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A Model-based Fiscal Taylor Rule and a Toolkit to  
Assess the Fiscal Stance

by Jean-Marc Fournier and Philipp Lieberknecht

**I N T E R N A T I O N A L M O N E T A R Y F U N D**

## IMF Working Paper

Fiscal Affairs Department

### A Model-based Fiscal Taylor Rule and a Toolkit to Assess the Fiscal Stance

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#### Abstract

This paper presents a model-based fiscal Taylor rule and a toolkit to assess the fiscal stance, defined as the change in the structural primary balance. This is built on the normative buffer-stock model of the government (Fournier, 2019) which includes key channels like hysteresis, cycle-dependent multipliers and a risk premium. A simple fiscal Taylor rule prescribes the fiscal stance as a function of past government debt, past output gap and the past structural primary balance. Applications suggest several advanced economies could have better managed their fiscal stance over the last 20 years. Simulations provide fiscal stance recommendations over the medium-term.

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<b>Content</b>	<b>Page</b>
ABSTRACT .....	2
I. INTRODUCTION .....	6
II. THE MODEL .....	9
A. The Economy .....	9
B. Calibrating the Model.....	13
III. THE TOOLBOX.....	16
A. Global Solution of the Model.....	16
B. A Simple Decomposition to Describe the Fiscal Stance Advice .....	18
C. A Linear Approximation: The Fiscal Taylor Rule .....	19
IV. APPLICATIONS.....	20
A. Historical Fit of the Model-based Fiscal Stance .....	20
B. Forward-Looking Simulation.....	22
C. Case Study 1: Germany.....	24
D. Case Study 2: France.....	25
E. Scenario Analysis with Structural Reforms or Various Fiscal Instruments .....	29
V. CONCLUSION.....	30
VI. REFERENCES .....	32
VII. APPENDIX .....	36
 <b>FIGURES</b>	
Figure 1. Fiscal Stance Toolkit Scheme .....	8
Figure 2. Baseline Fiscal Reaction Function to Debt .....	17
Figure 3: Forward-Looking Simulation for Germany .....	24
Figure 4. Decomposition of Fiscal Stance Advice in 2020 in Germany .....	25
Figure 5: Forward-Looking Simulation for France .....	26

Figure 6. Decomposition of Fiscal Stance Advice in 2020 in France .....	27
Figure 7. Fiscal Tightening by 2024 in France – Sensitivity analysis. Percent of GDP.....	27
Figure 8. Severe Recession in France .....	29
Figure 9. Fiscal Implications of Higher Potential Growth Boost in .....	30

## **TABLES**

Table 1. Common Parameters.....	14
Table 2. Country Specific Parameters .....	16
Table 3: Fiscal Taylor Rules in Advanced Economies .....	20
Table 4: Historical Fit of the Recommended Fiscal Stance.....	21
Table 5: Historical Fit of the Recommended Fiscal Stance with Real Time Output Gap .....	22

## I. INTRODUCTION

Providing advice on the fiscal stance in a country requires considering a large set of perspectives, which can be handled well with analytical tools. However, currently there is no tool available to IMF country teams and authorities to assess the fiscal stance.<sup>2</sup> This paper introduces such a tool, with the goal of informing policy discussions with a model-based analysis built on a consistent set of considerations, bringing more clarity and discipline.<sup>3</sup> For instance, the tool provides the factors driving the appropriate fiscal stance, and can relate year to year changes in advice on the appropriate fiscal stance to changes in the driving factors. The tool-based fiscal stance analysis serves as a useful starting point which can be refined with further available information and expert judgment.

This paper describes the toolkit and a fiscal Taylor rule designed to assess the appropriate fiscal stance. Fiscal stance is defined here as the change in the structural primary balance, encompassing all the discretionary decisions.<sup>4</sup> The toolkit can answer questions regarding government decisions such as: given its debt and deficit level and position in the cycle, should a country ease or tighten its fiscal stance? How should the government react in case of a large downturn? Was fiscal stimulus withdrawn too quickly after the global financial crisis?

The toolkit is built on the normative buffer-stock model of the government balance (Fournier, 2019), which computes the fiscal stance maximizing intertemporal welfare. The conceptual framework is a fiscal variant of the buffer-stock model of the consumer (Carroll, 1992/1997; Deaton 1991). The forward-looking benevolent government balances short-run economic stabilization and long-term consequences of debt. The tractable and parsimonious model focuses on the key links between fiscal stance, the economic cycle and public debt.

The model-based toolkit builds a bridge between the rich academic discussion on fiscal policy and practical implementation by policy makers. The literature on practical fiscal stance guidance is scarce, with papers assuming ad hoc objective functions for the government in terms of output gap and debt (Kanda, 2011) or an ad hoc rule of thumb (Carnot, 2014). This literature fits with policy makers' needs well as the policy discussion on fiscal stance driven by needs to stabilize the cycle and public debt risks. It also provides realistic quantitative recommendations that would have been difficult to derive from the academic discussion. However, in this practical literature, the government objective function

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<sup>2</sup> The closest issues for which the IMF relies on analytical tools are the Debt Sustainability Analysis and the Fiscal Space Assessment. These tools assess the extent to which countries *can* increase public debt. Our toolkit assesses the extent to which countries *should* increase (or decrease) public debt, depending on the position in the cycle.

<sup>3</sup> The toolkit consists of a Matlab code with documentation available upon request.

<sup>4</sup> This definition of the fiscal stance is commonly used by practitioners (e.g. Carnot, 2014; Bankowsky and Ferdinandusse, 2017).

requires an explicit assumption on relative weights of output gap and debt. These are either estimated based on observed fiscal stance, implicitly assuming these were optimal (Kanda, 2011), or arbitrary (Carnot, 2014). Bankowsky and Ferdinandusse (2017) consider the two objectives separately, arguing that the literature on fiscal reaction functions does not provide optimal weights. Our toolkit goes beyond these approaches, deriving practical fiscal stance advice from a model where the government follows the objective to maximize welfare. The coefficients associated with the output gap and debt are outcomes of the model and can reflect country-specific features.

The model includes various aspects from the rich and sometimes contradictory academic discussion on the appropriate fiscal stance. The toolkit can thus help policy makers to weigh the various arguments previously discussed in the literature.

