ASYMMETRIC MACROECONOMIC STABILIZATION AND FISCAL CONSOLIDATION IN THE OECD AND THE EURO AREA

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ABSTRACT

This paper presents empirical evidence of asymmetric fiscal policy along the business cycle, using a real-time panel data on 19 OECD countries. We estimate various specifications of fiscal policy rules, in which ex ante fiscal policy has two major objectives: macroeconomic stabilization and fiscal consolidation. First, we find that a symmetric fiscal policy rule may not be an accurate representation of real-time fiscal policy. We find evidence in favor of asymmetric fiscal policy, in particular regarding the response to output gap. Second, fiscal policy appears to be generally procyclical in downturns and a-cyclical in upturns, typically in the Euro Area and during the crisis. Third, we do not find significant evidence of a procyclical fiscal consolidation in the OECD and the Euro Area, although surplus-debt feedback coefficients are generally larger in downturns. Our results are robust to an alternative measure of business cycle and to country exclusion.

KEY WORDS

Fiscal policy rules, real-time data, asymmetric stabilization, fiscal consolidation

JEL

E61, E62, H6

Asymmetric macroeconomic stabilization and fiscal consolidation in the OECD and the Euro Area*

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Abstract

This paper presents empirical evidence of asymmetric fiscal policy along the business cycle, using a real-time panel data on 19 OECD countries. We estimate various specifications of fiscal policy rules, in which *ex ante* fiscal policy has two major objectives: macroeconomic stabilization and fiscal consolidation. First, we find that a linear fiscal policy rule is not an accurate representation of real-time fiscal policy. We find evidence in favour of asymmetric fiscal policy, in particular regarding the response to output gap. Second, fiscal policy appears to be generally procyclical in downturns and a-cyclical in upturns, typically in the Euro Area and during the crisis. Third, we do not find evidence of a procyclical fiscal consolidation in the OECD and the Euro Area, although surplus-debt feedback coefficients are generally larger in downturns. Our results are robust to an alternative measure of business cycle and to country exclusion.

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1 Introduction

The outbreak of the COVID-19 pandemic and the consequences of massive lockdowns have forced governments into large fiscal stimuli. They will inevitably lead to a substantial increase in public debt-to-GDP ratios and they will consequently raise the issue of debt sustainability, as after the Global Financial Crisis. It might therefore also lead to pro-cyclical fiscal policies if fiscal consolidation plans come too early, i.e. before the economy has recovered. Within the OECD, EU countries remain specific because of required compliance to the fiscal surveillance framework, which is regularly considered as a cause of *procyclical* fiscal policy. Yet, the COVID-19 crisis has induced a temporary suspension of the European Union (EU) fiscal framework –the Stability and Growth Pact (SGP)–, just a few weeks after the European Commission launched a review on the

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European fiscal surveillance framework (European Commission, 2020). In a preparatory document, the Commission argues that the fiscal framework has been effective overall at achieving its objectives.[1] Meanwhile, it acknowledges a few vulnerabilities, among which debt sustainability in high-debt countries and pro-cyclicality are not the tiniest, and the excessive complexity of the fiscal framework.[2]

This paper addresses questions of macroeconomic stabilization and fiscal consolidation through the lens of empirical fiscal policy rules (or fiscal reaction functions). Using various vintages of the OECD Economic Outlook from 1996 to 2017 (December Edition), we study fiscal policy rules in real-time (or *ex ante* fiscal rules). These rules relate the structural primary balance to lagged public debt and to output gap and therefore abstract from automatic stabilizers (i.e. the purely cyclical component of fiscal policy). Precisely, we focus on the *endogenous* discretionary response of fiscal policy to business cycle and public debt.[3] Finally, by using real-time data, the assessment of fiscal decisions is not subject to data revisions, most notably on real GDP and its potential. This is a necessary step to shed light on the actual compliance of governments with the fiscal framework.

We add to the existing literature in three respects. First, we update earlier studies with a panel of OECD countries and we compare fiscal decisions in non-European countries, that are not compelled by the EU fiscal surveillance framework, to EU and Euro Area countries. Therefore, we study whether compliance to the EU fiscal framework impinges on the properties of fiscal policy-making (i.e. cyclicality, sustainability).

Second, we assess asymmetries in fiscal decisions. For instance, we extend the analysis of a "deficit bias" by Eyraud et al. (2017) to OECD countries. This bias arises when fiscal policy is procyclical during good times and fetters automatic stabilisers in bad times, hence leading to procyclicality also in bad times. We also check whether the fiscal reaction to public debt differs along the business cycle. Although to our knwowledge this has not been estimated so far, there have been many debates in the Euro Area about the supposedly bad timing of fiscal consolidation.

Third, we investigate the incidence of the global financial crisis on the behavior of governments: after the crisis (or after deep recessions), have governments become more or less stabilizing, or have they become more or less sensitive to debt hikes?

Our main results are fourfold. First, we find that a linear fiscal policy rule does not give an accurate representation of real-time fiscal policy. The response of fiscal policy to the output gap is weak for OECD or Euro Area countries. In contrast, we find strong evidence of asymmetries in fiscal reaction functions, in particular for the response to the output gap. Second, fiscal policy is generally procyclical in downturns and a-cyclical in upturns. In particular, we focus on the Euro area and find evidence of procyclical policy between 2009-2013. Third, our results do not provide evidence of a procyclical fiscal consolidation in OECD or Euro Area countries. It remains though that the point estimates of the surplus-debt feedback coefficients are generally larger in downturns than in upturns in the Euro Area, but they are not statistically significant. Fourth, the

[1] Objectives are: *"ensuring sustainable government finances and economic growth, as well as avoiding macroeconomic imbalances; enabling closer coordination of economic policies; and promoting convergence in Member States' economic performance"*.

[2] See European Commission (2020), p.59: *"The fiscal framework (which includes the secondary legislation and other documents that provide more details and transparency on how surveillance is carried out in practice) has grown excessively complex."*. The simplification of the fiscal framework is advocated by the European Fiscal Board (2020) .

[3] We take care of possible endogeneity in the estimation of policy decisions. We systematically compare results obtained with a Least Square Dummy Variable estimator with an Instrumental Variable General Method of Moments estimator.

real-time information of a deep recession does not produce a counter-cyclical fiscal reaction in the Euro Area: the discretionary fiscal stance is a-cyclical.

We check whether evidence of procyclical *ex ante* discretionary fiscal policy is robust to an alternative measure of economy's position in the business cycle. Indeed, output gap forecasts tend to be negative on average, which mechanically reduces observations of positive output gaps and may bias our estimates of the asymmetric fiscal rule specification. In addition, discrete dummy variables for crisis years or deep recessions are likely to be too crude to capture an economy's position in the business cycle. Hence, we use a calibrated logistic transition function that addresses these two caveats. Our transition function takes into account the negative average of output gap forecasts, using a country-specific normalized output gap forecast measure, and allows for smooth-transition between upturns and downturns. This alternative measure of business cycle stance confirms the baseline findings. In addition, results do not seem to be driven by a single country, as estimates are fairly stable and robust to country exclusion.

The remainder of the paper is structured as follows. Section 2 reviews the literature on real time fiscal rules. Section 3 sketches different specifications of fiscal rules and recalls the stability conditions of public debt when fiscal policy is inertial. Section 4 provides a description of the dataset. Section 5 presents the empirical methodology and the results. Section 6 proposes some robustness checks. The last section concludes.

2 Related literature

As acknowledged by Cimadomo (2016) in his survey, the first paper introducing real-time data in the estimation of fiscal rules is Loukoianova and Vahey (2003) who apply Barro (1979)'s tax smoothing approach to US data. Since then, there have been only a few papers discussing and estimating fiscal rules in real time. In contrast, the literature on *ex post* fiscal rules emerged much earlier and has been abundant (see e.g. Barro (1986), Bohn (1998), Arreaza et al. (1999), Galí and Perotti (2003), Huart (2013), Plödt and Reicher (2015), Checherita-Westphal and Žd'árek (2017)).

There are two different strands in the literature on real-time fiscal rules. First, some papers mix *ex post* and real-time data to assess fiscal reaction functions. More precisely, they explain fiscal outcomes (or *ex post*/revised primary or cyclically-adjusted primary balance) by some real-time variables. These can be the output gap, Forni and Momigliano (2004), the output gap and the lagged fiscal balance, Golinelli and Momigliano (2006), or the measurement error made in the real-time evaluation of the output, see Bernoth et al. (2015) and Poghosyan and Tosun (2019).

The second strand includes exclusively real-time data, for the independent and dependent variables. Cimadomo (2012) studies the fiscal reaction function of a panel of 19 OECD countries between 1994 and 2006 and concludes that discretionary fiscal policy has been counter-cyclical, especially in economic expansions. Giuliodori and Beetsma (2008) explore the interdependence of discretionary fiscal policy among EU countries and show that fiscal plans in large countries impinge on those of the smaller countries, while the reverse is not true. They also confirm Cimadomo (2012)'s result that fiscal policy has been counter-cyclical during expansions. Lewis (2013) applies the same methodology to Central and Eastern European Countries, except that he uses the *ex ante* total budget balance as the fiscal dependent variable. He concludes in favour of counter-cyclicality as well.

Beetsma and Giuliodori (2010) estimate the fiscal rules on real-time data between 1995 and 2006 and study the fiscal reactions to new information, particularly on economic activity.[4] They distinguish two phases in fiscal practice : there is the budget preparation period and then the implementation period. Beetsma and Giuliodori thus show that, in the first phase, fiscal policy is acyclical in the EU and counter-cyclical in other OECD countries. In the second phase, European fiscal policies become pro-cyclical while they become acyclical in the other OECD countries.

Paloviita and Kinnunen (2011) include the 2008-2009 crisis in their sample, which extends from 1997 to 2010, and estimate the reaction of the primary structural balance to the output gap for a panel of 12 Euro Area countries. They show that fiscal planning is counter-cyclical, on the one hand, and, on the other hand, that the fiscal policy implemented was modified during the economic crisis phase to respond to fiscal forecast errors and mitigate the effects of the crisis.

On a sample of Euro Area countries between 1999 and 2015, Eyraud et al. (2017) show that fiscal policy has been pro-cyclical and show evidence of a deficit bias: fiscal policy is pro-cyclical in good times and a-cyclical in bad times.

In contrast with this literature, Kalckreuth and Wolff (2011) focus on a single country, the US. They also compute exclusively the reaction of fiscal policy to economic activity and show that the discretionary fiscal stance reacts instantaneously to a change in economic activity, in a counter-cyclical manner.

