forecast errors, relaxing the fiscal effort in case of positive surprises and leaving it unchanged in case of negative ones.

Against those risks, a more cautious design of fiscal policy is advisable. A sound approach requires Member States to react to uncertainty, since a biased reaction function to uncertain fiscal outcomes can jeopardise the sustainability of public finances in the EU. An appropriate policy response to uncertainty should include taking precautionary measures against the possibility of worse-than-expected outcomes. (97) In addition, policies that foster economic resilience can reduce the likelihood of large negative macroeconomic shocks and limit their adverse consequences.

(97) Such mechanisms include: delegation of specific operations to agencies that would follow more closely the relevant economic developments; triggers that predefine the context for activating a policy or putting it back on the political agenda; expiration dates that would give a policy a temporary effect; and indexing that would allow a policy to gradually adjust to economic and social conditions (Auerbach, 2014; Kamin, 2014).

REFERENCES

Abel, J., Rich, R., Song, J., Tracy, J., 2016. The measurement and behavior of uncertainty: Evidence from the ECB survey of professional forecasters. Journal of Applied Econometrics 31(3), 533-550.

Abrigo, M., Love, I., 2016. Estimation of panel vector autoregression in Stata. Stata Journal 16(3), 778-804.

Alesina, A., Favero, C., Giavazzi, F., 2012. The output effect of fiscal consolidations. NBER Working Papers 18336.

Auerbach, A., 2014. Fiscal uncertainty and how to deal with it. Hutchings Center on Fiscal and Monetary Policy at Brookings Working Paper 6, 15 December.

Auerbach, A., Gorodnichenko, Y., 2012. Measuring the output responses to fiscal policy. American Economic Journal: Economic Policy 4(2), 1-27.

Bachmann, R., Elstner, S., Sims, E., 2013. Uncertainty and economic activity: Evidence from business survey data. American Economic Journal: Macroeconomics 5(2), 217-49.

Baker, S., Bloom, N., Davis, S., 2016. Measuring economic policy uncertainty. The Quarterly Journal of Economics 131(4), 1593-1636.

Balta, N., Valdez Fernandez, I., Ruscher, E., 2013. Assessing the impact of uncertainty on consumption and investment. European Commission. Quarterly Report on the Euro Area 12(2), 7-16.

Barsky, R., Kilian, L., 2004. Oil and the macroeconomy since the 1970s. Journal of Economic Perspectives 18(4), 115-134.

Bekaert, G., Hoerova, M., Duca, M., 2013. Risk, uncertainty and monetary policy. Journal of Monetary Economics 60(7), 771-788.

Belinga, V., Benedek, M., de Mooij, R., Norregaard, M., 2014. Tax buoyancy in OECD countries. IMF Working Paper 14/110.

Blanchard, O., 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.

Blanchard, O., Quah, D., 1989. The dynamic effects of aggregate demand and supply disturbances. American Economic Review 79(4), 655-673.

Bloom, N., 2009. The impact of uncertainty shocks. Econometrica 77(3), 623-685.

Bloom, N., Floetotto, M., Jaimovich, N., Saporta-Eksten, I., Terry, S., 2018. Really uncertain business cycles. Econometrica 86(3), 1031-1065.

Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics 87(1), 115-143.

Blundell, R., Stoker, T., 2005. Heterogeneity and aggregation. Journal of Economic Literature 43(2), 347-391.

Bohn, H. 1998. The behaviour of U.S. public debt and deficits. The Quarterly Journal of Economics 113(August), 949-963.

Brambor, T., Clark, W., Golder, M., 2006. Understanding interaction models: Improving empirical analyses. Political Analysis 14(1), 63-82.

Braumoeller, B., 2004. Hypothesis testing and multiplicative interaction terms. International Organization 58(4), 807-820.

Brown, K., Harlow, W., Tinic, S., 1988. Risk aversion, uncertain information, and market efficiency. Journal of Financial Economics 22(2), 355-385.

Budina, N., van Wijnbergen, S., 2008. Quantitative approaches to fiscal sustainability analysis: A case study of Turkey since the crisis of 2001, The World Bank Economic Review 23(1), 119-140.

Buti, M., Padoan, P., 2013. How to make Europe's incipient recovery durable: End policy uncertainty. VOX, 12 September.

Cagala, T., Glogowsky, U., 2014. XTVAR: Stata module to compute panel vector autoregression, statistical software components S457944, Boston College Department of Economics, revised 2 April 2015.

Caldara, D., Kamps, C., 2017. The analytics of SVARs: A unified framework to measure fiscal multipliers. The Review of Economic Studies 84(3), 1015-1040.

Canova, F., Pappa, E., 2007. Price differentials in monetary unions: The role of fiscal shocks. The Economic Journal 117(520), 713-737.

Celasun, O., Debrun, X., Ostry, J., 2007. Primary surplus behavior and risks to fiscal sustainability in emerging market countries: A "fan-chart" approach, IMF Staff Papers 53(3), 401-425.