Some contributions in the literature recommend an expansionary fiscal stance to smooth the cycle, especially in large downturns. Delong and Summers (2012) and Krugman (2015) argue that recessions have long-run negative effects on output, as human capital is lost through unemployment and investment is slack. The authors make the case for expansionary fiscal policies to avoid these damages. The toolkit includes this hysteresis effect. Furthermore, fiscal multipliers are magnified in recessions, in line with Auerbach and Gorodnichenko (2013).

The model also includes limits to the capacity of fiscal stimulus to boost the real economy discussed in the literature. The model considers a government that decides fiscal plans before the year starts to reflect implementation lags (Blanchard and Perotti, 2002). The model also features an adjustment cost reflecting the difficulty of implementing effectively a large fiscal stimulus, and of reversing such a stimulus (IMF, 2017). The Buffer-stock model of the government reflects the concern that governments may have insufficient buffers in bad times. The model also features a risk premium on government bonds rising in debt, in line with the empirical literature (Gruber and Kamin, 2012; Poghosyan, 2012; D'Agostino and Ehrmann, 2014; Fall and Fournier, 2015; Henao-Arbelaiez and Sobrinho, 2017). This raises the marginal cost of a given increase in debt, but also decreases the surplus needed in a debt-reduction path.

The main new insight of the buffer-stock model of the government is that fiscal stance should be less counter-cyclical at high debt levels than at low debt levels. This model includes costs of high public debt—higher interest rates and a higher risk of losing market access. When debt is low, the government can increase debt at moderate cost. This possibility is similar to having a buffer, and the government can and should use fiscal stance to smooth the cycle. When debt is high (and so the buffer is small), the marginal cost of debt is higher. The government thus prefers to respond less to offset a given negative shock even if it could do so, thereby preserving the small buffer. Hysteresis reinforces this interaction between debt and the appropriate reaction to shocks. At low debt, more hysteresis should lead to a larger reaction against negative shocks, as expected (see also Engler and Tervala, 2018). However,

at high debt, hysteresis magnifies the cost of a debt crisis, so that governments should moderate counter-cyclical reactions to shocks.

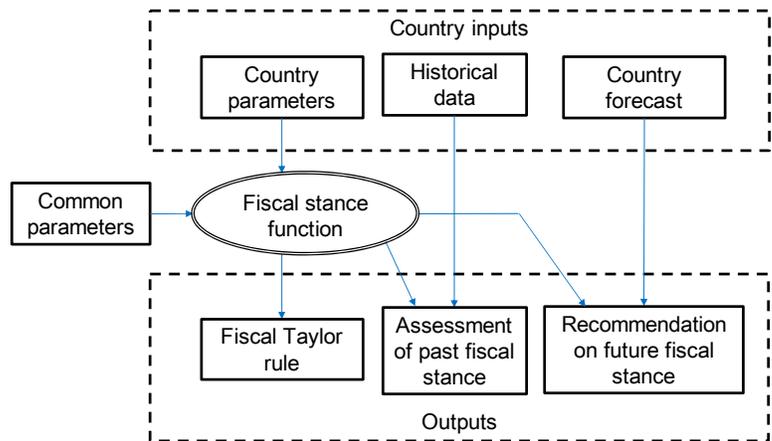
The appropriate government behavior can be summarized by a simple fiscal Taylor rule. This is a linear approximation in past primary balance, debt and the output gap augmented with an interaction term between debt and the output gap. This fiscal Taylor rule can be used to provide a rule of thumb on the extent to which policy makers should react to a recession, for instance.

This model is used to develop a handy Matlab toolkit that can be used by practitioners (Figure 1). A (nonlinear) fiscal stance function is at the core of the toolkit. This function takes the output gap, public debt and the last primary balance as arguments, and returns the fiscal stance in the following year recommended by the model. Parameters are calibrated to compute this function, including country-specific parameters

reflecting local features. Users can adjust these parameters to reflect additional knowledge in a relatively straightforward way. For instance, the fiscal multiplier is an explicit parameter, as it is easier to find country-specific information on such a parameter, rather than on deeper ones such as price stickiness. The non-linear fiscal stance function is then simplified into a fiscal Taylor rule. The user can also provide historical data to compare past actual fiscal stance outcomes with model prescriptions. This can illustrate strengths and weaknesses of past policy choices. The toolkit can also be used to provide an advice about future fiscal stance. For this purpose, the country forecast provides the arguments (output gap, debt, and initial primary balance) for the fiscal stance function. Contributions of the output gap and of debt and primary balance can show the extent to which the recommendation reflects cyclical or debt considerations. Furthermore, alternative scenarios, such as a recession scenario, can illustrate the appropriate reaction to shocks.

The toolbox provides a starting point for a discussion which can build on model-based results and additional consideration. To keep the model tractable and avoid the curse of dimensionality, several issues are not explicitly modeled. The user may want to discuss the uncertainty related to the output gap, the role of different fiscal instruments, the interaction with monetary policy, national fiscal rules, inequality, aging or political considerations. For instance, with comparative static exercises, the user can have an indicative starting point to discuss the relative merits of various fiscal instruments. Public investment supply effects could be discussed with a higher potential output scenario (see Buffie et al. 2012 for a

**Figure 1. Fiscal Stance Toolkit Scheme**



discussion of the effect of public investment on the debt dynamic). A user could also check if the toolkit fiscal stance assessment respects the country's fiscal rules, and if this is not the case it could adjust the recommendation.<sup>5</sup> More broadly, the user can explore the sensitivity to any parameter deemed useful in his/her analysis.

The rest of the paper is organized as follows. Section 2 provides a brief overview of the model. Section 3 analyzes the fiscal stance function, decomposes fiscal stance recommendation into a debt and a cyclical component, and approximates the fiscal stance function with the fiscal Taylor rule. Section 4 discusses applications. A comparison of past decisions with model recommendations reveals that only a few G7 economies exhibited an appropriate fiscal stance on average over the last 20 years. Case studies for Germany and France illustrate that with different initial debt levels and primary balances, prescriptions are different. A variant with higher potential growth shows how the appropriate fiscal stance differs in the case of reforms improving potential growth, such as a public investment program or higher innovation. A variant with a temporary growth boost shows the implication of a reform package that increases the output level.