3 Fiscal rules and sustainability conditions

Theoretical as well as empirical analysis of fiscal rules (or reaction functions) generally introduces two main fiscal policy objectives: on the one hand, ensuring fiscal sustainability (or stabilization of the public debt ratio as a percentage of GDP) and on the other hand, counter-cyclical stabilization through the reaction to a measure of the position in the macroeconomic cycle, the output gap or the deviation of the unemployment rate from its long-term structural level. But there is sometimes some confusion about their foundations: are fiscal reaction functions *positive* or *normative* concepts? In this section, we aim to clarify these questions and to justify our modeling approach.

The modeling of fiscal policy rules, symmetrical to that of the Taylor rule, can be derived fom several and different theoretical approaches. Initially, Bohn (1998) seminal paper builds on the tax-smoothing approach *à la* Barro (1979) to specify the following linear fiscal policy rule:

$$s_t = \alpha_0 + \gamma b_{t-1} + \alpha_y \hat{y}_t + \alpha_{\hat{g}} \hat{g}_t + \varepsilon_t \tag{1}$$

In that framework, government chooses the tax rate that minimizes tax collection costs inter temporally. It implies that primary surplus s_t shall react strictly positively to changes in the stock of government debt b_t but shall also react negatively to *transitory* shocks to output fluctuations $\hat{y}_t$ and real government spending $\hat{g}_t$. Bohn (1998) shows that $\gamma > 0$ is a sufficient condition for the government intertemporal budget constraint to hold (i.e. the No-Ponzi Game condition) in a dynamically efficient economy, as long as transitory components of output and real government spending are bounded. For the debt-to-GDP ratio to be stationary, the government shall react

[4]See also Beetsma et al. (2009, 2013) on fiscal policy in the EU in real time.

more than the interest rate-growth differential, i.e. $\gamma > (r - y)/(1 + y)$.[5]

Fiscal policy rules can also be derived from the linear-quadratic (LQ) framework developed by Benigno and Woodford (2004) in which fiscal policy (similarly to monetary policy) aims to minimise both the volatility of inflation and the output gap, subject to its inter-temporal budget constraint. Recently, Fournier (2019) and Fournier and Lieberknecht (2020) developed a framework for fiscal policy analysis in which they derived fiscal Taylor rules as approximation of optimal fiscal policy. In their approach, close to the Ramsey optimal policy, the government seeks to maximize the welfare of a representative household, subject to the government inter-temporal budget constraint, in an economy with hysteresis effects, state-dependent fiscal multipliers and default-risk premium on public debt.

As in the case of a (monetary) Taylor rule, one can either calibrate the parameters of the fiscal policy rule to match (approximately) the optimal policy solution and eventually confront the observed fiscal policy stance to the simulated optimal fiscal policy stance as in Fournier and Lieberknecht (2020). Or, alternatively, one can go to the data, *estimate* the parameters and test whether they satisfy fiscal sustainability conditions or if they indicate a counter- or procyclical fiscal stance. The second perspective is the most common in the literature, and the one adopted in this paper.

Here, we adopt the following general specification:

$$sps_t = \alpha_0 + \rho sps_{t-1} + \gamma b_{t-1} + \alpha_y \hat{y}_t + \varepsilon_t \tag{2}$$

where sps_t is the structural primary surplus in percent of potential GDP, b_{t-1} is the end-of-period public debt in percent of GDP and $\hat{y}_t$ is the output gap. Our specification diverges in three respects from the usual framework of Bohn (1998). First, we choose the structural primary surplus rather than the primary surplus and abstract from the purely cyclical, non-discretionary component. This choice allows us to study the *endogenous* (or systematic) discretionary component of fiscal policy without having to control for automatic stabilizers and other transitory components. Here, we speak of "endogenous discretionary" fiscal response as opposed to purely random and *exogenous* discretionary fiscal policy (e.g. *exogenous* fiscal policy shocks in SVARs, see Blanchard and Perotti (2002)). In that sense, discretionary fiscal policy has two components: a systematic, endogenous component and a purely random, exogenous component. Second, we do not include transitory real government spending; this choice is motivated by the fact we use the structural primary surplus. As a result, the latter excludes a large part of transitory components of the primary surplus. These transitory components may be related either to the business cycle (i.e. automatic stabilizers) but also to transitory shocks to spendings and receipts, e.g. due to transitory higher or lower elasticities of fiscal variables to GDP.[6] Third, we take into account fiscal policy inertia (or persistence), through the ρ parameter. This specification then must be rewritten to be strictly comparable to equation (1). As long as $|\rho| < 1$, equation (2) can be rewritten in an

[5] In that case, $\alpha_0 = \bar{s} - \gamma\bar{b}$, where $\bar{b}$ denotes the steady-state debt-to-GDP ratio and $\bar{s} = \frac{r-y}{1+y}\bar{b}$ denotes the debt-stabilizing primary balance-to-GDP ratio.r_t is the nominal interest rate and y_t is the nominal growth rate.

[6] In Barro (1979) and Bohn (1998, 2008), the cyclical component of real government spending is constructed as the difference between the observed real government spending and the permanent component of real government spending. And the latter is calculated as the present-value of expected future real government spending, or military spending, as implied from an AR(2) process. Sometimes, this transitory component is simply obtained from the Hodrick-Prescott filter, as in Mendoza and Ostry (2008).

infinite moving-average representation

$$\begin{aligned} sps_t &= \alpha_0(1-\rho L)^{-1} + \gamma(1-\rho L)^{-1}b_{t-1} + \alpha_y(1-\rho L)^{-1}\hat{y}_t + (1-\rho L)^{-1}\varepsilon_t \\ &= \alpha_0(1-\rho)^{-1} + \gamma\sum_{k=0}^{\infty}\rho^k b_{t-1-k} + \alpha_y\sum_{k=0}^{\infty}\rho^k\hat{y}_{t-k} + \sum_{k=0}^{\infty}\rho^k\varepsilon_{t-k} \end{aligned} \tag{3}$$

with L the lag operator. Evaluating equation (3) at the steady-state yields the long-run feedback coefficient associated to public debt, which is defined by $\gamma^{LR} = \gamma/(1-\rho)$. Following Bohn (1998), a sufficient condition for the present-value budget constraint of government (or No-Ponzi Game condition) is $\gamma^{LR} > 0$ in a dynamically efficient economy and provided the transitory component of primary surplus is bounded.[7] In contrast, the debt-stability condition in equation (3) cannot be immediately derived from the analysis of zero-inertia fiscal policy rule like (1), since it depends on the whole past of output gap, public debt and shocks.

To our knowledge, Daniel and Shiamptanis (2013, see eq. 14–16) are among the few to derive the stability condition of public debt in presence of fiscal policy inertia. They show the public debt-to-GDP ratio is stable if and only if two conditions are satisfied:

1. Primary surplus reacts more to public debt than the interest rate-growth differential, adjusted for policy inertia:
$$\gamma^{LR} \equiv \frac{\gamma}{1-\rho} > x$$
where $x \equiv (r-y)/(1+y)$ is the interest rate-growth differential.
2. Fiscal policy is not too much inertial:
$$\rho \in [0, \rho^{max})$$
with $\rho^{max} \equiv (1+x)^{-1}$.

Appendix A.1 provides the proof of these debt-stability conditions in presence of fiscal policy inertia.

Importantly, the condition on fiscal policy inertia implies that *difference–level* specifications of fiscal rules (i.e. where the variation of primary surplus reacts to the level of public debt) implicitly assume that fiscal policy cannot stabilize public debt, unless $x < 0$. Indeed, such specifications are equivalent to the case $\rho = 1$, which can be stable if and only if $\rho^{max} > 1$. Highlighting this latter point is important because difference-level fiscal rules are commonly found in the literature and nevertheless aim to discriminate between sustainable and unsustainable fiscal policies.

4 Dataset

Unlike monetary policy, which almost directly controls the short-term interest rate via open-market operations and is observed in real-time, fiscal policy does not really have an instrument that the government would control instantaneously.

This is because the primary budget balance, and even more so the primary structural balance are statistical constructions, which are at best available on a quarterly basis and which are subject to revisions. These phenomena are even more pronounced in the case of the primary structural

[7] Proof follows immediately from Bohn (1998). Provided $|\rho| < 1$, for any $\gamma > 0$ we have $\gamma^{LR} > 0$.

balance insofar as it depends in addition on estimates of potential GDP and on government expenditure and revenues elasticities to nominal GDP. Moreover, given the existence of automatic stabilisers, the dynamics of revenues and prices are largely endogenous to economic activity, and are partially beyond the control of governments in the execution of their budgets. There is also a long time lag between a fiscal decision and its implementation, usually due to the parliamentary process. As a result, the *ex post* level of balance (as a percentage of GDP) can deviate very significantly from the *ex ante* planned level. Finally, measures of potential GDP and output gap themselves tend to be sharply revised, for example since the financial crisis and recession in 2008 (see Coibion et al., 2018), and this mechanically induces a bias in the estimation of the fiscal response to economic activity.

Therefore, highlighting the determinants of fiscal decision requires to use real-time measures of the fiscal instrument and the variables of interest (GDP, output gap, inflation, public debt, etc.), following the example of Golinelli and Momigliano (2006), Beetsma and Giuliodori (2010), Cimadomo (2012, 2016).

To build our database in real time, we have used different vintages of the Economic Outlook of OECD (December edition) from 1996 to 2017. By convention, *ex post* time series are taken from the OECD Economic Outlook (Dec. 2017) and ends in 2016. Yet, we are fully aware that these series are subject to future revisions of national accounts up to 2 or 3 years. For real-time data, we have extracted the *forecast* and the *nowcast* of the different vintages of the OECD. Formally, the real-time measurement of the variable x_t for a set of information $\mathcal{I}$ is designated by $x_{t|\mathcal{I}}$. Hence, the nowcast is $x_{t|t}$ and the forecast is $x_{t|t-1}$. Our real-time series cover the years 1996-2018. Our dataset includes the primary structural balance (in percent of potential GDP), gross and net financial public debt (in percent of GDP) , output gap (in percent of potential GDP), potential GDP, short and long nominal interest rate, nominal effective exchange rate, for a panel of 19 countries. By primary structural balance, we refer to the "cyclically adjusted primary balance", which does not take into account exceptional and temporary measures in its calculation. The panel includes the first 15 Member States of the European Union, plus 4 advanced OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, New Zealand, Portugal, Spain, Sweden, the United Kingdom and the United States.

