Real-time fiscal policy responses in the OECD from 1997 to 2018: procyclical but sustainable?

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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 evidence in favor of asymmetric fiscal policy along the business cycle, in particular regarding the response to output gap. Second, fiscal policy appears to be procyclical in downturns and a-cyclical in upturns. Third, we do not find significant evidence of a procyclical fiscal consolidation in the OECD. Our results are robust to an alternative estimator, to an alternative measure of business cycle and to country exclusion.

JEL: E61, E62, H6
Keywords: Fiscal policy rules, real-time data, asymmetric stabilization, fiscal consolidation

1 Introduction

After the global financial and the Covid-19 crises, most advanced and emerging countries have implemented large fiscal stimuli to dampen their economies from the real effects of the shocks. Meanwhile, they have also produced as a by-product a surge in public debt-to-GDP ratios. These fiscal reactions have then revived policy debates on the properties of fiscal decisions in terms of macroeconomic stabilization and debt sustainability.

This paper investigates these two properties by estimating fiscal reaction functions on a panel of OECD countries. Following Golinelli and Momigliano (2006) and Cimadomo (2012), we use various vintages of the OECD Economic Outlook (December Edition) to estimate these reaction functions in real-time (or *ex ante* fiscal reaction functions). Thus, we focus on fiscal *decisions*, hence on the discretionary fiscal stance, but not on fiscal outcomes. Fiscal outcomes are certainly important but they may overlook the knowledge that policymakers had on the economic and financial

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environment at the time of their decisions. As a matter of fact, fiscal outcomes are potentially blurred by posterior data revisions that do not give a clear picture of the set of information at the disposal of policymakers. In contrast, policymakers' decisions under the real-time set of information at their disposal give insight on the real-time priorities of policymakers and, for countries facing fiscal rules, on their compliance with these rules.

The paper replicates earlier studies on real-time asymmetric fiscal reaction functions (e.g. Cimadomo (2016) and Giuliodori and Beetsma (2008), but it does so using an extended dataset that includes a major crisis (2007-2009) and therefore more frequent negative output gaps. The paper thus updates earlier outcomes in a more unstable macroeconomic environment. In such an environment, fiscal decisions may be viewed as ever more important to stabilize the whole economy. Checking whether they did so is an objective of this paper, but it is not the only one. During the European crisis of 2011-2012, the timing of fiscal consolidation during bad times has been much debated. To our knowledge, we add to the literature in testing for the hypothesis that fiscal consolidation (i.e. the specific response of structural primary balance to the level of public debt) is procyclical. We also study whether EMU membership introduces any modification in the results and we therefore question policymakers' compliance with the existing rules.

Main results are threefold. First, we confirm that a symmetric fiscal policy rules is unlikely an accurate representation of real-time fiscal policy. In particular, the response of fiscal policy to the output gap is weakly significant, if not absent. Second, we also confirm that the impact of the output gap on the reaction function is non-linear; however, we add a new though expected result. Actually, testing for asymmetric reaction functions delivers contrasting results along the business cycle but it is noteworthy that it contradicts the conclusions of former papers. Fiscal policy appears to be procyclical in downturns and a-cyclical in upturns. Furthermore, procyclicality in downturns appears to come mainly from EMU countries. Third, results do not support evidence of a procyclical fiscal consolidation, i.e. a larger response of structural primary balance to public debt in downturns, which looks at odds with the criticisms against the application of fiscal rules, at least in European countries. Quite interestingly, this latter result works for EMU countries as well.

Our results are not sensitive to alternative estimator and specifications.The introduction of an Instrumental Variable General Method of Moments estimator to check for a possible endogeneity bias in the baseline estimations does not modify the results. We also 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 variable are likely to be too discrete and too simple to capture an economy's position in the business cycle. Hence, we use a simple 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. Using this alternative measure of business cycle stance confirms the baseline findings. In addition, results related to pro-cyclicality of fiscal policy 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 reaction functions whereas section. Section 3 provides a description of the dataset. Section 4 presents the empirical methodology and the results. Section 5 proposes the 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 reaction functions is Loukoianova and Vahey (2003) who applies Barro (1979)'s tax smoothing approach to US data. Since then, there have been only a few papers discussing and estimating fiscal reaction functions in real time. In contrast, the literature on *ex post* fiscal reaction function 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 reaction functions. 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 reaction functions on real-time data between 1995 and 2006 and then study the fiscal reactions to new information, particularly on economic activity.[1] 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

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

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 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 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 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 of 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.[2]

Figures 5–7 in Appendix A.2 report 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 7 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.

4 Empirical analysis

We turn to the empirical analysis in real-time. In particular, we investigate how discretionary fiscal policy, i.e. structural primary surplus, responds *ex ante* to expected output gap and to current estimates of public debt-to-GDP ratio and how it might vary along the business cycle, hence characterising some potential asymmetries.

4.1 Models

Fiscal reaction function and sustainability condition Theoretical (e.g. Benigno and Woodford (2004) or Fournier and Lieberknecht (2020) as well as empirical (e.g. Bohn (1998)) analyses of fiscal reaction functions generally introduce 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.

Here, we adopt the following general specification:

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

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 specifications diverge in three di-

[2]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.

rections from the usual framework of Bohn (1998). First, we do not include transitory real government spending.[3] Second, we choose the structural primary surplus rather than the primary surplus, which allow us to study the discretionary component of fiscal policy without having to control for automatic stabilisers and other transitory components. Third, we take into account fiscal policy inertia (or persistence), through the ρ parameter. To our knowledge, Daniel and Shiamptanis (2013, see eq. 14–16) have been the first to derive the stability conditions of public debt in presence of fiscal policy inertia in the a-periodic convergence case. 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: $\gamma^{LR} \equiv \gamma/(1-\rho) > x$ 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 for these conditions and further extends them to the periodic convergence case.