## II. THE MODEL

### A. The Economy

The model is based on the fiscal buffer-stock model proposed by Fournier (2019). Here, we focus on providing a brief overview about the key model features.<sup>6</sup>

The government maximizes household welfare by choosing the change in structural primary balance to stabilize output fluctuations under constraints. The value function of the government is

$$V_t(d_{t-1}, gap_{t-1}, pb_{t-1}^{st}) = \max_{\Delta pb_t^{st}} E_t \left[ u(c_t, L_t) + \beta V_{t+1}(d_t, gap_t, pb_t^{st}) \right]$$

where  $t$  is the year,  $d_t$  is the gross government debt to potential GDP ratio,  $gap_t$  is the output gap,  $pb_t^{st}$  is the structural primary balance,  $c_t$  is aggregate consumption<sup>7</sup>,  $L_t$  is labor,  $u(.,.)$  is the instantaneous utility function and  $\beta$  is the discount factor. The state of the economy is summarized by three variables: government debt, the output gap and the structural primary balance. The optimization is subject to the structure of the economy and the government budget constraint that takes the form of a risk of losing market access rising in debt (see below). With this intertemporal objective, the model addresses the question of the pace of

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<sup>5</sup> Beyond a qualitative discussion, one may use the model presented here to look for an optimal fiscal stance path within the fiscal rules' constraint.

<sup>6</sup> For more details about the model features, we refer the interested reader to Fournier (2019).

<sup>7</sup> Public and private consumption are not distinguished, and hence assumed to provide the same utility.

fiscal adjustment. In each period, utility cannot be further improved by postponing (or frontloading) a part of the adjustment recommended by the model. Simulation over several years thus provide an appropriate pace of consolidation.

The per-period utility function is

$$u(c_t, L_t) = \frac{c_t^{1-\sigma}}{1-\sigma} - \xi y_t^{*1-\sigma} \frac{L_t^{1+\eta}}{1+\eta}$$

which is a standard representative agent constant relative risk aversion utility function in consumption and labor where  $\rho$  is the parameter of risk aversion. Households enjoy consumption, but also face labor disutility. Utility peaks at an equilibrium output for which the marginal income gain of work equates the marginal loss of utility due to labor. The labor weight  $\xi y_t^{*1-\sigma}$  evolves with potential output per capita, so that the optimal output level also grows with the economy, and  $\xi$  can be calibrated so that utility peaks when output is equal to its potential. In other words, utility declines not only if output decreases below its potential, but also if output increases above potential, consistent with the view that positive output gaps can be associated with costly distortions. This gives the government a motive to counter output deviations from this potential.

The model features rising market pressure when debt is rising. First, the interest rate increases in public debt, in line with empirical evidence (Gruber and Kamin, 2012; Poghosyan, 2012; D'Agostino and Ehrmann, 2014; Fall and Fournier, 2015; Henao-Arbelaez and Sobrinho, 2017). This sensitivity of the interest rate to debt reflects a higher risk premium and can be regarded as the consequence of an excess of supply of government bonds. Furthermore, the risk premium increases in the change in debt; investors are more likely to be concerned if debt is rising. Symmetrically, even at high debt levels, the risk premium may be moderate if the government shows its capacity to reduce it. Second, a risk of losing market access rules out unbounded debt paths. The probability to lose market access also depends on the level and the change of government debt:

$$P(lma) = [1 + \exp(d_1(1 - d_t / \bar{d} - d_2(d_t - d_{t-1})))^{-1}$$

where  $d_1$  governs the debt limit uncertainty,  $d_2$  governs the effect of a debt change on the risk of losing market access, and  $\bar{d}$  is the debt level at which the probability to lose market access is 50% (given no change in the debt level). If the government loses market access, it has to keep debt constant under an adverse scenario of a shock of  $d_3\sigma$ , where  $\sigma$  is the standard

deviation of economic shocks, to be explained below and  $d_3$  is a parameter, calibrated once of all countries.<sup>8</sup>

The budget constraint of the government is governed by a standard debt accumulation dynamic, with a deterministic stock-flow adjustment  $sf_t$  that can capture planned one-offs:

$$d_t = \left( \frac{1 + r(d_{t-1}, \Delta d_t)}{1 + g_t^*} \right) d_{t-1} - pb_t + sf_t$$

In a simple baseline approach, the risk premium is linear in past debt and in debt change, so that this implicit definition of the new debt level can be solved directly.<sup>9</sup> In alternative cases with a non-linear effect of debt and debt change on the risk premium, this can be solved with a linear approximation of the effect of debt change on the risk premium.

Output is driven by a long-term exogenous potential growth and by hysteresis costs in the long-run. Output is produced by a standard linear production function in labor:

$$Y_t = A_t L_t$$

where  $A_t$  is productivity and  $L_t$  is labor. Potential output  $\bar{Y}_t$  is the output that would prevail if labor is at its equilibrium level  $\bar{L}$  :

$$\bar{Y}_t = A_t \bar{L}$$

Productivity is affected by a permanent hysteresis effect of crisis. If production is substantially below its potential, the effect on the unemployed is likely to be deleterious with regard to their skills, their networks, and their morale. (Blanchard and Summers, 1987, DeLong and Summers, 2012).

$$A_t = A \prod_{\tau=1}^t \left( (1 + g_\tau^*) \left( 1 + h \cdot (\min(\text{gap}_{\tau-1}, h^{th}) - h^{th}) \right) \right)$$

---

<sup>8</sup> The model has been designed for advanced economies, where default events are very rare, while loss of market can happen and typically generate a fiscal tightening.

<sup>9</sup> This risk premium and the risk to lose market access are both a function of debt, in of these reflecting past observations. To build a link between these two functions, one would need to assess the perception by investors of the default risk under debt stress, and on the expected recovery rate. To build on the calibration on the literature, a risk premium which is linear in debt and change in debt is proposed here as a baseline. A non-linear alternative is available for users interested in exploring the sensitivity to this functional choice.