We have chosen to exclude Japan, which remains a singular case given the very high level of its public debt over the last 20 years. We also exclude Norway, which has exceptional net public assets (via its sovereign fund, which is backed by its oil resources) that are not reflected (by definition) in gross public debt. Figures 5–7 in Appendix A.2 show the *ex post*, the one-year ahead forecast and the current-year nowcast of structural primary balance, gross public debt and output gap. A visual inspection easily shows the non negligible discrepancy between ex ante and ex post measures of fiscal policy or output gaps. Table 8 completes this description and reports descriptive statistics for these variables.

In our estimates, we choose to use the gross financial liabilities as a measure of public debt, rather than the net financial liabilities or the Maastricht gross public debt, for several reasons. First, the Maastricht definition of gross public debt does not apply to extra-EU countries and therefore limits our ability to estimate a common fiscal rule within the panel of OECD countries. Second, we agree with the arguments of Panizza and Presbitero (2013) in favor of using gross financial debt rather than net financial debt. While the latter is probably a better measure of the financial position of government, its calculation is subject to caveat and assumptions as it requires to evaluate financial assets of government. In contrast, the definition of gross financial debt remains fairly stable and homogeneous across time and countries. Third, we can argue that gross debt is a measure of government indebtedness, which is invariant to fiscal stress compared to net government debt. Suppose a fiscal crisis occurs, it may likely be that the government makes fire sales and incurs capital losses when trying to liquidate a part of its financial assets.

5 Empirical analysis

We turn to the empirical analysis in real-time. In particular, we investigate how discretionary fiscal policy endogenously responds *ex ante* to expected output gap and to current estimate of public debt-to-GDP ratio and how it might vary along the business cycle, hence characterising some potential asymmetries. We compare systematically least square estimates to instrumental variables estimates that correct for the endogeneity that may arise from reverse causality between structural primary surplus and output gap but also from potential simultaneity bias between the level of public debt and structural primary surplus (Leeper and Li, 2017).

5.1 Models

Specifications. We estimate various specifications of equation (2) on panel real-time data, with time and country fixed effects to account for unobserved heterogeneity. We start from the following baseline specification:

$$sps_{i,t|t-1} = \rho sps_{i,t-1|t-1} + \gamma b_{i,t-1|t-1} + \alpha_y \hat{y}_{i,t|t-1} + \alpha_i + \delta_t + \varepsilon_{i,t} \tag{4}$$

where α_i and δ_t are country and time fixed effects. The above specification postulates fiscal policy is linear along the business cycle. A positive (resp. negative) α_y implies countercyclical (resp. procyclical) discretionary fiscal policy. Interpretations regarding sign and magnitude of the surplus-debt feedback coefficient γ as well as fiscal policy inertia ρ were extensively developed in section 3.

Then we relax the linear fiscal policy assumption and consider a second specification in which we assume *ex ante* fiscal policy reacts to expected output gap differently along the business cycle, i.e. depending on the sign of expected output gap:

$$\begin{aligned} sps_{i,t|t-1} &= \rho sps_{i,t-1|t-1} + \gamma b_{i,t-1|t-1} + \alpha_{y,1} \mathbb{1}(\hat{y}_{i,t|t-1} \geq 0) \hat{y}_{i,t|t-1} \\ &+ \alpha_{y,2} \mathbb{1}(\hat{y}_{i,t|t-1} < 0) \hat{y}_{i,t|t-1} + \alpha_i + \delta_t + \varepsilon_{i,t} \end{aligned} \tag{5}$$

where $\mathbb{1}(\hat{y}_{i,t|t-1} \geq 0)$ is a dummy variable equal to 1 when the expected output gap is respectively zero or positive and 0 otherwise and $\mathbb{1}(\hat{y}_{i,t|t-1} < 0)$ is a dummy variable equal to 1 when the expected output gap is negative and 0 otherwise.

Finally, we consider a last specification in which, in addition to asymmetric responses to expected output gap, we allow a differentiated response to the lagged public debt level along the business cycle:

$$\begin{aligned} sps_{i,t|t-1} &= \rho sps_{i,t-1|t-1} + \gamma_1 \mathbb{1}(\hat{y}_{i,t-1|t-1} \geq 0) b_{i,t-1|t-1} + \gamma_2 \mathbb{1}(\hat{y}_{i,t-1|t-1} < 0) b_{i,t-1|t-1} \\ &+ \alpha_{y,1} \mathbb{1}(\hat{y}_{i,t|t-1} \geq 0) \hat{y}_{i,t|t-1} + \alpha_{y,2} \mathbb{1}(\hat{y}_{i,t|t-1} < 0) \hat{y}_{i,t|t-1} + \alpha_i + \delta_t + \varepsilon_{i,t} \end{aligned} \tag{6}$$

Each specification is estimated using the Least-Square Dummy Variables (LSDV) estimator and using the IV/GMM estimator. In both cases, we use the cross-section SUR Panel Corrected Standard Error (PCSE) for the variance-covariance estimator.

Endogeneity biases and instruments selection. Equations (4), (5) and (6) are potentially subject to several endogeneity biases: reverse causality bias between structural primary surplus and output gap, Nickell (1981)'s bias in dynamic panel data models with fixed-effects and simultaneity biases induced by monetary-fiscal interactions (Cochrane, 2001, Leeper and Li, 2017).

Real-time macroeconomic data can be useful to find instruments in IV/GMM estimates as different forecast vintages for the same macroeconomic variable allow the econometrician to find efficient instruments that are more likely to be exogenous as the information set differs.

Following Beetsma and Giuliodori (2010), Cimadomo (2012), among others, we adopt the following strategy to select instruments. First, for nowcast explanatory variables, e.g. the nowcast gross public debt $b_{i,t-1|t-1}$, we systemically use the *same* period forecast, i.e. $b_{i,t-1|t-2}$. If the nowcast explanatory variable is interacted with a dummy variable, we also use the forecast interacted variable as instrument. In the case of the expected output gap $\hat{y}_{i,t|t-1}$, we use the previous period nowcast of the output gap $\hat{y}_{i,t-1|t-1}$ as an instrument. Second, we add three additional instruments to correct for the potential reverse causality between expected output gap and structural primary surplus: (i) the previous period forecast of the change in structural primary surplus, (ii) the nowcast of the previous period average output gap in others OECD countries (excluding the country i) and (iii) the previous period real-time output gap forecast error in country i, i.e. $FE^{\hat{y}}_{i,t-1|t-1} \equiv \hat{y}_{t-1|t-1} - \hat{y}_{t-1|t-2}$, which carries information about expected output gap $\hat{y}_{t|t-1}$ but is unlikely *caused by* –and not even *correlated with*– the expected structural primary surplus $sps_{i,t|t-1}$, see Figure 1.[8] Third, we use the previous period forecasts of the *first-difference* of short-term nominal interest rate, nominal effective exchange rate and structural primary surplus.

5.2 Baseline results

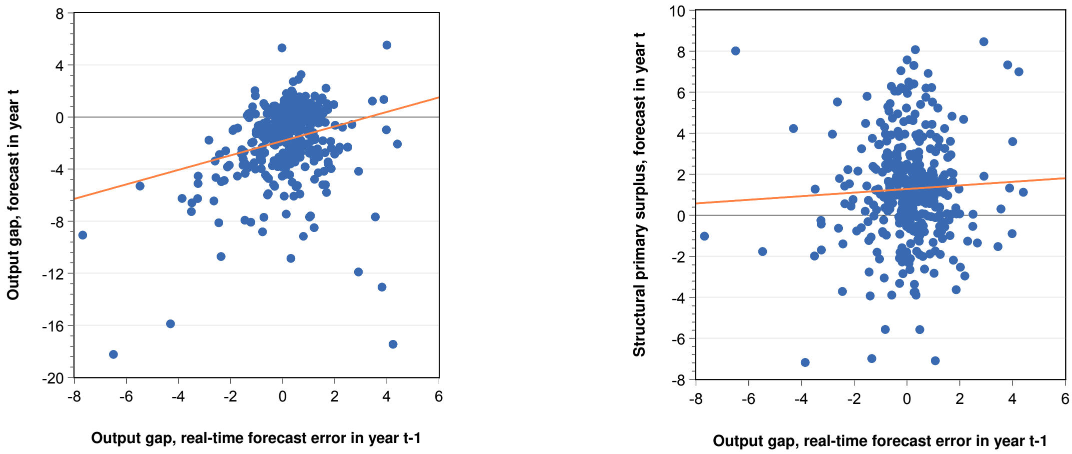
We estimate equations (4)–(6) on a panel of 19 OECD countries (see results in Table 1) and then specifically on a subset of 12 countries participating to the EMU (see results in Table 3). We estimate two additional specifications for the Euro Area countries in which we use dummy variables for the crisis years and the depth of recessions.

Linear *vs* non-linear fiscal policy?

Our baseline linear specification (4) suggests a globally procyclical fiscal policy, as the estimated *ex ante* response to expected output gap is negative. Yet, this result is only significant in LSDV estimates for the full OECD sample. Regarding the Euro area, both for LSDV and GMM, estimates

[8] Bivariate panel regressions with country and period fixed effects confirm these findings.

Figure 1: Real-time output gap forecast error $FE^{\hat{y}}_{i,t-1|t-1}$ bivariate correlations



(a) Output gap forecast $\hat{y}_{t|t-1}$ **(b)** Structural primary surplus forecast $sps_{t|t-1}$

Source: One-year ahead forecasts and current-year forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec. 2017).