Checherita-Westphal, C., Žďárek, V., 2017. Fiscal reaction function and fiscal fatigue: Evidence for the euro area. ECB Working Paper 2036.

Cherif, R., Hasanov, F., 2018. Public debt dynamics: the effects of austerity, inflation, and growth shocks. Empirical Economics 54(3), 1087-1105.

Christiano, L., Eichenbaum, M., Evans, C., 1999. Monetary policy shocks: What have we learned and to what end? Handbook of Macroeconomics 1, 65-148.

Chudik, A., Mohaddes, K., Pesaran, M., Raissi, M., 2017. Is there a debt-threshold effect on output growth? Review of Economics and Statistics 99(1), 135-150.

Chung, H., Leeper, E., 2007. What has financed government debt? NBER Working Paper 13425.

Coenen, G., Erceg, C., Freedman, C., Furceri, D., Kumhof, M., Lalonde, R., Laxton, D., Lindé, J., Mourougane, A., Muir, D., Mursula, S., 2012. Effects of fiscal stimulus in structural models. American Economic Journal: Macroeconomics 4(1), 22-68.

Combes, J., Minea, A., Sow, M., 2017. Is fiscal policy always counter-(pro-) cyclical? The role of public debt and fiscal rules. Economic Modelling 65, 138-146.

Dabla-Norris, M., Lima, F., 2018. Macroeconomic effects of tax rate and base changes: Evidence from fiscal consolidations. IMF Working Paper 18/220.

Diether, K., Malloy, C., Scherbina, A., 2002. Differences of opinion and the cross section of stock returns. The Journal of Finance 57(5), 2113-2141.

Ellison, S., Williams, A., 2012. Eurachem/CITAC guide: Quantifying uncertainty in analytical measurement, third edition.

Elsby, M., Michaels, R., Ratner, D., 2015. The beveridge curve: A survey. Journal of Economic Literature 53(3), 571-630.

European Central Bank, 2016. The impact of uncertainty on activity in the euro area. ECB Economic Bulletin 8.

European Commission, 2011. Public Finances in EMU. European Economy 3, September.

European Commission, 2012. Report on public finances in EMU. European Economy 4, July.

Favero, C., Giavazzi, F., 2007. Debt and the effects of fiscal policy. NBER Working Papers 12822.

Favero, C., Giavazzi, F., 2009. How large are the effects of tax changes? Working Papers Bocconi University 350.

Fernández-Villaverde, J., Guerrón-Quintana, P., Kuester, K., Rubio-Ramírez, J., 2015. Fiscal volatility shocks and economic activity. American Economic Review 105(11), 3352-3384.

Fioramanti, M., Gonzalez Cabanillas, L., Roelstraete, B., Ferrandis Valterra, S., 2016. European Commission's forecasts accuracy revisited: Statistical properties and possible causes of forecast errors. ECFIN Discussion Paper 27.

Frankel, J., Schreger, J., 2013. Over-optimistic official forecasts and fiscal rules in the eurozone. Review of World Economics 149(2), 247-272.

Gechert, S., 2015. What fiscal policy is most effective? A meta-regression analysis. Oxford Economic Papers 67(3), 553-580.

Giorno, C., Richardson, P., van den Noord, P., 1995. Estimating potential output, output gaps and structural budget balances. OECD Economics Department Working Papers 24.

González Cabanillas, L., Terzi, A., 2012. The accuracy of the European Commission's forecasts re-examined. European Economy. Economic Papers 476.

Hadri, K., 2000. Testing for stationarity in heterogeneous panel data. The Econometrics Journal 3(2), 148-161.

Havik, K., Mc Morrow, K., Orlandi, F., Planas, C., Raciborski, R., Röger, W., Rossi, A., Thum-Thysen, A., Vandermeulen, V., 2014. The production function methodology for calculating potential growth rates & output gaps. European Economy. Economic Papers 535.

Iacoviello, M., 2000. House prices and the macroeconomy in Europe: Results from a structural VAR analysis. ECB Working Paper 18.

Jara, H. X., Tumino A., Sutherland, H., 2015. The redistributive and stabilising effects of an EMU unemployment benefit scheme under different hypothetical unemployment scenarios. EUROMOD Working Paper EM18/15.

Jordà, Ò., Schularick, M., Taylor, A., 2016. Sovereigns versus banks: credit, crises, and consequences. Journal of the European Economic Association 14(1), 45-79.

Jurado, K., Ludvigson, S., Ng, S., 2015. Measuring uncertainty. American Economic Review 105(3), 1177-1216.

Kamin, D., 2014. In good times and bad: Designing legislation that responds to fiscal uncertainty. Hutchings Center on Fiscal and Monetary Policy at Brookings Working Paper 7, 15 December.