(continued)

where  $A = \bar{L} = 1$  and  $g^*$  is the potential growth rate that would prevail in the absence of hysteresis. The parameter  $h \geq 0$  governs the size of hysteresis, and  $h^{th}$  is the output gap threshold below which hysteresis affects potential output. Hysteresis is modelled as a permanent loss of potential output level if the output gap is below a given threshold. Such an effect on output levels is in line with Mourougane (2017) who finds large hysteresis effects on potential GDP levels but no effect on long-run potential growth. The threshold allows an association of hysteresis with large negative output, in line with the literature on hysteresis that focuses on deep recession (e.g. Cerra and Sexana 2008). This feature creates an asymmetry: recessions reduce intertemporal welfare more than booms.<sup>10</sup>

Output deviates from its potential because of a process of shocks  $v_t$  and the structural primary balance reflecting fiscal stimulus or restraint. The fiscal multiplier depends on the output gap itself, in line with recent empirical literature on larger multipliers in downturns (Baum et al, 2012; Auerbach and Gorodnichenko 2013), corroborated by modeling with financial frictions (Canzoneri et al., 2016). Indeed, when economic slack is large, a demand stimulus is more likely to boost output as there is spare production capacity. The sensitivity of the output gap to the primary balance is its derivative with respect to the primary balance, which is set equal to a usual fiscal multiplier  $m_1$  when the economy is at output equilibrium. The additional term governed by coefficient  $m_2$  magnifies the multiplier in downturns:

$$\frac{\partial gap(pb_t, v_t)}{\partial pb_t} = -m_1(1 - m_2 gap(pb_t, v_t))$$

At the same time, the primary balance is the sum of a cyclical component and of a structural component decided by the government:

$$pb_t = pb_t^{st} + a.gap_t$$

where  $a$  is an automatic stabilizer coefficient. This defines a two-way relationship between the output gap and the primary balance. An increase in the structural primary balance is a fiscal tightening, and this implies a decrease in the output gap. At the same time, a decrease in the output gap reduces tax revenue or increases means-tested transfers, and this implies a decrease in the primary balance. The equilibrium is solved analytically, and an approximation of the solution for small shocks shows that the effect of shocks and of changes in the primary balance are reduced by automatic stabilizers:<sup>11</sup>

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<sup>10</sup> An alternative way to model larger welfare costs for a negative output gap relative to overheating could be an asymmetry in the per-period utility function, provided that this asymmetry can be calibrated.

<sup>11</sup> This approximation is a simplified version of the formula used in the model. See the appendix and Fournier (2019) for more details.

$$gap_t \approx \frac{v_t - m_1 p b_t^{st}}{1 + m_1 a}$$

The structural balance that offsets the underlying shock process is  $v_t/m_1$  in this approximation. It is larger when the fiscal multiplier is lower. It is worth noting that the parameter  $m_1$  captures a causal effect of the primary balance on the output gap. Many authors regard the fiscal multiplier as the causal effect of a change in the structural primary balance on output, encompassing the mitigating effect of automatic stabilizers (as in Batini et al. 2014). The multiplier considered in such papers corresponds to  $m_1/(1+m_1.a)$ .

Finally, the aggregate resource constraint is:

$$c_t = y_t (1 - \chi(\Delta p b_t^{st})^2)$$

where  $c_t$  denotes aggregate consumption (both private and public), and the last term represents some fiscal adjustment costs, which we model as direct resource costs relative to output. These adjustment costs can reflect implementation costs of changes in spending plans, and/or costs associated with tax uncertainty (e.g. Skinner, 1988). This can also reflect the difficulty in reversing fiscal decisions (IMF, 2017).

To summarize, the model includes key relevant channels that affect the appropriate fiscal stance, advocated from both “dovish” and “hawkish” perspectives. The dovish channels include hysteresis and cycle-dependent fiscal multipliers that magnify the cost of inaction in bad times, whereas the hawkish channels are given by the risk premium and the risk of losing market access that constitute the costs of debt. Some channels are implicit. This is the case of monetary policy reacting to fiscal stance change, reducing its effect on output and dampening shocks. The calibration of the fiscal multiplier and of the output shocks should capture these effects.

## B. Calibrating the Model

The toolkit is making use of a common calibration for standard parameters such as preference parameters, and of country-specific parameters to reflect country features such as specific fiscal multipliers.<sup>12</sup> This calibration is a positive assessment of the economy reflecting empirical evidence in the literature and can easily be adjusted by users. There are four sets of parameters: a) welfare function parameters, b) fiscal parameters, c) parameters governing the cost of debt and d) economy parameters (Table 1).

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<sup>12</sup> One could argue that social preferences are country-specific, and hence preference parameters' calibration may be refined if country-specific studies provide relevant information.

**Table 1. Common Parameters**

<b>Welfare function</b>	
Discount factor $\beta$	0.99
Risk aversion $\sigma$	2
Labor elasticity $\eta$	1/0.3
Weight of labor $\xi$	1
<b>Fiscal parameters</b>	
Fiscal multiplier sensitivity to shocks $m_2$	3
Adjustment cost $\chi$	3
<b>Interest rate and debt parameters</b>	
Effect of debt level on the risk premium $\alpha$	1.5%
Effect of debt change on the risk premium $\alpha_2$	0.5%
Debt level at which the risk to lose market access is 50% $\bar{d}$	150%
Debt limit accuracy $d_1$	3
Effect of debt change on the risk to lose market access is $d_2$	1
Adverse scenario coefficient in case of loss of market access $d_3$	0
<b>Economy parameters</b>	
Hysteresis	10%
Hysteresis threshold	-1%

The welfare function parameters  $\beta, \sigma, \eta$  and  $\xi$  are standard in the literature. As a benevolent government should maximize household welfare, the government objective function can be interpreted as household utility. The calibration follows the rich literature on quantitative DSGE models. The discount factor is on the conservative side, but at the same time future utility is also discounted via long-term per capita growth in this model, so that with growth rate at 1.5%, the overall discount rate is 0.975. This is comparable with most DSGE models using detrended consumption (e.g. Smets and Wouters, 2007). With a weight for labor set to one, the instantaneous utility peaks when the output gap is null. The labor elasticity is consistent with the usual values found in the literature.

The set of fiscal parameters combines common and country-specific parameters. The average fiscal multiplier  $m_1$  and automatic stabilizers  $a$  are country-specific and are discussed below. With  $m_2 = 3$ , a negative output gap of five percent lowers the standard fiscal multiplier by 0.15. This lies in between empirical estimates of such a link with the position in the cycle (Baum et al 2012; Auerbach and Gorodnichenko 2013) and other studies that find that the

fiscal multiplier is independent from the state of the economy (Ramey and Zubairy 2018).<sup>13</sup> The adjustment cost parameter is set at  $\chi = 3$ . This is a moderate adjustment cost as the model can recommend quite a sizeable adjustment if the previous primary balance level was far from appropriate. One can hardly infer this parameter from historical data as one cannot exclude that the observed degree of fiscal inertia reflects suboptimal political constraints. Higher adjustment cost can create convergence difficulties – the government need to be able to adjust to preserve long-run sustainability. For this reason, a moderate adjustment cost is regarded as appropriate here.