Table 1: Real-time fiscal policy rules in 19 OECD countries (1997-2018)

Dependent variable: $sps_{i,t\|t-1}$	**Baseline**		**Asymmetric stabilization**		**Asymmetric stab. and consolidation**	
	LSDV	IV/GMM	LSDV	IV/GMM	LSDV	IV/GMM
$sps_{i,t-1\|t-1}$	0.600***	0.692***	0.587***	0.682***	0.588***	0.685***
	(0.042)	*(0.050)*	*(0.041)*	*(0.049)*	*(0.041)*	*(0.050)*
$b_{i,t-1\|t-1}$	0.014***	0.015***	0.014***	0.014***		
	(0.005)	*(0.006)*	*(0.005)*	*(0.006)*		
$\hat{y}_{i,t\|t-1}$	-0.094**	-0.075*				
	(0.038)	*(0.045)*				
$b_{i,t-1\|t-1} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$					0.016***	0.024**
					(0.006)	*(0.011)*
$b_{i,t-1\|t-1} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$					0.014***	0.014**
					(0.005)	*(0.006)*
$\hat{y}_{i,t\|t-1} > 0$			0.164	0.093	0.134	-0.216
			(0.174)	*(0.280)*	*(0.194)*	*(0.442)*
$\hat{y}_{i,t\|t-1} < 0$			-0.128***	-0.099**	-0.133***	-0.122**
			(0.039)	*(0.050)*	*(0.039)*	*(0.049)*
γ^{LR}	0.036	0.048	0.035	0.045		
$\gamma^{LR} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$					0.039	0.077
$\gamma^{LR} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$					0.034	0.044
R^2	0.89	0.89	0.90	0.89	0.90	0.89
Durbin-Watson	1.84	2.00	1.85	2.01	1.86	2.05
Sargan J-stat		4.02		3.95		2.97
p-value		0.55		0.56		0.70
Cross-sections N	19	19	19	19	19	19
Periods T	22	21	22	21	22	21
Obs. (unbalanced)	402	381	402	381	402	381

Notes: Equations are estimated with country and period fixed-effects and we report robust standard errors in parentheses. Results are significant at 1% level ('***'), 5% level ('**') and 10% level ('*').
Source: OECD Economic Outlook vintages (Dec. 1996 – Dec. 2017), authors' calculations.

are more imprecise and the output gap coefficient is never significant at the 5%-level. On the contrary, for non-linear specifications, we find evidence of differentiated responses to output gap both in terms of sign and magnitude and also in terms of precision. In particular, the coefficient associated to zero or positive output gap is never significant. These findings must yet be interpreted cautiously given forecast and nowcast output gap series tend to be negative on average, which reduces the number of observations of zero or positive expected output gap, see Figure 7 and Table 8 in Appendix A.2. We address this problem in Section 6. We find no significant evidence of a differenciated response to debt, except for GMM estimates of equation (6). Globally, our results point to a differentiated, asymmetric fiscal policy, in terms of response to output gap.

Heterogeneity between EMU and non-EMU countries

Table 2 presents results for specifications in which we investigate how EMU membership may explain results shown in Table 1. First, we find evidence of procyclicality within the EMU and countercyclicality within non-EMU countries, using our baseline linear specification. These results are further confirmed and detailed by estimates for the asymmetric stabilization specification. We find EMU fiscal policy is particularly procyclical in downturns; while more likely acyclical in upturns. For non-EMU countries, coefficients associated to output gap are rarely significant, except in the IV/GMM specification, pointing to a significant countercyclicality. These observations strengthen our finding that fiscal policy is likely to be asymmetric along the business cycle. Second, we do not find significant and clear evidence of differences in terms of fiscal consolidation inside and outside the EMU. LSDV estimates show remarkably similar estimates of the surplus-debt coefficients across countries and along the business cycle while IV/GMM estimates are non-significant although they may differ substantially. These results motivate our choice to focus on the 12 EMU countries in our panel.

Evidence of procyclical fiscal policy

We find evidence of a broadly procyclical discretionary fiscal policy. In contrast with the baseline linear specification, asymmetric specifications of fiscal policy show significant evidence of a procyclical response of structural primary surplus to output gap in *downturns*, both in the OECD and the Euro Area.[9] Structural primary balance response to output gap in *upturns* is generally estimated positive but never significant –as mentioned before, imprecise results for zero or positive output gaps must be cautiously interpreted at this stage. Consequently, our results suggest that discretionary fiscal policy is a-cyclical in upturns while significantly procyclical in downturns.

Table 4 shows results for real-time fiscal policy rules in the Euro Area, in which we make the lagged public debt and the output gap interact with two alternative dummies. In the "Crisis" specification, the dummy *Crisis* is equal to 1 during the years 2009-2013 and thus covers all the years from the Great Recession to the end of the second Euro Area recession, according to the CEPR Euro Area Business Cycle Dating Committee. In the deep recession specification, rather than using a zero output gap as an exogenous threshold, we define a real-time indicator of deep recessions equal to 1 when the forecast (resp. nowcast) output gap falls below minus two country-specific standard deviations of output gap. From these two specifications, we draw two conclusions. First, we find significant evidence in favor of a procyclical fiscal stance during crisis

[9] According to the baseline specification, procyclicality is not strongly significant, only at 10% level, but is quite robust to LSDV and GMM estimator since the coefficient is always negative

Table 2: Real-time fiscal policy rules in the OECD: EMU membership (1997-2018)

Dependent variable: $sps_{i,t\|t-1}$	**Baseline**		**Asymmetric stabilization**		**Asymmetric stab. and consolidation**	
	LSDV	IV/GMM	LSDV	IV/GMM	LSDV	IV/GMM
$sps_{i,t-1\|t-1}$	0.597***	0.674***	0.588***	0.668***	0.588***	0.665***
	(0.041)	*(0.048)*	*(0.041)*	*(0.043)*	*(0.041)*	(0.057)
$b_{i,t-1\|t-1}$	0.013**	0.012**	0.013**	0.011**		
	(0.005)	*(0.005)*	*(0.005)*	*(0.005)*		
$\mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} > 0) \times b_{i,t-1\|t-1}$					0.013**	0.016
					(0.006)	*(0.012)*
$\mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0) \times b_{i,t-1\|t-1}$					0.013**	0.012*
					(0.005)	*(0.006)*
$(1-\mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} > 0) \times b_{i,t-1\|t-1}$					0.012*	0.026
					(0.006)	*(0.036)*
$(1-\mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0) \times b_{i,t-1\|t-1}$					0.012**	0.009
					(0.005)	*(0.008)*
$\mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1}$	-0.111***	-0.108**				
	(0.039)	*(0.045)*				
$\mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1} \geq 0$			0.148	0.043	0.141	-0.047
			(0.219)	*(0.324)*	*(0.251)*	*(0.469)*
$\mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1} < 0$			-0.141***	-0.125***	-0.137***	-0.124**
			(0.039)	*(0.048)*	*(0.041)*	*(0.051)*
$(1-\mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1}$	0.079	0.151**				
	(0.052)	*(0.058)*				
$(1-\mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1} \geq 0$			0.089	0.152	0.086	-0.384
			(0.160)	*(0.257)*	*(0.158)*	*(0.888)*
$(1-\mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1} < 0$			0.075	0.145**	0.067	0.057
			(0.060)	*(0.069)*	*(0.062)*	*(0.133)*
γ^{LR}	0.032	0.036	0.031	0.034		
$\gamma^{LR} \times \mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$					0.031	0.046
$\gamma^{LR} \times \mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$					0.031	0.034
$\gamma^{LR} \times (1-\mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$					0.029	0.075
$\gamma^{LR} \times (1-\mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$					0.028	0.026
R^2	0.90	0.90	0.90	0.90	0.90	0.89
Durbin-Watson	1.93	2.12	1.95	2.13	1.95	2.11
Sargan J-stat		3.05		2.96		3.45
p-value		0.69		0.71		0.63
Cross-sections N	19	19	19	19	19	19
Periods T	22	21	22	21	22	21
Obs. (unbalanced)	402	381	402	381	402	381

Notes: Equations are estimated with country and period fixed-effects and we report robust standard errors in parentheses. Dummy variable $\mathbb{1}_{EMU,t}$ is equal to 1 when the country enters in the EMU and 0 otherwise. Results are significant at 1% level ('***'), 5% level ('**') and 10% level ('*').
Source: OECD Economic Outlook vintages (Dec. 1996 – Dec. 2017), authors' calculations.

years, based on GMM estimates.[10] Second, we find inconclusive results using the deep recession specification: output gap coefficients are never significant.

Former results on real-time data by Cimadomo (2012) indicated that discretionary fiscal policy was found to be countercyclical, when using real-time data as opposed to *ex post*. To partly reconcile our results with these former findings, we first notice that Cimadomo's evidence of countercyclical fiscal policy was particularly driven by economic expansion. In this paper, we find positive (but non-significant) point estimates for output gap in upturns. Finally, his dataset ended up in 2006 and did not cover the Great Recession, the Sovereign Debt Crisis and the subsequent Euro Area 2011-2013 recession. In contrast, our dataset covers years up to 2018 which certainly explains differences and tends to suggest the existence of a structural break in fiscal policy rules.

[10]Differences between the LSDV and the GMM estimates are particularly pronounced in that case, which may indicate a strong endogeneity bias for these years.

Table 3: Real-time fiscal policy rules in 12 Euro area countries (1997-2018)

Dependent variable: $sps_{i,t\|t-1}$	**Baseline**		**Asymmetric stabilization**		**Asymmetric stab. and consolidation**	
	LSDV	IV/GMM	LSDV	IV/GMM	LSDV	IV/GMM
$sps_{i,t-1\|t-1}$	0.505***	0.596***	0.492***	0.580***	0.488***	0.576***
	(0.051)	*(0.064)*	*(0.050)*	*(0.061)*	*(0.050)*	*(0.063)*
$b_{i,t-1\|t-1}$	0.021***	0.018**	0.021***	0.017**		
	(0.007)	*(0.009)*	*(0.007)*	*(0.009)*		
$\hat{y}_{i,t\|t-1}$	-0.078*	-0.089*				
	(0.041)	*(0.048)*				
$b_{i,t-1\|t-1} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$					0.018**	0.015
					(0.008)	*(0.014)*
$b_{i,t-1\|t-1} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$					0.021***	0.018**
					(0.007)	*(0.008)*
$\hat{y}_{i,t\|t-1} > 0$			0.214	0.178	0.268	0.228
			(0.205)	*(0.312)*	*(0.233)*	*(0.451)*
$\hat{y}_{i,t\|t-1} < 0$			-0.113***	-0.122**	-0.102**	-0.115**
			(0.042)	*(0.054)*	*(0.040)*	*(0.048)*
γ^{LR}	0.043	0.044	0.041	0.041		
$\gamma^{LR} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$					0.036	0.036
$\gamma^{LR} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$					0.042	0.042
R^2	0.87	0.87	0.88	0.87	0.88	0.87
Durbin-Watson	1.99	2.24	2.04	2.28	2.03	2.27
Sargan J-stat		4.15		3.95		3.98
p-value		0.53		0.56		0.55
Cross-sections N	12	12	12	12	12	12
Periods T	22	21	22	21	22	21
Obs. (unbalanced)	253	239	253	239	253	239

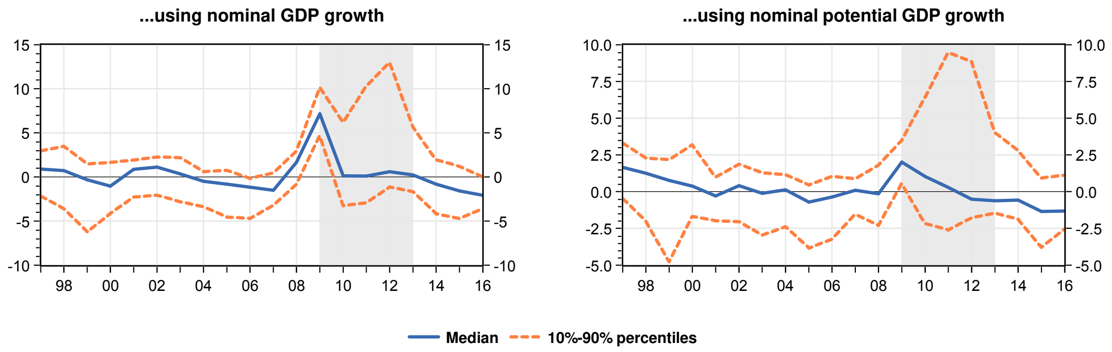
Notes: Equations are estimated with country and period fixed-effects and we report robust standard errors in parentheses. Results are significant at 1% level ('***'), 5% level ('**') and 10% level ('*').
Source: OECD Economic Outlook vintages (Dec. 1996 – Dec. 2017), authors' calculations.