Specifications. We estimate various specifications of equation (1) on real-time panel data, with time and country fixed effects to account for unobserved heterogeneity. We start from the following baseline specification:

$$sps_{i,t|t-1} = \rho sps_{i,t-1|t-1} + \gamma b_{i,t-1|t-1} + \alpha_y \hat{y}_{i,t|t-1} + \alpha_i + \delta_t + \varepsilon_{i,t} \tag{2}$$

where α_i and δ_t are country and time fixed effects. The above specification postulates fiscal policy is symmetric along the business cycle. A positive (resp. negative) α_y implies countercyclical (resp. procyclical) discretionary fiscal policy.

Then we relax the symmetric 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:

$$\begin{aligned} sps_{i,t|t-1} &= \rho sps_{i,t-1|t-1} + \gamma b_{i,t-1|t-1} + \alpha_{y,1}\mathbb{1}(\hat{y}_{i,t|t-1} \geq 0)\hat{y}_{i,t|t-1} \\ &+ \alpha_{y,2}\mathbb{1}(\hat{y}_{i,t|t-1} < 0)\hat{y}_{i,t|t-1} + \alpha_i + \delta_t + \varepsilon_{i,t} \end{aligned} \tag{3}$$

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 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:

$$\begin{aligned} sps_{i,t|t-1} &= \rho sps_{i,t-1|t-1} + \gamma_1\mathbb{1}(\hat{y}_{i,t-1|t-1} \geq 0)b_{i,t-1|t-1} + \gamma_2\mathbb{1}(\hat{y}_{i,t-1|t-1} < 0)b_{i,t-1|t-1} \\ &+ \alpha_{y,1}\mathbb{1}(\hat{y}_{i,t|t-1} \geq 0)\hat{y}_{i,t|t-1} + \alpha_{y,2}\mathbb{1}(\hat{y}_{i,t|t-1} < 0)\hat{y}_{i,t|t-1} + \alpha_i + \delta_t + \varepsilon_{i,t} \end{aligned} \tag{4}$$

[3]In Barro (1979) and Bohn (1998, 2008) this measure is constructed as the difference between the observed real government spending and the permanent component of real government spending. The permanent component 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).

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

4.2 Baseline results

In the following, we report the results of estimated equations (2)–(4) on a panel of 19 OECD countries (see Table 1), also adding a dummy for EMU membership (see Table 2).

Evidence of procyclical fiscal policy

The baseline symmetric specification (2) suggests a globally procyclical fiscal policy, as the estimated *ex ante* response to expected output gap is negative. Interestingly, an asymmetric specification shows evidence of differentiated responses to output gap in terms of sign, magnitude and precision. The coefficient associated to zero or positive output gap is always positive but never statistically significant[4].In contrast, we find evidence of a highly significant procyclical response of structural primary surplus to output gap in *downturns*. Consequently, results suggest that discretionary fiscal policy is a-cyclical in upturns while significantly procyclical in downturns.

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**
$sps_{i,t-1\|t-1}$	0.6005***	0.5873***	0.5883***
	(0.0421)	(0.0411)	(0.0414)
$b_{i,t-1\|t-1}$	0.0144***	0.0143***	
	(0.0050)	(0.0048)	
$\hat{y}_{i,t\|t-1}$	-0.0936**		
	(0.0381)		
$\hat{y}_{i,t\|t-1} \geq 0$		0.1642	0.1341
		(0.1745)	(0.1944)
$\hat{y}_{i,t\|t-1} < 0$		-0.1278***	-0.1332***
		(0.0389)	(0.0390)
$b_{i,t-1\|t-1} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$			0.0159***
			(0.0058)
$b_{i,t-1\|t-1} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$			0.0142***
			(0.0048)
γ^{LR}	0.036	0.035	
$\gamma^{LR} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$			0.039
$\gamma^{LR} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$			0.034
Adj. R^2	0.881	0.884	0.883
Durbin-Watson	1.84	1.85	1.86
Cross-sections	19	19	19
Periods	22	22	22
Obs. (unbalanced)	402	402	402

Notes: Equations are estimated with LSDV estimator and country and time 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.

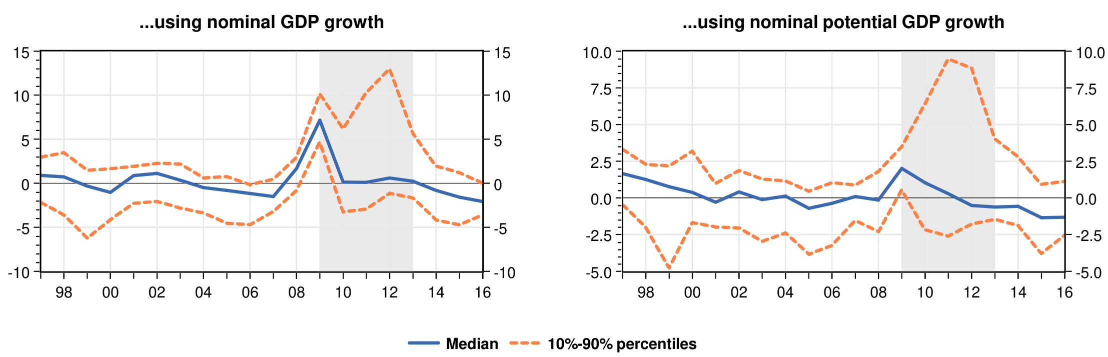
[4] These findings must yet be interpreted cautiously given forecast and nowcast output gap series tend to be negative on average, which reduces the number of observations of zero or positive expected output gap, see Figure 7 and Table 7 in Appendix A.2. We address this problem in Section 5.

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*, particularly in economic expansions. In this paper, we find a positive (but non-significant) point estimates associated to output gap in expansions. The main reason for these opposite conclusions lies on differences in the datasets, both in terms of years and countries covered. His dataset started in 1994 and ended up in 2006 and did not cover the Great Recession, the Sovereign Debt Crisis and the subsequent Euro Area 2011-2013 recession; in comparison, our dataset covers years up to 2018. He also included Japan and Norway, which we excluded from our panel[5], whereas we added two other countries: New Zealand and Luxembourg. If we restrain our sample on the years 1997-2006, we find relatively similar results, with a significant countercyclical fiscal policy in expansions in the OECD, consistent with Cimadomo (2012, see table 4).[6] Still, we also find a significant procyclical fiscal policy in recessions in contrast with his results.