The debt parameters govern the cost of government debt via the risk premium and the risk to lose market access. The constant in the risk premium is calibrated with the current debt level and the current interest rate level. The risk premium is a linear function of government debt, where the slope is  $\alpha = 1.5$ , which is in the middle of empirical estimates (Gruber and Kamin, 2012; Poghosyan, 2012; D’Agostino and Ehrmann, 2014; Fall and Fournier, 2015; Henao-Arbelaez and Sobrinho, 2017). For the risk of losing market access,  $d_1 = 3$ ,  $d_2 = 1$ ,  $d_3 = -1$  and  $\bar{d} = 150\%$ . The latter reflects debt levels at which fiscal stress has been more frequent over the last twenty years among the scare cases of advanced economies with fiscal distress.<sup>14</sup>

We calibrate the hysteresis parameters  $h = 0.1$  and  $h^{th} = -1\%$ , such that the long-run effect is in line with Blanchard Summers (1987) and Delong and Summers (2012) and Ball (2014) who postulate long-term effects of around 0 – 20%.

Country-specific parameters include fiscal and macro-economy parameters (Table 2). The fiscal multiplier if the output gap is zero  $m_1$  is calibrated with a continuous version of the fiscal multiplier bucket approach following Batini et al. (2014) in which the fiscal multiplier is a function of a country’s exchange rate regime (which also covers monetary policy types), labor market rigidity, and trade openness. Automatic stabilizers are estimated by Price et al. (2015). The economy parameters are calibrated with country-specific 20-year averages of IMF World Economic Outlook (WEO) July 2019 data. Shock parameters are estimated with shocks reflecting the output gap and the primary balance to derive their size and persistence:

$$v_t = \left( gap_t - \frac{1}{m_2} \right) e^{-m_1 m_2 p b_t} + \frac{1}{m_2}$$

---

<sup>13</sup> Numerical results indicate, however, that results do not depend much on this parameter.

<sup>14</sup> In practice, simulations show that governments should generate surpluses at high debt levels beyond those required to make sure debt is expected to stabilize in most cases. Governments react to rising interest rate, and hence reduce debt before losing market access. That is why results are not too sensitive to the parameters governing the risk of losing market access, except if the starting point is associated with a high risk of debt distress (high debt countries with low structural primary balance).

**Table 2. Country Specific Parameters**

Country	$m_1$	Automatic stabilizers	potential growth per capita	r-g	Shock persistence $\rho_{shock}$	Shock size $\sigma_\varepsilon$
Canada	0.70	0.56	0.36%	1.77%	0.72	0.021
France	0.98	0.61	1.08%	1.05%	0.58	0.024
Germany	0.84	0.48	1.21%	1.28%	0.32	0.025
Italy	1.00	0.5	0.42%	2.47%	0.58	0.022
Japan	0.87	0.41	0.90%	0.63%	0.47	0.040
Sweden	0.62	0.66	0.95%	0.16%	0.53	0.027
United Kingdom	0.72	0.59	0.91%	1.00%	0.70	0.028
United States	0.86	0.5	1.31%	-0.29%	0.67	0.044

Note:  $m_1$  is the fiscal multiplier when the output gap is zero. The interest-growth-rate differential r-g is reported at the 2018 debt level.

### III. THE TOOLBOX

#### A. Global Solution of the Model

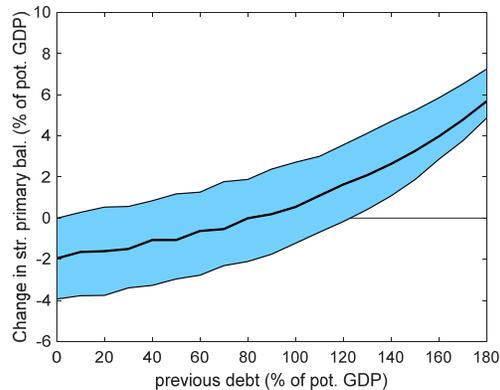
The model delivers the appropriate fiscal stance as a function of past debt, past output gap and past primary structural balance. The model is solved using a global solution method rather than a local solution around the steady state, so that results are valid with countries with particularly high or low debt. This global solution is the government's choice of the change in primary structural balance as a function of the three state variables:

$$\Delta pb_t^{st} = f_\Theta(d_{t-1}, gap_{t-1}, pb_{t-1}^{st})$$

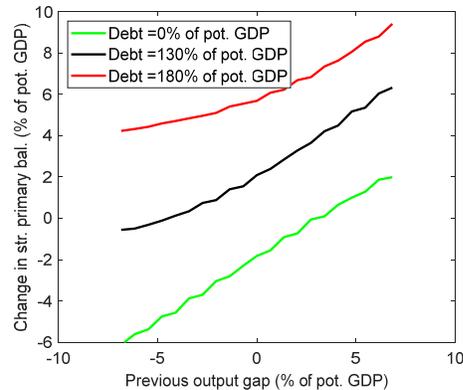
Fournier (2019) illustrates the effect of debt and of the output gap on the appropriate fiscal stance for a virtual country with cross-country average parameters (Figure 2, panels A and B). The first panel illustrates the reaction to debt, reporting the appropriate fiscal stance as a function of the past debt level, holding previous output gap and structural balance at zero (thick solid line in Figure 2, Panel A). The thin solid lines correspond to the reaction to debt if the lagged output gap corresponds to a one-standard deviation positive or negative shock. The width of the band shows the extent to which governments should react to shocks. The second chart reports the appropriate fiscal stance as a function of the past output gap, holding the debt level and previous primary balance constant (Figure 3, Panel B). This second chart suggests that the reaction to the output gap is roughly linear, so that the information on reaction to shocks is well summarized with the width of the band in the first chart.

## Figure 2. Baseline Fiscal Reaction Function to Debt

Panel A. Structural primary balance change in percent of potential GDP



Panel B. Reaction to output shocks at different debt levels



Note: The large solid line indicates the appropriate fiscal stance if the previous output gap is zero. The thin solid lines indicate the appropriate fiscal stance in case of a one-standard deviation positive or negative shock. The width of the blue band thus indicates the extent to which a government should use fiscal policy to counteract output shocks.