Debt stabilization and fiscal consolidation

One striking result of our estimates is that the surplus-debt short-run coefficient γ is almost always found to be positive and strongly significant across equations, panels and both in LSDV and GMM estimates. The only exception is the case of the Euro Area, when we interact the lagged public debt level with the lagged nowcast output gap. Taking into account fiscal policy inertia, we calculate point estimates for the long-run surplus-debt coefficient γ^{LR}. In comparison with median interest rate-growth differentials, we find large values for this coefficient, ranging from 3.4% to 7.7%. Apart from the crisis years (2009-2013), estimated average long-run surplus-debt coefficient is above the interest rate-growth differential, whatever GDP or potential GDP growth is considered (see Figure 2). Long-run surplus-debt coefficients are generally larger when estimated by GMM, because of higher fiscal policy inertia. Last but not least, given an average value for interest rate-growth differential x close to 0 in our sample (i.e. $\rho^{max} \approx 1$), the estimated persistence of fiscal policy rules, ranging from 0.48 to 0.69, is compatible with debt-stability.

We do not find significant evidence of asymmetries in the response to government gross debt, along the business cycle. Point estimates of long-run surplus-debt coefficient are a bit larger in downturns, within the Euro Area, in particular during crisis years and during deep recessions, see Tables 3 and 4. Within the OECD, we rather observe similar coefficient, or even higher in upturns. Yet all these differences are not statistically significant. As mentioned before, the only exception

Figure 2: Interest rate-growth differentials in the OECD, in percentage points



Notes: We use *ex post* data from the OECD Economic Outlook Dec. 2017 for the long-term nominal interest rate, GDP and potential GDP growth and GDP deflator growth rate.

is, within the Euro Area, the non-significant response to lagged debt in upturns, see Table 3. Overall, these results do not provide evidence of any bias toward procyclical fiscal consolidation in the Euro Area.

6 Robustness checks

Our baseline results indicate (i) a procyclical fiscal policy in downturns in the Euro Area, (ii) a-cyclical or countercyclical fiscal policy in the rest of the OECD and (iii) no significant evidence of procyclical fiscal consolidation. In this section, we investigate whether these findings are robust either to a business cycle measure smoother than dummy variables for expected positive and negative gaps, or to country exclusion.

6.1 Business cycle measure

As already mentioned, Figure 7 shows that real-time measures (one-year ahead forecast and current-year nowcast) of output gap tend to be negative on average and rarely positive in our sample. Using a discrete dummy variable to capture the current stage of business cycle will inevitably limit the number of observations of positive output gaps and reduce the precision of our estimates of asymmetric specifications. It can also be considered as an excessively simple and crude way to capture the economy's position in the business cycle.

Hence, we construct a normalized variable inspired by the calibrated transition function used by Auerbach and Gorodnichenko (2012). Our calibrated transition function $F(.)$ is defined by:

$$F(x_{i,t|t-1}) = \frac{\exp(-\theta x_{i,t|t-1})}{1 + \exp(-\theta x_{i,t|t-1})} \tag{7}$$

The variable $x_{i,t|t-1}$ is the normalized output gap forecast at time $t-1$ for period t for country i defined by $x_{i,t|t-1} \equiv \frac{\hat{y}_{i,t|t-1} - \overline{\hat{y}_i}}{\sigma_{\hat{y}_i}}$ where $\overline{\hat{y}_i}$ and $\sigma_{\hat{y}_i}$ are respectively the average and standard-deviation of output gap one year-ahead forecast in country i. Transition function $F(.)$ fluctuates between 0 (upturns) and 1 (downturns) depending on the normalized output gap forecast at time $t-1$ for

Table 4: Crisis and deep recessions effects on real-time fiscal policy rules in the Euro Area

Dependent variable: $sps_{i,t\|t-1}$	**Crisis years 2009-2013**		**Deep recessions** $\hat{y}_{i,t\|t-1} < -2\sigma_{\hat{y}}$	
	LSDV	IV/GMM	LSDV	IV/GMM
$sps_{i,t-1\|t-1}$	0.513***	0.614***	0.497***	0.601***
	(0.050)	*(0.065)*	*(0.051)*	*(0.065)*
$b_{i,t-1\|t-1} \times (1 - \mathbb{1}(Crisis))$	0.021***	0.018**		
	(0.007)	*(0.009)*		
$b_{i,t-1\|t-1} \times \mathbb{1}(Crisis)$	0.036***	0.025**		
	(0.009)	*(0.011)*		
$\hat{y}_{i,t\|t-1} \times (1 - \mathbb{1}(Crisis))$	-0.043	-0.015		
	(0.050)	*(0.068)*		
$\hat{y}_{i,t\|t-1} \times \mathbb{1}(Crisis)$	-0.085	-0.165***		
	(0.054)	*(0.059)*		
$b_{i,t-1\|t-1} \times (1 - \mathbb{1}(Deep\ recession))$			0.021***	0.018**
			(0.007)	*(0.009)*
$b_{i,t-1\|t-1} \times \mathbb{1}(Deep\ recession)$			0.028***	0.025***
			(0.007)	*(0.009)*
$\hat{y}_{i,t\|t-1} \times (1 - \mathbb{1}(Deep\ recession))$			-0.079	-0.098
			(0.052)	*(0.068)*
$\hat{y}_{i,t\|t-1} \times \mathbb{1}(Deep\ recession)$			-0.017	0.0003
			(0.056)	*(0.059)*
$\gamma^{LR} \times (1 - \mathbb{1}(Crisis))$	0.043	0.046		
$\gamma^{LR} \times \mathbb{1}(Crisis)$	0.074	0.064		
$\gamma^{LR} \times (1 - \mathbb{1}(Deep\ recession))$			0.042	0.045
$\gamma^{LR} \times \mathbb{1}(Deep\ recession)$			0.055	0.062
R^2	0.88	0.87	0.88	0.87
Durbin-Watson	2.08	2.36	2.04	2.29
Sargan J-stat		3.71		5.23
p-value		0.59		0.39
Cross-sections N	12	12	12	12
Periods T	22	21	22	21
Obs. (unbalanced)	253	239	253	239

Notes: Equations are estimated with country and period fixed-effects and we report robust standard errors in parentheses. Results are significant at 1% level ('***'), 5% level ('**') and 10% level ('*').
Source: OECD Economic Outlook vintages (Dec. 1996 – Dec. 2017), authors' calculations.

period t.[11]

We calibrate the slope parameter $\theta = 3$ in an *ad hoc* manner such that our indicator of business cycle is continuous (as opposed to discrete dummy variables) but not too smooth, thus implying marked "regime shifts". In Figures 3 and 4, we compare our baseline measure with the dummy variable and with alternative transition functions. First, our transition function provides a richer description of the data, compared to a dummy variable. In particular, it significantly changes the diagnosis about real-time position in the business cycle for some countries (Italy, Belgium, Luxembourg or Austria), which is both due to the use of a normalized output gap forecast and a smooth transition function, see Figure 3. Second, we observe that a lower value of θ may be too low to discriminate between upturns and downturn –for example in Greece or in Italy before 2007–, which motivates our choice of a higher slope of the transition function. Finally, we also calculate the *nowcast* transition function in order to use its lag as an instrument in IV/GMM estimates.

Finally, we re-estimate equations (5) and (6) by IV/GMM, using transition function $F(x_{i,t|t-1})$

[11] Here, we nonetheless use the sample average of output gap forecasts from 1996 to 2017 to normalize the output gap forecasts. This choice would yet be still consistent with our real-time approach if we assume that the negative average output gap forecast is a constant bias of macroeconomic forecasters.

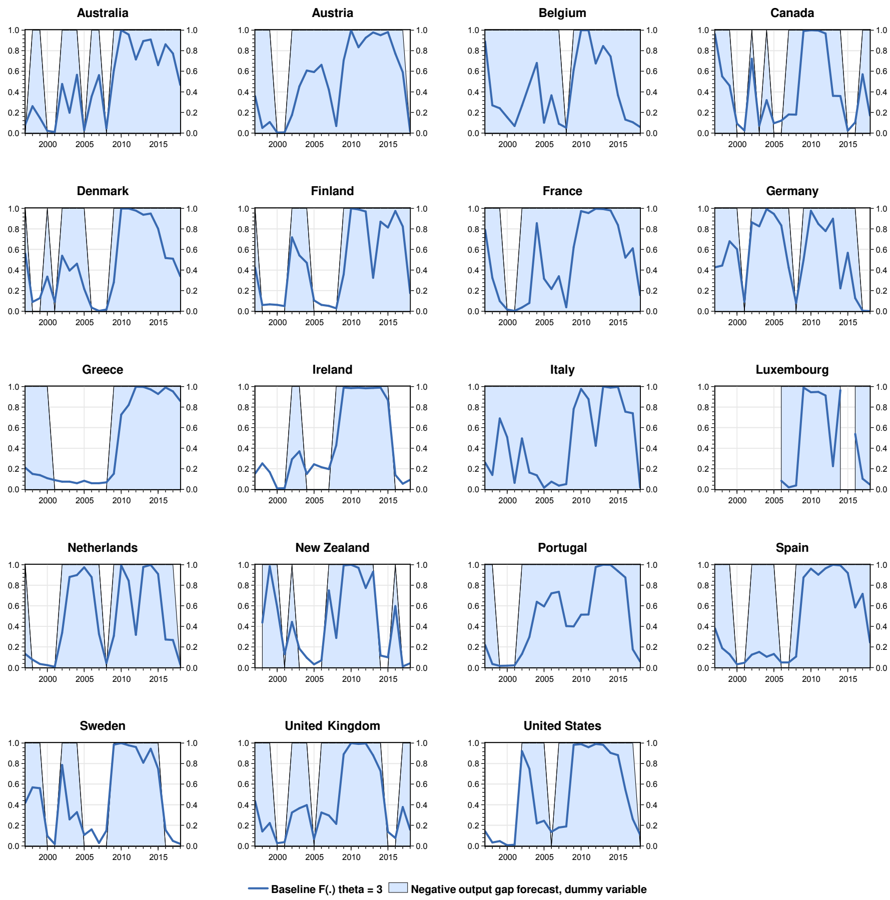
Table 5: Robustness to business cycle measure $F(x_{i,t|t-1})$, IV/GMM estimates