Debt stabilization

One striking result of our estimates is that the surplus-debt short-run coefficient γ is always found to be positive and strongly significant across specifications. 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, above 3.5%. Except in 2009 if we look at the median or except during the crisis years (2009-2013) if we look at the 90th percentile of the interest rate-growth differential, estimated average long-run surplus-debt coefficients are above the interest rate-growth differential, whatever GDP or potential GDP growth is considered (see Figure 1). 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.

Figure 1: 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.

[5] This choice is motivated in section 3.
[6] Available from the authors upon request.

Fiscal consolidation

We test the hypothesis that governments' reactions towards public debt may have been contingent to the business cycle. We introduce a possible distinction between these reactions in upturns and downturns and wonder whether fiscal consolidation (to stabilize debt) has been more prone to occur during downturns than during upturns. Between 2011 and 2013, many euro area countries have had to limit their deficits and debts to escape the financial turmoil that had first erupted in Greece, but they did so during a recession. We wish to investigate whether governments have deliberately decided to reduce their public debt during a downturn, and more so than if they had been in an upturn. We may also expect that this possible reaction during downturns has been compensated by fiscal fatigue from governments unable to have their primary surplus keep pace with the increase in their public debt (see Ghosh et al. (2013) and Checherita-Westphal and Žd'árek (2017)).

We do not find significant evidence of asymmetries in the response to government gross debt along the business cycle. We observe similar coefficients in downturns and upturns. Overall, these results do not provide evidence of a bias towards procyclical fiscal consolidation during periods of negative output gaps. They do not provide evidence of fiscal fatigue during downturns either.

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 acyclicality within non-EMU countries, using our baseline symmetric specification. The asymmetric stabilization specification shows that EMU fiscal policy is particularly procyclical in downturns; while it is acylical in upturns. For non-EMU countries, coefficients associated to output gap are not significan and point to a acyclicality in all specifications. Second, we find no 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. To sum up, the distinction between EMU and non-EMU countries does not have an impact on fiscal reaction *vis-à-vis* public debt but it has a major one as regards the cyclical features of fiscal reaction functions. The procyclical property of fiscal policies in downturns is entirely atributed to EMU countries.

5 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 an Intrumental Variable estimator, to a business cycle measure smoother than dummy variables for expected positive and negative gaps, or to country exclusion.

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**
$sps_{i,t-1\|t-1}$	0.5953***	0.5878***	0.5878***
	(0.0411)	(0.0407)	(0.0413)
$\mathbb{1}_{EMU,t} \times b_{i,t-1\|t-1}$	0.0134**	0.0129**	
	(0.0052)	(0.0052)	
$(1-\mathbb{1}_{EMU,t}) \times b_{i,t-1\|t-1}$	0.0106**	0.0116**	
	(0.0049)	(0.0048)	
$\mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1}$	-0.1051***		
	(0.0404)		
$(1-\mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1}$	0.0690		
	(0.0515)		
$\mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1} \geq 0$		0.1417	0.1410
		(0.2208)	(0.2509)
$\mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1} < 0$		-0.1370***	-0.1373***
		(0.0416)	(0.0406)
$(1-\mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1} \geq 0$		0.0935	0.0858
		(0.1608)	(0.1576)
$(1-\mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1} < 0$		0.0684	0.0668
		(0.0604)	(0.0620)
$\mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0) \times b_{i,t-1\|t-1}$			0.0129**
			(0.0063)
$\mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0) \times b_{i,t-1\|t-1}$			0.0128**
			(0.0052)
$(1-\mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0) \times b_{i,t-1\|t-1}$			0.0119*
			(0.0063)
$(1-\mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0) \times b_{i,t-1\|t-1}$			0.0116**
			(0.0048)
$\gamma^{LR} \times \mathbb{1}_{EMU,t}$	0.033	0.031	
$\gamma^{LR} \times (1-\mathbb{1}_{EMU,t})$	0.026	0.028	
$\gamma^{LR} \times \mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$			0.031
$\gamma^{LR} \times \mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$			0.031
$\gamma^{LR} \times (1-\mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$			0.029
$\gamma^{LR} \times (1-\mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$			0.028
Adj. R^2	0.886	0.888	0.887
Durbin-Watson	1.93	1.95	1.95
Cross-sections	19	19	19
Periods	22	22	22
Obs. (unbalanced)	402	402	402

Notes: Equations are estimated with LSDV estimator country and time 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.

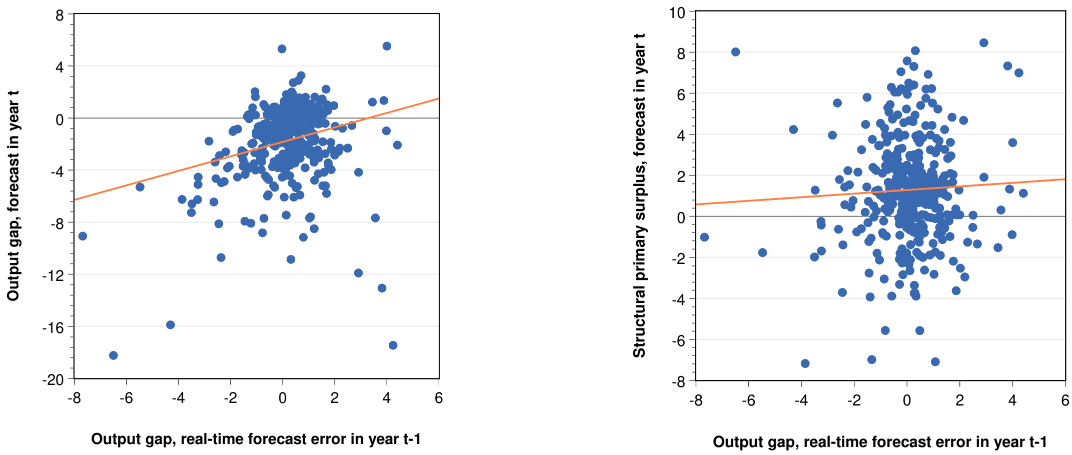
5.1 Endogeneity biases and instruments selection.