As debt increases, the reaction to debt is sharper and the reaction to shocks is weaker. The solid line in Figure 2, Panel A is convex—the slope is steeper at high debt. As there are rising costs of high debt, the reaction to debt should become sharper and sharper as debt increases. This reaction to debt is consistent with the assumption that governments do not default. They rather generate the necessary surpluses to repay debt. These results indicate a substantial tightening at very high debt levels, reflecting a sizeable interest rate risk premia and low adjustment cost in the set of parameters used here. At low debt levels, the wide blue band indicates that governments should make a wide use of fiscal policy to offset shocks. This is less the case at high debt levels – the blue band narrows and the line is flatter in Figure 2, Panel B. Because high debt reduces the capacity to offset shock, such a consolidation policy increases future welfare, offsetting the instantaneous welfare cost.<sup>15</sup>

The interest-rate growth rate differential, hysteresis, fiscal multipliers, preference parameters, and shock persistence are important drivers on the appropriate fiscal stance. Fournier (2019) provides a sensitivity analysis to several main drivers. The interest-rate growth rate differential changes debt dynamic such that the surplus needs to preserve sustainability. The effect of debt on interest rate and hysteresis increase the recommended interaction between debt and cyclical stocks. The implication of hysteresis on fiscal stance recommendation is to react more to negative shocks at low debt, as expected and in line with Engler and Tervala (2018). However, at high debt, hysteresis magnifies the cost of a debt crisis, and hence increases the marginal cost of debt, so that governments should moderate counter-cyclical

<sup>15</sup> Kamenik et al. (2013) and Fall and Fournier (2015) illustrate with stochastic simulations the high risks for highly indebted countries to do as much countercyclical fiscal policy as low-debt countries.

reactions to shocks. Different fiscal multipliers have an effect on the reaction to shocks, a higher preference for the present reduces the reaction to debt, and high shock persistence should lead to less stimulus to counter negative shocks at high debt to preserve sustainability.

The relevance of relying on the output gap deserves a discussion given the difficulty to measure it in real time (see Turner et al., 2016 for instance). Let us first assume that the output gap is uncertain, but without systematic bias. This first case can be analyzed with the Brainard principle (Brainard, 1967). Uncertainty on the effects of policy affects decision making. By contrast, the certainty equivalence (Theil, 1961) holds when uncertainty is independent to policy action. Here, output gap uncertainty affects the fiscal multiplier and hence the government should do less consolidation during observed booms and less stimulus in observed downturns than what a face-value reading of the output gap would suggest.<sup>16</sup> In addition, a prudent government concerned by the risk of a systematic optimistic bias would rather increase the balance – relative to what a face-value reading of the output gap suggests – not only during downturns but also during booms. To address this second type of risk, the tool can use an output gap adjusted for the historical bias. One can also compare the fiscal stance recommendation for different estimates of the output gap.

With these caveats in mind, the output gap is still useful as it captures a mismatch between short-term demand and a long-term supply level. Recent research to improve the real-time measure of output gap suggests using structural methods (Coibion et al 2018), or better including information on circumstances such as capacity utilization rates (Turner, 2016). This can strengthen the capacity of this indicator to disentangle demand-side and supply-side challenges. In sum, the tool recommendation to ease fiscal stance in case of lower output gap corresponds to the idea that a short-term fiscal stimulus is warranted when demand is below potential supply.

## B. A Simple Decomposition to Describe the Fiscal Stance Advice

Contributions of the stabilization and sustainability considerations describe the extent to which each of these is shaping the recommendation:

$$\begin{aligned}
 \Delta pb_t^{st} &= f_{\theta_t}(d_{t-1}, gap_{t-1}, pb_{t-1}^{st}) \\
 &= \underbrace{f_{\theta_t}(d_{t-1}, gap_{t-1}, pb_{t-1}^{st}) - f_{\theta_t}(d_{t-1}, 0, pb_{t-1}^{st})}_{\text{stabilization}} + \dots \\
 &\quad \underbrace{f_{\theta_t}(d_{t-1}, 0, pb_{t-1}^{st}) - f_{\theta_t}(d^*, 0, pb^*)}_{\text{debt and primary balance (sustainability)}} + \dots \\
 &\quad \underbrace{f_{\theta_t}(d^*, 0, pb^*) - f_{\theta_t}(d^*, 0, pb^*)}_{\text{other } (r_t, \dots)} + \underbrace{f_{\theta_t}(d^*, 0, pb^*)}_{=0}
 \end{aligned}$$

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<sup>16</sup> The Brainard principle should also lead policy makers to react less to shocks if uncertainty surrounding the fiscal multiplier is large.

We shut off inputs one by one to compute the contributions. First, we shut off the output gap input to isolate the stabilization effect. This exercise depends on the debt level because at higher debt levels, the fiscal policy should react less to the cycle. To be policy relevant, this is done at the last year's debt level, which is the one that should be considered to inform the discussion about stabilization. Second, the contribution of sustainability is isolated with further shutting off the debt and the lagged primary balance effects. This captures the extent to which the last year primary balance was far away from a level which ensures sustainability. For this purpose, these two state variables are replaced by their long-run equilibrium stable values  $d^*$  and  $pb^*$ . This sustainability component embeds a welfare consideration: it can be negative if sustainability gains from high lagged primary balance are dominated by its welfare cost in terms of high taxation or low public spending. Third, the recommendation can be different from a neutral stance even at equilibrium values because of short-run considerations such as a temporarily lower interest environment.

### C. A Linear Approximation: The Fiscal Taylor Rule

We simplify the numerical solution of the government into a simple fiscal Taylor rule. This approximation of the model is more tractable and easier to apply, yet summarizes reasonably well the whole fiscal behavior. The global solution shows that fiscal stance reaction to shocks should depend on the debt level. The fiscal Taylor rule is thus a linear function of the state variables augmented with the interaction between debt and the output gap:

$$\Delta pb_t^* = \Delta pb^{st}(d_{t-1}, gap_{t-1}, pb_{t-1}^{st}) \approx \beta_0 + \beta_1 pb_{t-1}^{st} + \beta_2 d_{t-1} + \beta_3 gap_{t-1} + \beta_4 d_{t-1} gap_{t-1}$$

The coefficient  $\beta_1$  governs the reaction to the past primary structural balance, which is expected to be negative. Coefficients  $\beta_2$  and  $\beta_3$  represent the reaction to debt and the output gap, respectively. Given the fiscal reaction function in Figure 1, we would expect both to be positive. Lastly, the interaction term  $\beta_4$  should be negative given that we observe that counter-cyclicality of the appropriate fiscal stance decreases at high debt levels.<sup>17</sup>

The parameter values  $\beta_0 - \beta_4$  are obtained by a simple Ordinary Least Squares (OLS) regression of the global solution on the state variables (Table 3). Any point in the grid used to solve the model is a set of state variables (output gap, primary balance and debt), and the fiscal stance function maps this set of state variables to the appropriate fiscal stance. Any such point can thus be used as an observation in a regression of the model-based fiscal stance on the state variables. The fiscal Taylor rule is estimated with the same debt range for all countries (30% of GDP to 150% of GDP) for the sake of comparability. As model solutions are smooth, the linear fiscal Taylor rule is a very good approximation of the global solution

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<sup>17</sup> The model also exhibits a non-linearity in the reaction to debt which could be captured with a squared-term. This is not done here to keep the fiscal Taylor rule simple, but users may add such a squared term.