Dependent variable: $sps_{i,t\|t-1}$	**Asymmetric stabilization**			**Asymmetric stab. and consolidation**		
	EURO-12	OECD-19	OECD-19 with EMU dummy	EURO-12	OECD-19	OECD-19 with EMU dummy
$sps_{i,t-1\|t-1}$	0.584***	0.684***	0.668***	0.584***	0.687***	0.669***
	(0.063)	*(0.049)*	*(0.047)*	*(0.064)*	*(0.050)*	*(0.048)*
$b_{i,t-1\|t-1}$	0.018**	0.014**				
	(0.009)	*(0.006)*				
$\mathbb{1}_{EMU,t} \times b_{i,t-1\|t-1}$			0.013**			
			(0.006)			
$(1-\mathbb{1}_{EMU,t}) \times b_{i,t-1\|t-1}$			0.008			
			(0.005)			
$(1-F(x_{i,t\|t-1})) \times b_{i,t-1\|t-1}$				0.018*	0.017**	
				(0.009)	*(0.006)*	
$(1-F(x_{i,t\|t-1})) \times \mathbb{1}_{EMU,t} \times b_{i,t-1\|t-1}$						0.015**
						(0.006)
$(1-F(x_{i,t\|t-1})) \times (1-\mathbb{1}_{EMU,t}) \times b_{i,t-1\|t-1}$						0.010*
						(0.006)
$F(x_{i,t\|t-1}) \times b_{i,t-1\|t-1}$				0.018**	0.011**	
				(0.009)	*(0.005)*	
$F(x_{i,t\|t-1}) \times \mathbb{1}_{EMU,t} \times b_{i,t-1\|t-1}$						0.010*
						(0.006)
$F(x_{i,t\|t-1}) \times (1-\mathbb{1}_{EMU,t}) \times b_{i,t-1\|t-1}$						0.005
						(0.005)
$(1-F(x_{i,t\|t-1})) \times \hat{y}_{i,t\|t-1}$	0.088	0.057		0.082	0.051	
	(0.189)	*(0.172)*		*(0.187)*	*(0.173)*	
$(1-F(x_{i,t\|t-1})) \times \mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1}$			-0.001			0.002
			(0.204)			*(0.202)*
$(1-F(x_{i,t\|t-1})) \times (1-\mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1}$			0.078			0.064
			(0.152)			*(0.166)*
$F(x_{i,t\|t-1}) \times \hat{y}_{i,t\|t-1}$	-0.109**	-0.093*		-0.101*	-0.149**	
	(0.048)	*(0.045)*		*(0.061)*	*(0.062)*	
$F(x_{i,t\|t-1}) \times \mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1}$			-0.106**			-0.152**
			(0.048)			*(0.064)*
$F(x_{i,t\|t-1}) \times (1-\mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1}$			0.126*			0.082
			(0.065)			*(0.089)*
γ^{LR}	0.043	0.045				
$\gamma^{LR} \times \mathbb{1}_{EMU,t}$			0.038			
$\gamma^{LR} \times (1-\mathbb{1}_{EMU,t})$			0.023			
$\gamma^{LR} \times (1-F(x_{i,t\|t-1}))$				0.043	0.053	
$\gamma^{LR} \times F(x_{i,t\|t-1})$				0.044	0.035	
$\gamma^{LR} \times (1-F(x_{i,t\|t-1})) \times \mathbb{1}_{EMU,t}$						0.045
$\gamma^{LR} \times F(x_{i,t\|t-1}) \times \mathbb{1}_{EMU,t}$						0.030
$\gamma^{LR} \times (1-F(x_{i,t\|t-1})) \times (1-\mathbb{1}_{EMU,t})$						0.030
$\gamma^{LR} \times F(x_{i,t\|t-1}) \times (1-\mathbb{1}_{EMU,t})$						0.016
R^2	0.87	0.89	0.90	0.87	0.89	0.90
Durbin-Watson	2.27	2.01	2.13	2.27	2.01	2.12
Sargan J-stat	3.69	3.68	3.26	3.74	3.48	2.90
p-value	0.60	0.60	0.66	0.59	0.63	0.72
Cross-sections N	12	19	19	12	19	19
Periods T	21	21	21	22	21	21
Obs. (unbalanced)	239	381	381	239	381	381

Notes: Equations are estimated with country and period fixed-effects and we report robust standard errors in parentheses. Results are significant at 1% level ('***'), 5% level ('**') and 10% level ('*').
Source: OECD Economic Outlook vintages (Dec. 1996 – Dec. 2017), authors' calculations.

with $\theta = 3$ and report results in Table 5. We basically confirm our previous estimates in Section 5, which are robust to a smooth-transition business cycle measure corrected for the negative average in output gap forecasts. We confirm that *ex ante* discretionary fiscal policy has a procyclical bias in downturns in the Euro Area and is a-cyclical in upturns. We do not find strong evidence in favour of countercyclical discretionary fiscal policy in the rest of the OECD, as coefficients associated to output gap are rarely positive and significant, except maybe in downturns. Finally we confirm not

Figure 3: Transition function $F(x_{i,t|t-1})$ compared to negative output gap dummy variable



Notes: One-year ahead forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec. 2017).

finding strong evidence of procyclical consolidation in the Euro Area. Surplus-debt coefficients in downturns differ in terms of magnitude –higher in the EMU than in the rest of the OECD–, but are barely significant at 5% level in the EMU and non-significant in the rest of the OECD.

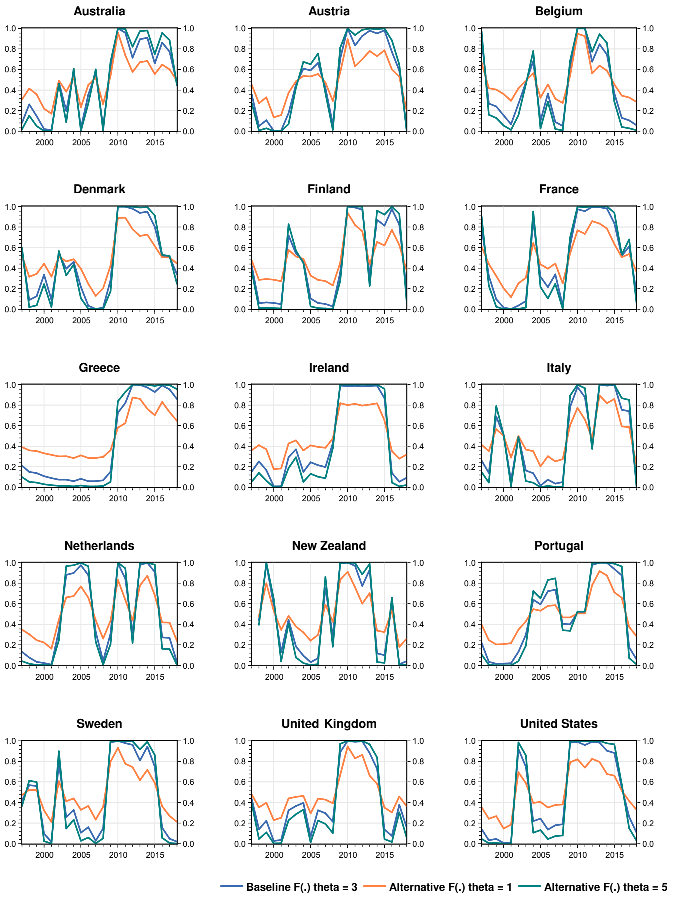
6.2 Country exclusion

We check whether our results are driven by a single country and focus on the asymmetric stabilization specification (5), which we estimate on EA-12 and OECD-19 panels in real-time, excluding one country at a time. Tables 6 and 7 report the IV/GMM estimates for our three key coefficients: surplus-debt coefficient, output gap coefficients in upturns and downturns, and test whether they are significantly different from our baseline results reported in Table 3.

First, regarding results for the EA-12 panel in Table 6, we find that point-estimates of coefficients are fairly stable and robust to country exclusion, although test significance varies. In particular, we notice that excluding several countries, for example Ireland, Finland, Portugal and France, reduces the statistical significance of estimated surplus-debt coefficient.

Our findings regarding procyclical fiscal policy in downturns and a-cyclical in upturns are robust to country exclusion. Coefficient associated to negative expected output gap varies between -0.075 when we exclude the Netherlands to -0.157 when excluding Luxembourg. Coefficient associated to positive (or zero) expected output gap are positive but never significant, as in the

Figure 4: Transition functions $F(x_{i,t|t-1})$ for different values of θ



Notes: One-year ahead forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec. 2017).

baseline results. In Table 7, we obtain similar results for the OECD-19 panel, which are also fairly robust to country exclusion. We observe that coefficients associated to negative expected output gap can be significant only at the 10% level. It supports the findings of a higher heterogeneity within the OECD, in particular between EMU and non-EMU countries, as found in Table 2 and developed in Section 5.

7 Conclusions

In this paper, we estimate real-time *ex ante* fiscal policy rules (or reaction functions) on a panel of 19 OECD countries, including 12 Euro Area countries. We describe fiscal policy behaviour along two dimensions: macroeconomic stabilization (i.e. reaction to output gap) and fiscal consolidation (i.e. reaction to lagged public debt-to-output ratio).