Equations (2), (3) and (4) are potentially subject to several endogeneity biases: reverse causality bias between structural primary surplus and output gap and simultaneity biases induced by monetary-fiscal interactions (Cochrane, 2001). We therefore use IV-GMM estimates to 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).

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 2.[7] Third, we use the previous period forecasts of the *first-difference* of short-term nominal interest rate, and nominal effective exchange rate.

Figure 2: 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).

One major difference between the baseline estimates with LSDV estimator and their counterparts with IV estimator (see Table 3) has to do with the weakly significant impact of the output gap on fiscal reaction in the latter setting. The point estimate is also lower than in the initial setting. Quite interestingly, this weakly significant procyclical feature on the whole sample hides a difference between EMU and non-EMU countries (see Table 4). In the baseline linear case, EMU governments continue to present a procyclical behaviour whereas non-EMU governments now present a countercyclical behaviour. This latter result is confirmed in the case of a recession, but not during an upturn and not if reaction to public debt is made contingent to the business cycle. All in all, the result of pro-cyclicality in EMU countries, mostly so during downturns, and a-cyclicality in non-EMU countries is confirmed with IV estimator. Results with IV estimator also confirm other outcomes obtained with LSDV estimator under an asymmetric specification. First, fiscal reaction functions fulfil the debt sustainability criterion, and in most cases, its long-

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

run value is higher than with the LSDV estimator [8].Second, there is no evidence of asymmetry in fiscal consolidation between upturns and downturns.

Table 3: Real-time fiscal policy rules in 19 OECD countries (1997-2018), IV/GMM

Dependent variable: $sps_{i,t\|t-1}$	**Baseline**	**Asymmetric stabilization**	**Asymmetric stab. and consolidation**
$sps_{i,t-1\|t-1}$	0.6919***	0.6819***	0.6849***
	(0.0498)	(0.0487)	(0.0497)
$b_{i,t-1\|t-1}$	0.0148***	0.0144***	
	(0.0056)	(0.0055)	
$\hat{y}_{i,t\|t-1}$	-0.0751*		
	(0.0448)		
$\hat{y}_{i,t\|t-1} \geq 0$		0.0933	-0.2160
		(0.2795)	(0.4416)
$\hat{y}_{i,t\|t-1} > 0$		-0.0993**	-0.1219**
		(0.0499)	(0.0487)
$b_{i,t-1\|t-1} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$			0.0241**
			(0.0115)
$b_{i,t-1\|t-1} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$			0.0137***
			(0.0055)
γ^{LR}	0.048	0.045	
$\gamma^{LR} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$			0.077
$\gamma^{LR} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$			0.044
Sargan J-stat	3.743	3.593	3.453
p-value	0.59	0.61	0.63
Adj. R^2	0.875	0.877	0.872
Durbin-Watson	2.00	2.01	2.05
Cross-sections	19	19	19
Periods	21	21	21
Obs. (unbalanced)	381	381	381

Notes: Equations are estimated with IV/GMM estimator and country and time 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.

5.2 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:

$$F(x_{i,t|t-1}) = \frac{\exp(-\theta x_{i,t|t-1})}{1 + \exp(-\theta x_{i,t|t-1})} \tag{5}$$

The variable $x_{i,t|t-1}$ is the normalized output gap forecast at time $t-1$ for period t for country i

[8]The case of non-EMU governments during a downturn when fiscal consolidation is made contingent to the business cycle is the exception.

Table 4: Real-time fiscal policy rules in the OECD: EMU membership (1997-2018), IV/GMM

Dependent variable: $sps_{i,t\|t-1}$	**Baseline**	**Asymmetric stabilization**	**Asymmetric stab. and consolidation**
$sps_{i,t-1\|t-1}$	0.6673***	0.6654***	0.6545***
	(0.0472)	(0.0432)	(0.0571)
$\mathbb{1}_{EMU,t} \times b_{i,t-1\|t-1}$	0.0129**	0.0123**	
	(0.0058)	(0.0056)	
$(1 - \mathbb{1}_{EMU,t}) \times b_{i,t-1\|t-1}$	0.0058	0.0061	
	(0.0053)	(0.0049)	
$\mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1}$	-0.0976**		
	(0.0482)		
$(1 - \mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1}$	0.1184**		
	(0.0540)		
$\mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1} \geq 0$		0.0348	-0.0466
		(0.3299)	(0.4687)
$\mathbb{1}_{EMU,t} \times \hat{y}_{i,t\|t-1} < 0$		-0.1121**	-0.1239**
		(0.0536)	(0.0511)
$(1 - \mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1} \geq 0$		0.1035	-0.3840
		(0.2533)	(0.8883)
$(1 - \mathbb{1}_{EMU,t}) \times \hat{y}_{i,t\|t-1} < 0$		0.1216*	0.0573
		(0.0672)	(0.1330)
$\mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0) \times b_{i,t-1\|t-1}$			0.0158
			(0.0118)
$\mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0) \times b_{i,t-1\|t-1}$			0.0116*
			(0.0059)
$(1 - \mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0) \times b_{i,t-1\|t-1}$			0.0258
			(0.0362)
$(1 - \mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0) \times b_{i,t-1\|t-1}$			0.0089
			(0.0077)
$\gamma^{LR} \times \mathbb{1}_{EMU,t}$	0.039	0.037	
$\gamma^{LR} \times (1 - \mathbb{1}_{EMU,t})$	0.017	0.018	
$\gamma^{LR} \times \mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$			0.046
$\gamma^{LR} \times \mathbb{1}_{EMU,t} \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$			0.034
$\gamma^{LR} \times (1 - \mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} \geq 0)$			0.075
$\gamma^{LR} \times (1 - \mathbb{1}_{EMU,t}) \times \mathbb{1}(\hat{y}_{i,t-1\|t-1} < 0)$			0.026
Sargan J-stat	3.743	3.593	3.453
p-value	0.59	0.61	0.63
Adj. R^2	0.884	0.885	0.879
Durbin-Watson	2.11	2.12	2.11
Cross-sections	19	19	19
Periods	21	21	21
Obs. (unbalanced)	381	381	381

Notes: Equations are estimated with IV/GMM estimator and country and time 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.