(the  $R^2$  is close to 1 in almost all countries). This opens the way for a simple tool. For a given country, the optimal fiscal stance can be summarized with a handful of coefficients.

**Table 3: Fiscal Taylor Rules in Advanced Economies**

Country	$\beta_0$ (constant)	$\beta_1$ (struct. pb)	$\beta_2$ (debt)	$\beta_3$ (gap)	$\beta_4$ (debt*gap)	$R^2$
Canada	-0.030	-0.446	0.083	1.401	-0.628	0.970
France	-0.028	-0.493	0.055	0.833	-0.190	0.975
Germany	-0.033	-0.651	0.078	0.578	-0.242	0.970
Italy	-0.044	-0.533	0.111	0.897	-0.426	0.961
Japan	-0.037	-0.544	0.016	0.417	0.062	0.998
Sweden	-0.026	-0.509	0.050	0.815	-0.031	0.993
United Kingdom	-0.026	-0.413	0.054	1.056	-0.185	0.987
United States	-0.033	-0.425	0.030	0.662	0.040	0.997

The coefficients of the fiscal Taylor rule reflect the patterns of the fiscal stance function, and magnitudes can be explained by key country features. For all countries, the coefficients for the linear terms are with the expected sign.  $\beta_2$  satisfies the Bohn (1998) principle. In Germany, shock persistence is lower. This increases the risk that a lagged fiscal impulse is not timely. As a result, the coefficient associated with the output gap is below the cross-country average. In countries with negative interest-growth-rate differentials at these debt levels such as Japan or the United States, the reaction to debt is lower and the reaction to shocks is independent from the reaction to debt: the interaction term is close to zero. The low interest rate provides more fiscal space.

#### IV. APPLICATIONS

##### A. Historical Fit of the Model-based Fiscal Stance

The recommended fiscal stance can be compared to the realized stance to gauge the extent to which countries follow an appropriate fiscal policy. For this purpose, the realized stance is the change in structural primary balance observed ex-post in the July 2019 World Economic Outlook (WEO) database.<sup>18</sup> The recommended fiscal stance is the stance prescribed by the toolkit, assuming the government knows lagged state variables as they are reported in the July 2019 WEO database. The hypothesis that the government behaves as recommended by

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<sup>18</sup> A similar exercise with real time estimates is presented in table 5.

the model is tested with a simple regression of the observed stance on the recommended stance.

**Table 4: Historical Fit of the Recommended Fiscal Stance**

Country	recommended stance	constant	r <sup>2</sup>	lagged st. pr. balance	recommended stance	constant	r <sup>2</sup>
Canada	0.445 (2.50)	-0.006 (-1.33)	0.25	-0.286 (-1.72)	0.41 (2.49)	0.002 (0.19)	0.44
France	0.002 (0.05)	-0.001 (-0.38)	.	-0.247 (-1.63)	0.017 (0.38)	-0.003 (-1.19)	0.13
Germany	0.65 (4.05)	-0.006 (-1.8)	0.48	-0.243 (-1.07)	0.562 (2.93)	-0.002 (-0.51)	0.55
Italy	0.281 (1.75)	-0.018 (-1.82)	0.15	-0.185 (-1.41)	0.23 (1.41)	-0.011 (-0.98)	0.23
Japan	-0.002 (-0.25)	0.001 (0.2)	0.00	-0.466 (-2.22)	-0.004 (-0.55)	-0.023 (-2.02)	0.23
Sweden	0.303 (2.04)	0.003 (1.24)	0.19	-0.433 (-4.11)	0.332 (3.19)	0.005 (3.27)	0.59
United Kingdom	0.102 (2.38)	-0.001 (-0.25)	0.24	-0.131 (-0.65)	0.085 (1.66)	-0.003 (-0.44)	0.27
United States	0.44 (1.02)	-0.003 (-0.32)	0.09	-0.338 (-1.39)	0.162 (0.35)	-0.012 (-1.15)	0.22

Note: Each country line reports two regressions, a first one without and a second one with lagged structural primary balance. The dependent variable is the observed change in the structural primary balance. Prais-Winsten estimation with AR (1) residuals. t-ratios in parenthesis. Sample: 1996–2016.

The hypothesis is accepted if the coefficient for the recommended stance is one and the constant zero. If one assumes that adjustment costs are larger than those included in the model, then the realized stance would depend on both the recommended stance and on the lagged primary balance. In this second set of regressions, a significantly positive coefficient associated with the recommended stance means that the government goes in the direction recommended by the model. Regressions of the realized stance over the last 20 years are reported in table 4.

Results suggest that half of advanced economies considered here have made fiscal stance decisions that are broadly consistent with the model prescription. In Canada, Germany, Sweden and the United Kingdom, there is a significant positive association between recommended and actual decisions, while in other countries, the association between the appropriate stance and past decisions is weak or inexistent. In any case, stance adjustments are smaller than the model recommendation (coefficients below one). Overall, a weak association is consistent with empirical works indicating that many governments have failed

to deliver counter-cyclical fiscal stance (e.g. Lane, 2003, Égert, 2012, Bloch and Fournier, 2018). In addition, in all G7 countries, the observed primary balance is below the model recommendation on average, in line with the view that political economy considerations can lead to a debt bias (Alesina and Passalacqua, 2016).