Our main results are fourfold. First, we find that a linear fiscal policy rules does not give an accurate representation of real-time fiscal policy. The response of fiscal policy to the output gap is weak in OECD or Euro Area countries. In contrast, we find evidence of asymmetries in fiscal reaction functions, in particular for the response to the output gap. Second, fiscal policy is generally procyclical in downturns and a-cyclical in upturns. In particular, we focus on Euro area and find significant evidence of procyclical policy between 2009-2013. Third, our results do

Table 6: Robustness to country exclusion for the EA-12 panel

Excluded country	Surplus-debt coefficient	Output gap in upturns	Output gap in downturns	Adjusted R^2	Sargan J-stat (p-value)
Austria	0.0176**	0.1718	-0.1234**	0.8508	3.3778
	(0.0087)	(0.3152)	(0.0548)		(0.6419)
Belgium	0.0158*	0.1816	-0.1246**	0.8337	3.7202
	(0.0091)	(0.3120)	(0.0559)		(0.5904)
Finland	0.0137	0.1002	-0.1308**	0.8488	4.0076
	(0.0091)	(0.3294)	(0.0577)		(0.5483)
France	0.0171*	0.1864	-0.1219**	0.8386	4.2694
	(0.0092)	(0.3158)	(0.0565)		(0.5113)
Germany	0.0185**	0.1770	-0.1275**	0.8530	4.1942
	(0.0094)	(0.3604)	(0.0601)		(0.5218)
Greece	0.0186**	0.3227	-0.1567**	0.8146	4.5617
	(0.0086)	(0.3358)	(0.0704)		(0.4717)
Ireland	0.0101*	0.0934	-0.0754**	0.9337	5.2348
	(0.0053)	(0.1691)	(0.0337)		(0.3879)
Italy	0.0202**	0.1799	-0.1151**	0.8481	4.9266
	(0.0088)	(0.3029)	(0.0545)		(0.4249)
Luxembourg	0.0193**	0.1833	-0.1155**	0.8488	3.7898
	(0.0089)	(0.3123)	(0.0541)		(0.5801)
Netherlands	0.0202**	0.2219	-0.1102**	0.8492	4.0451
	(0.0090)	(0.3257)	(0.0551)		(0.5429)
Portugal	0.0135	0.1850	-0.1351**	0.8482	3.5674
	(0.0103)	(0.3201)	(0.0600)		(0.6132)
Spain	0.0194**	0.2154	-0.1300**	0.8525	3.9754
	(0.0094)	(0.3056)	(0.0591)		(0.5530)

Notes: We estimate equation (5) by IV/GMM with country and period fixed-effects and exclude one country at a time. We report robust standard errors in parentheses and results are significant at 1% level ('***'), 5% level ('**') and 10% level ('*').
Source: OECD Economic Outlook vintages (Dec. 1996 – Dec. 2017), authors' calculations.

not provide evidence of a procyclical fiscal consolidation in OECD or Euro Area countries. It remains though that the point estimates of the surplus-debt feedback coefficients are generally larger in downturns than in upturns in the Euro Area. Fourth, the real-time information of a deep recession does not produce a counter-cyclical fiscal reaction in the Euro Area: the discretionary fiscal stance is a-cyclical. In the context of COVID-19 crisis and, more importantly in the context of post-COVID-19 crisis, these results point to the risk of procyclical fiscal impulses, while debt sustainability conditions would continue to be met.

We have checked whether evidence of procyclical *ex ante* discretionary fiscal policy is robust to an alternative measure of economy's position in the business cycle. Hence, we use a calibrated logistic transition function that addresses these two caveats. Our transition function takes into account the negative average of output gap forecasts, using a country-specific normalized output gap forecast measure, and allows for smooth-transition between upturns and downturns. This alternative measure of business cycle stance confirms our baseline findings. In addition, results do not seem to be driven by a single country, as estimates are fairly stable and robust to country exclusion.

Fiscal policy implementation, from *ex ante* fiscal plans to realized/*ex post* fiscal outcomes is beyond the scope of this paper but our conclusions on the first stage are complementing those found on the latter stage. For instance, Beetsma and Giuliodori (2010) found that EU countries tend to react procyclically in the implementation stage, while other OECD countries react a-cyclically. Finally, in this paper, we focused on the discretionary component of fiscal policy and studied the reaction of the structural primary surplus to the macroeconomy. It remains that a large part of fiscal countercyclicality comes from automatic stabilizers (Aldama and Creel, 2018). Further research may therefore focus on the interactions between cyclical and cyclically-adjusted fiscal policies: by how much does procyclical discretionary fiscal policy counteract the countercyclical

Table 7: Robustness to country exclusion for the OECD-19 panel

Excluded country	**Surplus-debt coefficient**	**Output gap in upturns**	**Output gap in downturns**	**Adjusted R^2**	**Sargan J-stat (p-value)**
Australia	0.0165***	0.1128	-0.1030**	0.8798	5.6052
	(0.0056)	(0.2778)	(0.0495)		(0.3465)
Austria	0.0143**	0.0903	-0.1021**	0.8778	3.8870
	(0.0056)	(0.2807)	(0.0508)		(0.5658)
Belgium	0.0142**	0.0892	-0.1009**	0.8668	3.9415
	(0.0057)	(0.2819)	(0.0513)		(0.5579)
Canada	0.0141**	0.1334	-0.1027**	0.8720	3.8126
	(0.0055)	(0.2747)	(0.0488)		(0.5767)
Denmark	0.0117**	0.1261	-0.1144**	0.8777	3.4382
	(0.0057)	(0.3024)	(0.0505)		(0.6328)
Finland	0.0130**	0.0486	-0.1071**	0.8754	3.2073
	(0.0057)	(0.2890)	(0.0523)		(0.6681)
France	0.0139**	0.0938	-0.1011**	0.8741	3.9945
	(0.0059)	(0.2807)	(0.0511)		(0.5502)
Germany	0.0144**	0.0556	-0.1022*	0.8783	4.0093
	(0.0057)	(0.3121)	(0.0546)		(0.5481)
Greece	0.0135**	0.1130	-0.1244*	0.8589	3.7626
	(0.0056)	(0.3060)	(0.0693)		(0.5841)
Ireland	0.0097***	0.1517	-0.0451	0.9369	7.3894
	(0.0032)	(0.1398)	(0.0346)		(0.1933)
Italy	0.0149***	0.0935	-0.1031**	0.8740	3.8714
	(0.0055)	(0.2767)	(0.0506)		(0.5681)
Luxembourg	0.0150***	0.0922	-0.0962*	0.8762	3.8657
	(0.0056)	(0.2801)	(0.0500)		(0.5689)
Netherlands	0.0157***	0.1006	-0.0928*	0.8761	4.1467
	(0.0056)	(0.2881)	(0.0511)		(0.5285)
New Zealand	0.0144***	0.0933	-0.0993**	0.8769	3.9495
	(0.0055)	(0.2795)	(0.0499)		(0.5567)
Portugal	0.0120*	0.0826	-0.1067**	0.8773	3.3153
	(0.0062)	(0.2858)	(0.0538)		(0.6515)
Spain	0.0160***	0.1088	-0.0986*	0.8778	3.3768
	(0.0058)	(0.2786)	(0.0530)		(0.6421)
Sweden	0.0147**	0.0883	-0.0975*	0.8752	4.1803
	(0.0065)	(0.2970)	(0.0519)		(0.5238)
United Kingdom	0.0144***	0.0933	-0.0993**	0.8769	3.9495
	(0.0055)	(0.2795)	(0.0499)		(0.5567)
United States	0.0144***	0.0933	-0.0993**	0.8769	3.9495
	(0.0055)	(0.2795)	(0.0499)		(0.5567)

Notes: We estimate equation (5) by IV/GMM with country and period fixed-effects and exclude one country at a time. We report robust standard errors in parentheses and results are significant at 1% level ('***'), 5% level ('**') and 10% level ('*').
Source: OECD Economic Outlook vintages (Dec. 1996 – Dec. 2017), authors' calculations.

role of automatic stabilizers?

A Appendix

A.1 Debt-stability and fiscal policy inertia

We derive the debt-stability conditions of Daniel and Shiamptanis (2013) in a stylized debt-accounting model. Let b_t denotes the debt-to-GDP ratio, which evolves according the following simplified equation:

$$b_t = (1+x)b_{t-1} - s_t + v_t \tag{8}$$

where $x \equiv (r-y)/(1+y)$ and v_t stands for the stock-flow adjustments. Let s_t denotes the primary surplus, which evolves according the following fiscal policy rule with inertia:

$$s_t = \rho s_{t-1} + \gamma b_{t-1} + \mu_t \tag{9}$$

where μ_t gathers the transitory and the discretionary components of primary surplus, as well as the steady-state values of primary surplus and public debt. Finally, we assume $\rho \in [0,1]$.

For the sake of simplicity, we assume constant interest rates r and output growth rates y but it can easily be shown that it is equivalent to study the stability of a linearized version around the steady-state of the model. Alternatively, Daniel and Shiamptanis (2013) solve the model by isolating capital losses due to default, which ends up in using equation (8) where v_t contains expected capital losses.

Define $Y_t = (b_t, s_t)'$ and $\epsilon_t = (v_t, \mu_t)$ and rewrite the previous equations (8) and (9) as the following VAR model:

$$Y_t = AY_{t-1} + B\epsilon_t \tag{10}$$

where

$$A = \begin{pmatrix} 1+x-\gamma & -\rho \\ \gamma & \rho \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} 1 & -1 \\ 0 & 1 \end{pmatrix}$$

We study the stability of public as the stationarity conditions for the VAR model (10). The characteristic polynominal associated to (10) is $\lambda^2 - Tr(A)\lambda + Det(A) = 0$ where $Tr(A) = 1 + x - \gamma + \rho$ and $Det(A) = (1+x)\rho$.

First, a necessary condition such that at least one root lies within the unit-circle is that $|Det(A)| < 1$ which defines a upper-bound on fiscal policy inertia:

$$\rho < \rho^{max} \equiv \frac{1}{1+x} \tag{11}$$

Then, we must find a condition on γ such that the largest root lies within the unit circle. Two cases can arise. First, the system admits two or one real real roots, i.e. $\Delta = Tr(A)^2 - 4Det(A) \geq 0$. In that case, after any shock, public debt converges a-periodically toward its steady-state. Second, the system admits two complex roots (i.e. $\Delta \leq 0$) and public debt displays oscillatory (or periodic) convergence toward steady-state. After some algebra, one can show that the system will be oscillating if and only if the feedback coefficient on debt γ is *strictly larger* than the following threshold $\bar{\gamma}$, that is:

$$\gamma > \bar{\gamma} \equiv 1 + x + \rho - 2\sqrt{(1+x)\rho} \tag{12}$$

Aperiodic convergence. In the case $\gamma < \bar{\gamma}$, the largest root has a modulus lower than 1 if and only if:

$$-1 < \frac{Tr(A) + \sqrt{Tr(A)^2 - 4Det(A)}}{2} < 1$$

We focus on the right-hand side of the inequality and we rewrite it

$$(1 + x + \rho - \gamma)^2 - 4(1 + x)\rho < (1 - (x + \rho - \gamma))^2$$

which yields, after some algebra, the following condition:

$$\gamma > (1 - \rho)x \quad \text{or} \quad \gamma^{LR} > x \tag{13}$$

The left-hand side of the inequality would yield economically meaningless upper-bound for γ so we ignore it, following Bohn (1998), Daniel and Shiamptanis (2013).