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 period t.[9]

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

[9]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.

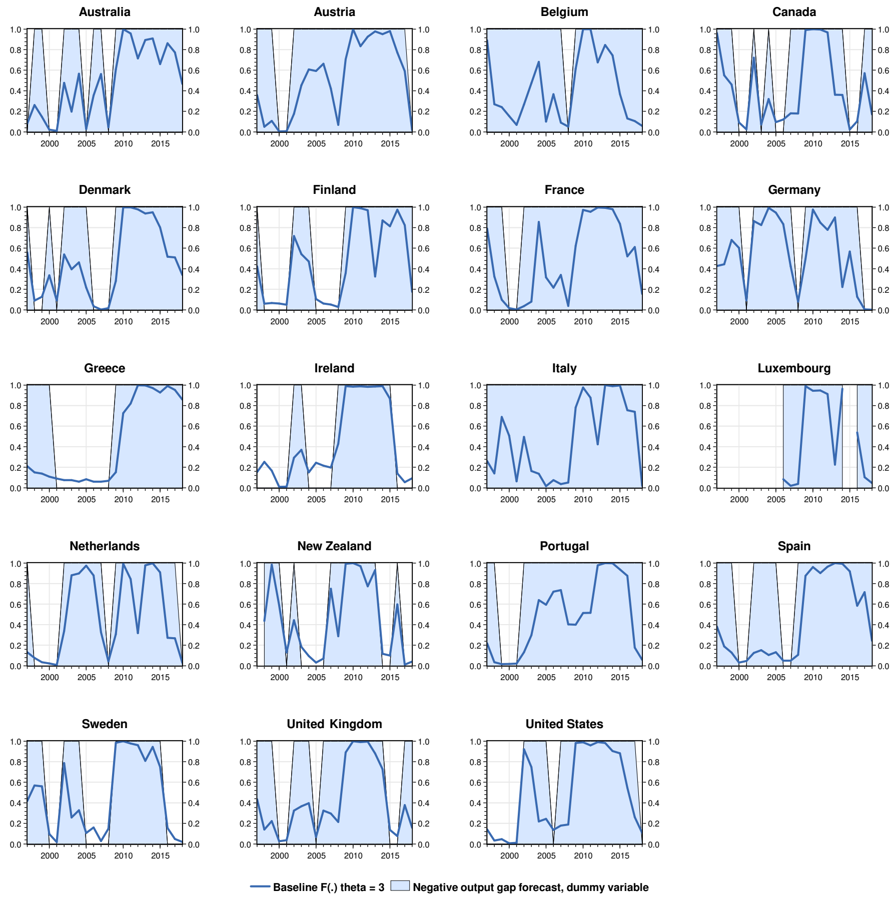
Table 5: Robustness to business cycle measure $F(x_{i,t|t-1})$

Dependent variable: $sps_{i,t\|t-1}$	**Asymmetric stabilization**		**Asymmetric stab. and consolidation**	
	OECD-19	OECD-19 with EMU dummy	OECD-19	OECD-19 with EMU dummy
$sps_{i,t-1\|t-1}$	0.5914***	0.5911***	0.5883***	0.5765***
	(0.0415)	(0.0408)	(0.0412)	(0.0406)
$b_{i,t-1\|t-1}$	0.0143***			
	(0.0049)			
$b_{i,t-1\|t-1} \times \mathbb{1}_{EMU,t}$		0.0137***		
		(0.0051)		
$b_{i,t-1\|t-1} \times (1 - \mathbb{1}_{EMU,t})$		0.0108**		
		(0.0049)		
$b_{i,t-1\|t-1} \times (1 - F(x_{i,t\|t-1})$			0.0131***	
			(0.0053)	
$b_{i,t-1\|t-1} \times (1 - F(x_{i,t\|t-1}) \times \mathbb{1}_{EMU,t}$				0.0118***
				(0.0055)
$b_{i,t-1\|t-1} \times (1 - F(x_{i,t\|t-1}) \times (1 - \mathbb{1}_{EMU,t})$				0.0118**
				(0.0057)
$b_{i,t-1\|t-1} \times (1 - F(x_{i,t\|t-1})$			0.0156***	
			(0.0050)	
$b_{i,t-1\|t-1} \times (1 - F(x_{i,t\|t-1}) \times \mathbb{1}_{EMU,t}$				0.0184***
				(0.0056)
$b_{i,t-1\|t-1} \times (1 - F(x_{i,t\|t-1}) \times (1 - \mathbb{1}_{EMU,t})$				0.0074
				(0.0050)
$\hat{y}_{i,t\|t-1} \times (1 - F(x_{i,t\|t-1})$	0.0466		0.0570	
	(0.1120)		(0.1134)	
$\hat{y}_{i,t\|t-1} \times (1 - F(x_{i,t\|t-1}) \times (1 - \mathbb{1}_{EMU,t})$		0.0349		0.0632
		(0.1362)		(0.1355)
$\hat{y}_{i,t\|t-1} \times (1 - F(x_{i,t\|t-1}) \times \mathbb{1}_{EMU,t}$		-0.0239		-0.0586
		(0.1265)		(0.1349)
$\hat{y}_{i,t\|t-1} \times F(x_{i,t\|t-1})$	-0.1124***		-0.0897*	
	(0.0381)		(0.0509)	
$\hat{y}_{i,t\|t-1} \times F(x_{i,t\|t-1}) \times \mathbb{1}_{EMU,t}$		-0.1194***		-0.0584
		(0.0389)		(0.0532)
$\hat{y}_{i,t\|t-1} \times F(x_{i,t\|t-1}) \times (1 - \mathbb{1}_{EMU,t})$		0.1008*		0.0300
		(0.0579)		(0.0847)
γ^{LR}	0.035			
$\gamma^{LR} \times \mathbb{1}_{EMU,t}$		0.033		
$\gamma^{LR} \times (1 - \mathbb{1}_{EMU,t})$		0.026		
$\gamma^{LR} \times (1 - F(x_{i,t\|t-1}))$			0.032	
$\gamma^{LR} \times F(x_{i,t\|t-1})$			0.038	
$\gamma^{LR} \times (1 - F(x_{i,t\|t-1})) \times \mathbb{1}_{EMU,t}$				0.028
$\gamma^{LR} \times (1 - F(x_{i,t\|t-1})) \times (1 - \mathbb{1}_{EMU,t})$				0.028
$\gamma^{LR} \times F(x_{i,t\|t-1}) \times \mathbb{1}_{EMU,t}$				0.043
$\gamma^{LR} \times F(x_{i,t\|t-1}) \times (1 - \mathbb{1}_{EMU,t})$				0.017
Adj. R^2	0.882	0.887	0.882	0.888
Durbin-Watson	1.850	1.952	1.844	1.931
Cross-sections	19	19	19	19
Periods	22	22	22	22
Obs. (unbalanced)	402	402	402	402