Kilponen, J., Pisani, M., Schmidt, S., Corbo, V., Hledik, T., Hollmayr, J., Hurtado, S., Júlio, P., Kulikov, D., Lemoine, M., Lozej, M., Lundvall, H., Maria, J. R., Micallef, B., Papageorgiou, D., Rysanek, J., Sideris, D., Thomas, C., De Walque, G., 2015. Comparing fiscal multipliers across models and countries in Europe. ECB Working Paper 1760.

Klomp, J., de Haan, J., 2009. Political institutions and economic volatility. European Journal of Political Economy 25(3), 311-326.

Knight, F., 1921. Risk, uncertainty and profit. Houghton Mifflin Company: The Riverside Press Cambridge, Boston.

Koester, G., Priesmeier, C., 2017. Revenue elasticities in euro area countries. ECB Working Paper 1989.

Lahiri, K., Sheng, X., 2010. Measuring forecast uncertainty by disagreement: The missing link. Journal of Applied Econometrics 25(4), 514-538.

Mankiw, N., Reis, R., Wolfers, J., 2003. Disagreement about inflation expectations. NBER Macroeconomics Annual 18, 209-248.

Martí, F., Pérez, J., 2015. Spanish public finances through the financial crisis. Fiscal Studies 36(4), 527-554.

Meinen, P., Roehe, O., 2017. On measuring uncertainty and its impact on investment: cross-country evidence from the euro area. European Economic Review 92, 161-179.

Mertens, K., Ravn, M., 2010. Measuring the impact of fiscal policy in the face of anticipation: a structural VAR approach. The Economic Journal 120(544), 393-413.

Mertens, K., Ravn, M., 2012. Empirical evidence on the aggregate effects of anticipated and unanticipated US tax policy shocks. American Economic Journal: Economic Policy 4(2), 145-81.

Mohl, P., Sondermann, D., 2013. Has political communication during the crisis impacted sovereign bond spreads in the euro area? Applied Economics Letters 20(1), 48-61.

Mountford, A., Uhlig, H., 2009. What are the effects of fiscal policy shocks? Journal of Applied Econometrics 24(6), 960-992.

Mourre, G., Astarita, C., Maftei, A., 2016. Measuring the uncertainty in predicting public revenue. European Economy. Economic Papers 39.

Mourre, G., Astarita, C., Princen, S., 2014. Adjusting the budget balance for the business cycle: The EU methodology. European Economy. Economic Papers 536.

Mourre, G., Princen, S., 2015. Tax revenue elasticities corrected for policy changes in the EU. European Economy. Economic Papers 18.

Mourre, G., Poissonnier, A. and Lausegger, M., 2019. The semi-elasticities underlying the cyclically-adjusted budget balance: An update and further analysis. European Economy. Economic Papers, forthcoming.

Perotti, R., 2005. Estimating the effects of fiscal policy in OECD countries. CEPR Discussion Paper 4842.

Petrolongo, B., Pissarides, C.A., 2001. Looking into the black box: A survey of the matching function. Journal of Economic Literature 39(2), 390-431.

Price, R., Dang, T., Botev, J., 2015. Adjusting fiscal balances for the business cycle: New tax and expenditure elasticity estimates for OECD countries. OECD Economics Department Working Papers 1275.

Price, R., Dang, T., Guillemette Y., 2014. New tax and expenditure elasticity estimates for EU budget surveillance. OECD Economics Department Working Papers 1174.

Romer, C., Romer, D., 2009. Do tax cuts starve the beast? The effect of tax changes on government spending. Brookings Papers on Economic Activity 40(1), 139-214.

Romer, C., Romer, D., 2010. The macroeconomic effects of tax changes: Estimates based on a new measure of fiscal shocks. American Economic Review 100(3), 763-801.

Roodman, D., 2009a. How to do xtabond2: An introduction to difference and system GMM in Stata. The Stata Journal 9(1), 86-136.

Roodman, D., 2009b. A note on the theme of too many instruments. Oxford Bulletin of Economics and Statistics 71(1), 135-158.

Rossi, B., Sekhposyan, T., 2017. Macroeconomic uncertainty indices for the euro area and its individual member countries. Empirical Economics 53(1), 41-62.

Rossi, B., Sekhposyany, T., Souprez, M., 2017. Understanding the sources of macroeconomic uncertainty. Barcelona Graduate School of Economics Working Papers 920.

Sims, C., Zha, T., 2006. Were there regime switches in US monetary policy? American Economic Review 96(1), 54-81.

van den Noord, P., 2000. The size and role of automatic fiscal stabilizers in the 1990s and beyond. OECD Economics Department Working Paper 230.

Vašíček, B., 2018. Impact of uncertainty shocks in the euro area. European Commission. Quarterly Report on the Euro Area 16(3), 25-40.

White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica, 48(4), May, 817-838.

Windmeijer, F., 2005. A finite sample correction for the variance of linear efficient two-step GMM estimators. Journal of Econometrics 126(1), 25-51.

Zarnowitz, V., Lambros, L., 1987. Consensus and uncertainty in economic prediction. Journal of Political Economy 95(3), 591-621.