In the special case $\gamma = \bar{\gamma}$, the system admits aperiodic convergence, provided $\rho \in [0, \rho^{max})$ and admits a double real root $\lambda = \sqrt{(1 + x)\rho}$

Periodic convergence. In the case $\gamma > \bar{\gamma}$, provided $\rho \in [0, \rho^{max})$, the system admits two complex conjugate roots of modulus:

$$|z| = |\bar{z}| = \sqrt{\left(\frac{Tr(A)}{2}\right)^2 + \left(\frac{\sqrt{|\Delta|}}{2}\right)^2}$$

such that:

$$|Tr(A)| = |z| + |\bar{z}|$$

from which we deduce that a condition for stability reduces to:

$$\frac{|Tr(A)|}{2} < 1$$

which immediately yields:

$$\frac{\gamma}{1 - \rho} > \frac{x}{1 - \rho} - 1$$

Then, recall that $\rho < \rho^{max} \equiv (1 + x)^{-1}$ and one can define an upper bound for the right-hand side of the previous inequality:

$$\frac{x}{1 - \rho} - 1 < \frac{x}{1 - \rho^{max}} - 1 = x$$

Finally, we find that

$$\gamma > (1 - \rho)x \tag{14}$$

is a *sufficient* condition for debt-stability, provided $\rho \in [0, \rho^{max})$.

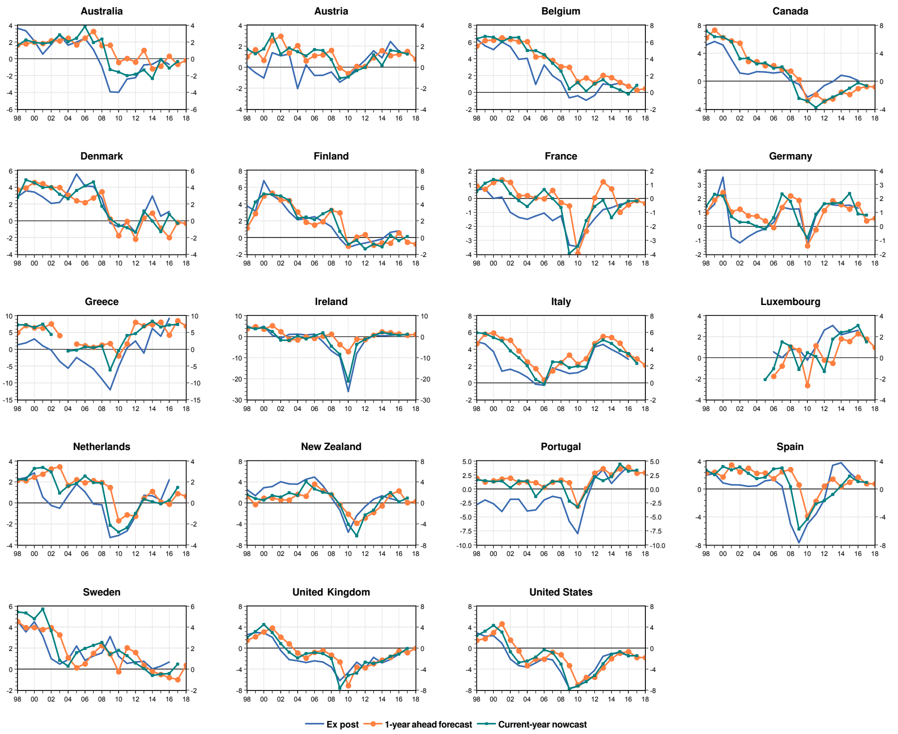
A.2 Dataset

Table 8: Descriptive statistics

	Structural primary surplus % of potential GDP			Output gap % of potential GDP			Gross financial public debt % of GDP		
	Ex post	Forecast	Nowcast	Ex post	Forecast	Nowcast	Ex post	Forecast	Nowcast
Mean	0.47	1.33	1.14	-0.65	-1.76	-1.70	74.0	74.4	74.2
Median	0.82	1.27	1.27	-0.56	-1.13	-1.21	68.4	67.2	67.5
Maximum	9.20	8.47	8.35	8.76	5.53	5.50	189.5	200.0	190.0
Minimum	-26.12	-7.18	-21.18	-15.09	-18.23	-15.16	9.0	3.7	4.5
Std. Dev.	3.14	2.47	2.92	3.00	2.77	2.70	34.5	35.1	34.6
Observations	407	407	407	417	407	407	416	408	408

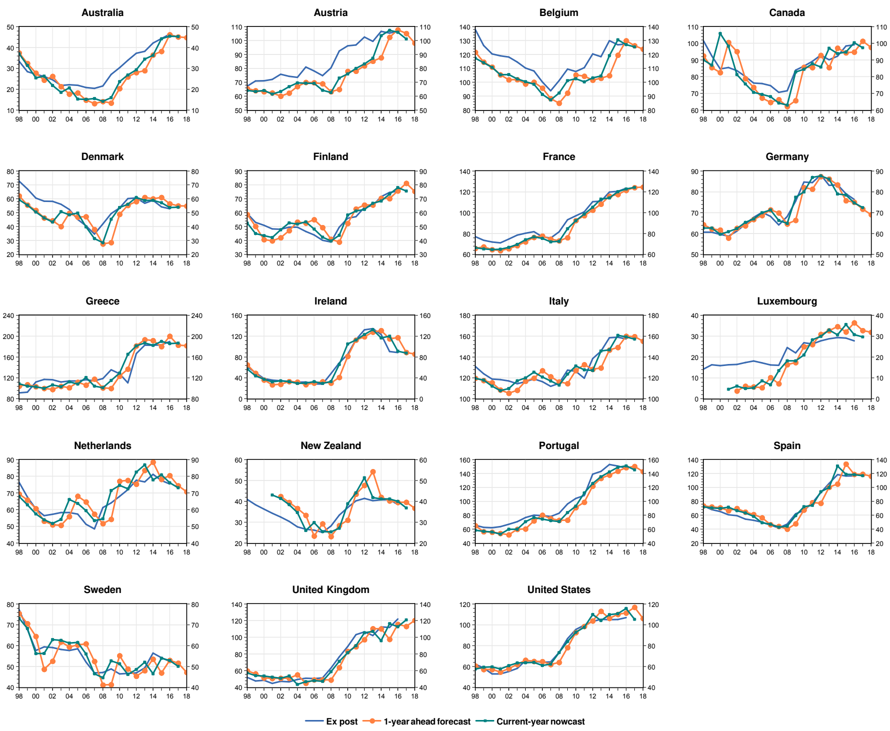
Notes: *Ex post* time series are those of the OECD Economic Outlook Dec. 2017. One-year ahead forecasts and current-year forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec.2017).

Figure 5: Structural primary surplus, in percentage of potential GDP



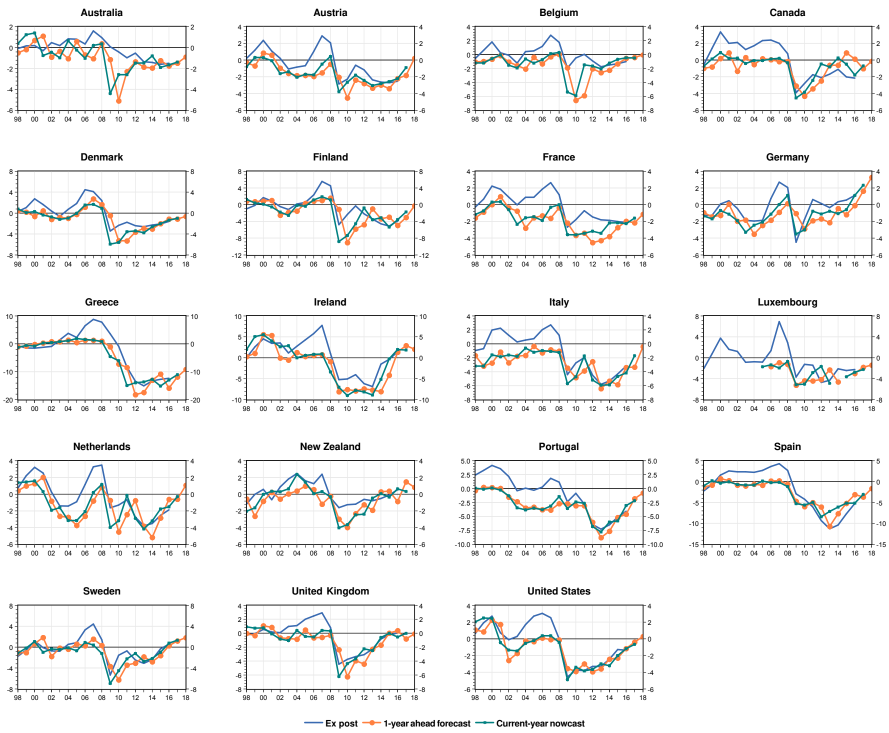
Notes: *Ex post* time series are those of the OECD Economic Outlook Dec. 2017. One-year ahead forecasts and current-year forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec.2017).

Figure 6: Government gross financial liabilities, in percentage of GDP



Notes: *Ex post* time series are those of the OECD Economic Outlook Dec. 2017. One-year ahead forecasts and current-year forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec.2017).

Figure 7: Output gap, in percentage of potential GDP



Notes: *Ex post* time series are those of the OECD Economic Outlook Dec. 2017. One-year ahead forecasts and current-year forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec.2017).

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ABOUT SCIENCES PO

Sciences Po is an institution of higher education and research in the humanities and social sciences. Its work in law, economics, history, political science and sociology is pursued through ten research units and several crosscutting programmes.
Its research community includes over two hundred twenty members and three hundred fifty PhD candidates. Recognized internationally, their work covers a wide range of topics including education, democracies, urban development, globalization and public health.
One of Sciences Po's key objectives is to make a significant contribution to methodological, epistemological and theoretical advances in the humanities and social sciences. Sciences Po's mission is also to share the results of its research with the international research community, students, and more broadly, society as a whole.

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