Notes: Equations are estimated with LSDV estimator and country and time 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.

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.

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

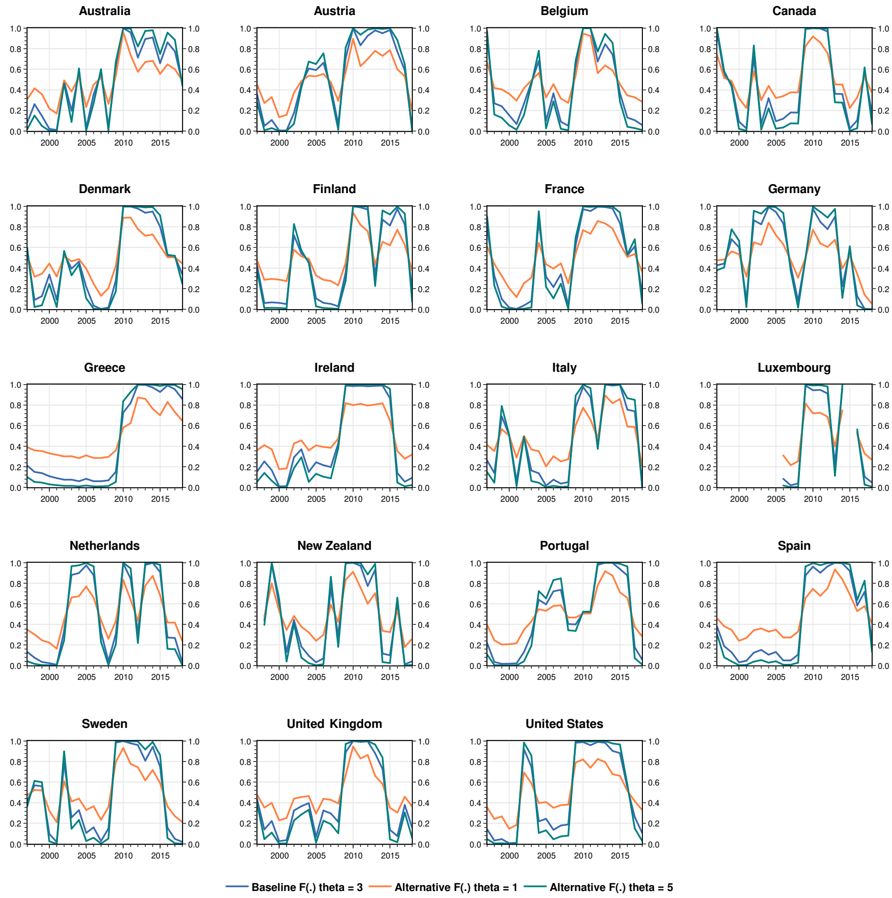


Notes: One-year ahead forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec.2017).

We re-estimate equations (3) and (4) by LSDV, using transition function $F(x_{i,t|t-1})$ with $\theta = 3$ and report results in Table 5. Results confirm the procyclical fiscal reaction during downturns on the full sample and more specifically in euro area countries. Debt sustainability is fulfilled in all cases; the debt-surplus coefficient ranges from 1.7% (for non-EMU countries during a downturn) to 4.3% (for EMU countries during a downturn). We find no evidence for EMU countries of debt stabilization depending on the business cycle position. In contrast, there is evidence of a statistically significant difference in debt stabilization during upturns and downturns in non-EMU countries. It remains that the last specification in Table 5 is the only exception for which fiscal reactions to business cycle positions are all non-significant. Running the same specification with IV/GMM give a different picture: fiscal reaction is procyclical in EMU countries during downturns whereas it is a-cyclical in non-EMU countries, and there is no distinct reaction to debt along the business cycles.[10]

[10]Results are available from the authors upon request.

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).

5.3 Country exclusion

We check whether our results are driven by a single country and focus on the asymmetric stabilization specification (3), which we estimate the OECD panel in real-time, excluding one country at a time. Table 6 report the estimates for our three key coefficients: surplus-debt coefficient, output gap coefficients in upturns and downturns, and we check whether they are significantly different from our baseline results reported in Table 1. First, we find that point estimates of coefficients related positive and negative output gaps are fairly stable and robust to country exclusion: coefficients associated to negative output gap are always negative and strongly significant, while coefficients associated to positive output gap are positive but rarely significant at 5% level. It confirms our main result that fiscal policy appears to be procyclical in downturns and likely acyclical. Second, we find that the coefficient associated to the public debt-to-GDP ratio (i.e. fiscal consolidation) is not robust to the exclusion of Ireland; in that case, point-estimate is lower than the average OECD and only significant at 10%. Yet, we would not interpret it as evidence that fiscal policy is not satisfying sustainability condition: using a IV/GMM estimator, this expection vanishes.[11]

[11] Results are available from the authors upon request.

Table 6: 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
Australia	0.0160***	0.1770*	-0.1281***	0.8860
	(0.0036)	(0.0926)	(0.0282)	
Austria	0.0143***	0.1670*	-0.1307***	0.8850
	(0.0036)	(0.0932)	(0.0285)	
Belgium	0.0139***	0.1593*	-0.1279***	0.8735
	(0.0037)	(0.0940)	(0.0286)	
Canada	0.0131***	0.1913**	-0.1253***	0.8779
	(0.0036)	(0.0925)	(0.0281)	
Denmark	0.0125***	0.1755*	-0.1336***	0.8840
	(0.0036)	(0.0969)	(0.0281)	
Finland	0.0138***	0.1471	-0.1344***	0.8832
	(0.0036)	(0.0942)	(0.0289)	
France	0.0143***	0.1621*	-0.1276***	0.8811
	(0.0037)	(0.0939)	(0.0288)	
Germany	0.0141***	0.1500	-0.1378***	0.8849
	(0.0036)	(0.0994)	(0.0294)	
Greece	0.0155***	0.2042**	-0.1577***	0.8717
	(0.0035)	(0.0928)	(0.0375)	
Ireland	0.0050*	0.1155	-0.0769***	0.9377
	(0.0028)	(0.0890)	(0.0215)	
Italy	0.0156***	0.1566*	-0.1289***	0.8812
	(0.0036)	(0.0919)	(0.0282)	
Luxembourg	0.0150***	0.1702*	-0.1259***	0.8830
	(0.0036)	(0.0924)	(0.0282)	
Netherlands	0.0149***	0.1930**	-0.1257***	0.8830
	(0.0036)	(0.0950)	(0.0290)	
New Zealand	0.0143***	0.1642*	-0.1278***	0.8835
	(0.0035)	(0.0913)	(0.0278)	
Portugal	0.0121***	0.1493	-0.1303***	0.8841
	(0.0038)	(0.0936)	(0.0293)	
Spain	0.0163***	0.1690*	-0.1234***	0.8835
	(0.0037)	(0.0935)	(0.0293)	
Sweden	0.0155***	0.1721*	-0.1256***	0.8829
	(0.0038)	(0.0954)	(0.0286)	
United Kingdom	0.0143***	0.1642*	-0.1278***	0.8835
	(0.0035)	(0.0913)	(0.0278)	
United States	0.0143***	0.1642*	-0.1278***	0.8835
	(0.0035)	(0.0913)	(0.0278)	

Notes: We estimate equation (3) by LSDV with country and time 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.

6 Conclusions

In this paper, we estimate real-time *ex ante* fiscal reaction functions on a panel of 19 OECD countries, including 12 Euro Area countries. It describes fiscal policy behavior 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 symmetric fiscal policy rules may not be an accurate representation of real-time fiscal policy. The response of fiscal policy to the output gap is weakly significant, if not absent. In contrast, we find significant evidence of asymmetries in fiscal reaction functions, in particular regarding the response to the output gap along the business cycle. Second, fiscal policy appears to be generally procyclical in downturns and a-cyclical in upturns. Third, our results do not significantly support evidence of a procyclical fiscal consolidation in the OECD. Third, results do not support evidence of a procyclical fiscal consolidation, i.e. a larger response of structural primary balance to public debt in downturns, which looks at odds with the criticisms against the application of fiscal rules, at least in European countries. Quite interestingly, this latter result works for EMU countries as well.

Our results are not sensitive to alternative estimator and specifications. Using a General Method of Moments estimator to check for possible endogeneity biases in Least-Square Dummy Variables estimations does not modify the results. We have also checked whether evidence of procyclical *ex ante* discretionary fiscal policy is robust to an alternative measure of economy's position in the business cycle. As a matter of fact, real-time output gap estimates and forecasts tend to be negative on average. Then 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. Hence, we use a simple 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. Using this alternative measure of business cycle stance, we confirm our baseline findings. Finally, our results related to pro-cyclicality of fiscal policy do not seem to be driven by a single country, as estimates for output gap coefficients 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 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:

$$b_t = (1+x)b_{t-1} - s_t + v_t \tag{6}$$

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:

$$s_t = \rho s_{t-1} + \gamma b_{t-1} + \mu_t \tag{7}$$

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 (6) 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 (6) and (7) as the following VAR model:

$$Y_t = AY_{t-1} + B\epsilon_t \tag{8}$$

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 (8). The characteristic polynominal associated to (8) 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:

$$\rho < \rho^{max} \equiv \frac{1}{1+x} \tag{9}$$

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:

$$\gamma > \bar{\gamma} \equiv 1 + x + \rho - 2\sqrt{(1+x)\rho} \tag{10}$$

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:

$$\gamma > (1 - \rho)x \quad \text{or} \quad \gamma^{LR} > x \tag{11}$$

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

$$\gamma > (1 - \rho)x \tag{12}$$

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

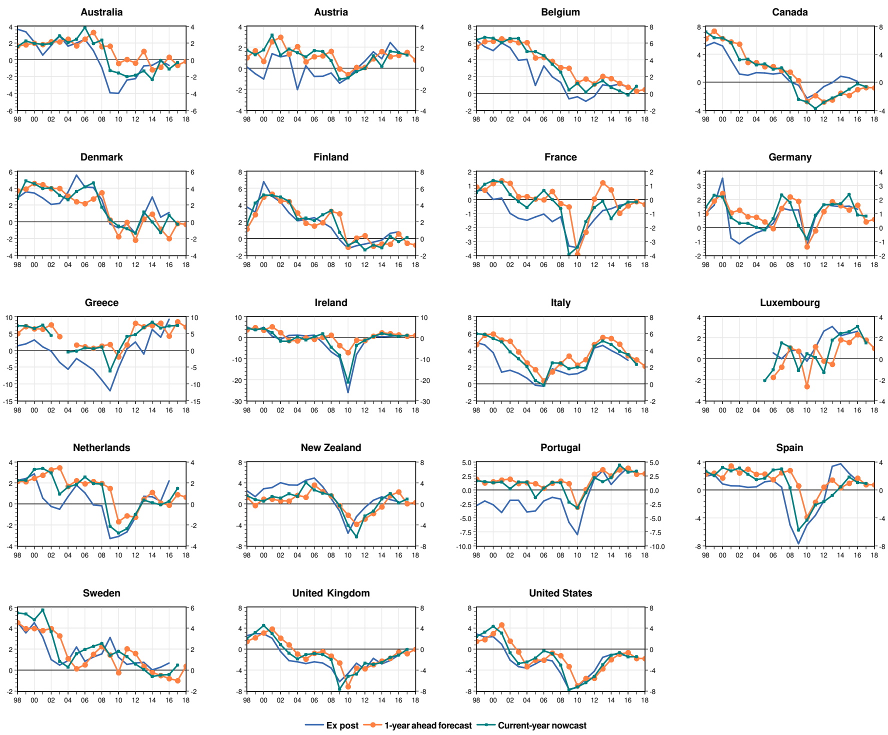
A.2 Dataset

Table 7: 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

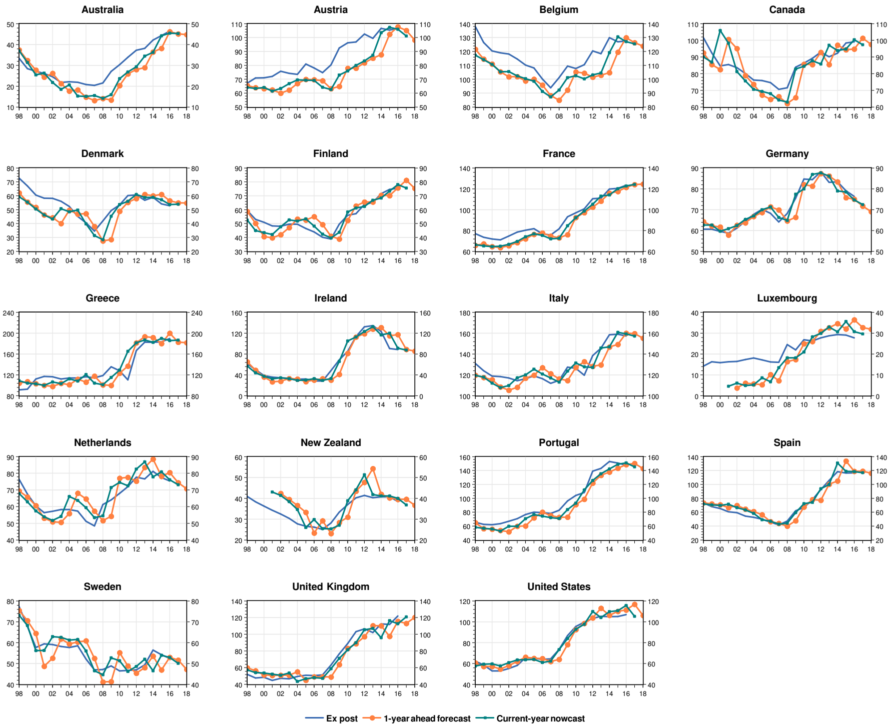
Notes: *Ex post* time series are those of the OECD Economic Outlook Dec. 2017. One-year ahead forecasts and current-year forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec.2017).

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



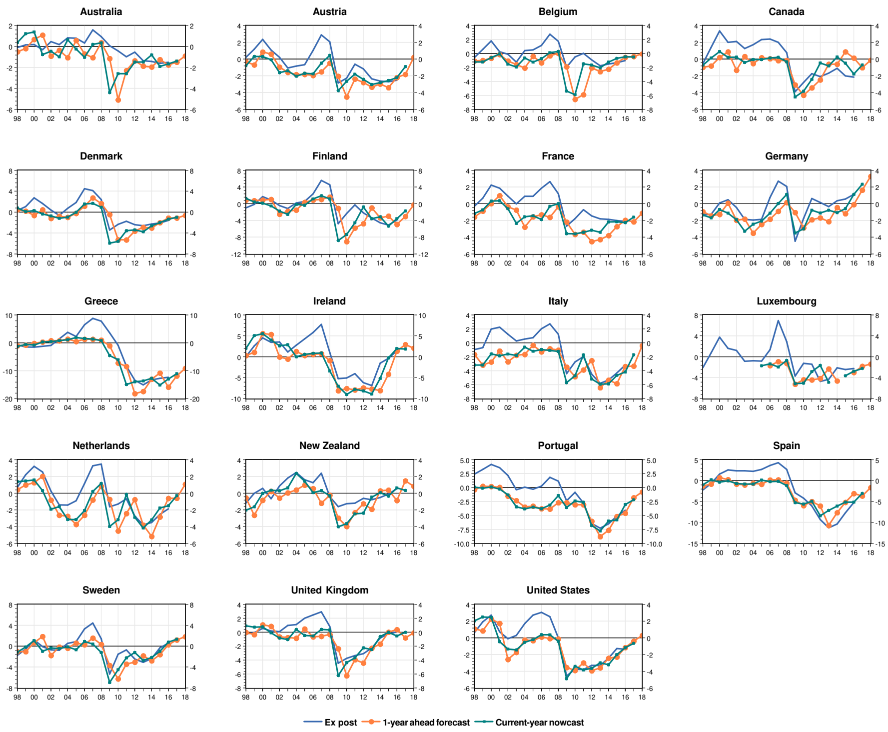
Notes: *Ex post* time series are those of the OECD Economic Outlook Dec. 2017. One-year ahead forecasts and current-year forecasts are taken from OECD Economic Outlook vintages (Dec. 1996–Dec.2017).

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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