**Table 5: Historical Fit of the Recommended Fiscal Stance with Real Time Output Gap**

Country	recommended			lagged st. pr. Balance	recommended		
	stance	constant	r <sup>2</sup>		stance	constant	r <sup>2</sup>
Canada	0.455 (1.58)	-0.005 (-1.04)	0.12	-0.139 (-0.86)	0.378 (1.18)	-0.001 (-0.20)	0.18
France	-0.017 (-0.77)	-0.001 (-0.54)	0.03	-0.243 (-1.35)	0.001 (0.04)	-0.003 (-1.13)	0.13
Germany	0.745 (3.63)	-0.004 (-1.46)	0.42	-0.207 (-0.98)	0.658 (2.73)	-0.001 (-0.38)	0.49
Italy	0.252 (1.62)	-0.015 (-1.69)	0.13	-0.207 (-1.59)	0.222 (1.46)	-0.009 (-0.94)	0.24
Japan	-0.002 (-0.25)	0.001 (0.2)	0.00	-0.467 (-2.22)	-0.004 (-0.51)	-0.023 (-2.02)	0.23
Sweden	0.391 (2.47)	0.005 (2.27)	0.25	-0.328 (-2.38)	0.256 (1.67)	0.006 (2.72)	0.44
United Kingdom	0.03 (2.69)	-0.001 (-0.13)	0.29	-0.118 (-0.67)	0.026 (2.07)	-0.002 (-0.38)	0.32
United States	0.152 (1.74)	-0.002 (-0.28)	0.21	-0.258 (-1.06)	0.101 (1.03)	-0.01 (-0.90)	0.28

Note: Each country line reports two regressions, a first one without and a second one with lagged structural primary balance. The dependent variable is the observed change in the structural primary balance. Prais-Winsten estimation with AR (1) residuals. t-ratios in

Similar regressions in which the recommended stance is calculated with real time output gap data provide a similar picture (Table 5). This confirms that weaknesses in the decision-making process play a large role, beyond inappropriate decisions that could be attributed to the difficulties to observe the output gap in real time.

## B. Forward-Looking Simulation

The fiscal Taylor rule can be used to assess the appropriate fiscal stance for a given country in the medium-run. Starting from empirically observed levels of the state variables (debt, output gap, and past structural primary balance), the model can be simulated forward. To provide a meaningful analysis of the short-run economic environment, we proceed as follows. For a given country, we assume that it will follow the appropriate fiscal stance of the infinite horizon problem in the long-run. However, within the WEO forecast period of five years followed by a transition period of ten years, the government solves a short-run finite

horizon problem given this long-run trajectory and WEO projections of interest rates in the upcoming years. The transition period is a 10-year linear transition between the last year of WEO forecast and the long-run parameters, reflecting in particular the slow changes in effective interest rates. This short-run solution is obtained by a finite horizon backward iteration.

The forward-looking simulation takes stochastic uncertainties about economic shocks into account and delivers a range of possible scenarios. Simulations paths are run from 2020 to 2024 (WEO forecast horizon), taking 2019 as the last observed year. We run 5,000 Monte-Carlo simulations, drawing shocks from the estimated distribution. The output gap is driven by these shocks, which can be countered to some extent by the appropriate stance. The resulting distribution of the appropriate fiscal stance and the associated debt and output gap trajectories can then be used to assess the risks and uncertainties over the medium-run. The scenarios can then be used to compare the fiscal Taylor rule recommendations for the medium-term with IMF recommendations or government plans. We furthermore compare the outcome of our fiscal Taylor rule to the recommendations following Carnot (2014). The author advocates to use a rule of thumb in which change in primary balance should be an average of a primary gap  $P_t$  reflecting the distance to the debt target and of  $S_t$ , a score on macroeconomic conditions<sup>19</sup>:

$$\begin{aligned}\Delta pb_t^{st} &= 0.25 * (P_t + S_t) \\ P_t &= 0.005D_{t-1} + 0.05(D_{t-1} - 60) - pb_{t-1} \\ S_t &= 0.5 * [gap_{t-1} / sd(gap) + \Delta gap_{t-1} / sd(\Delta gap)]\end{aligned}$$

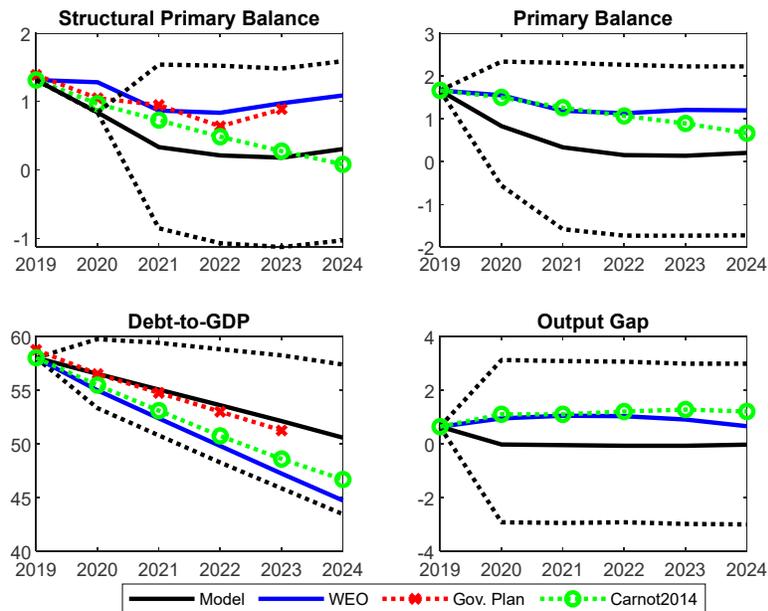
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<sup>19</sup> This is an average of the output gap and the change in the output gap aiming at mitigating the real time output gap uncertainty.

### C. Case Study 1: Germany

The fiscal Taylor rule recommends an expansionary fiscal stance to Germany for 2020 to 2022 (Figure 3). The decomposition of fiscal stance advice for 2020 shows that this is because primary balance is well above the level required to ensure sustainability and interest rates are very low (Figure 4). A reduction of the primary surplus can improve welfare. For instance, the government could reduce the tax and social contribution to GDP ratio which is about 1.5 points above the level observed five years ago. In other words, stabilizing the primary surplus at a high level has a welfare cost. The marginal cost in terms of debt risk is small. In sum, the primary balance and debt contribution is negative. The low interest rate environment also reduces the need to run a primary balance surplus as it reduces interest payment and hence future debt. By contrast, the cyclical assessment considered alone would warrant a small tightening as even with currently restrictive fiscal policy, the output gap is positive. It has a small contribution and does not offset the effect of high primary balance, moderate debt and low interest rates. As the last 20-year data suggests that shocks are less persistent in Germany than in a typical advanced economy, the implementation lag makes fiscal policy less effective in stabilizing output. The risk is higher that the magnitude or even the sign of the output gap changes from one year to the next one—the government should

**Figure 3: Forward-Looking Simulation for Germany**



Source: July 2019 WEO, model simulations and Carnot 2014 based on July WEO data.

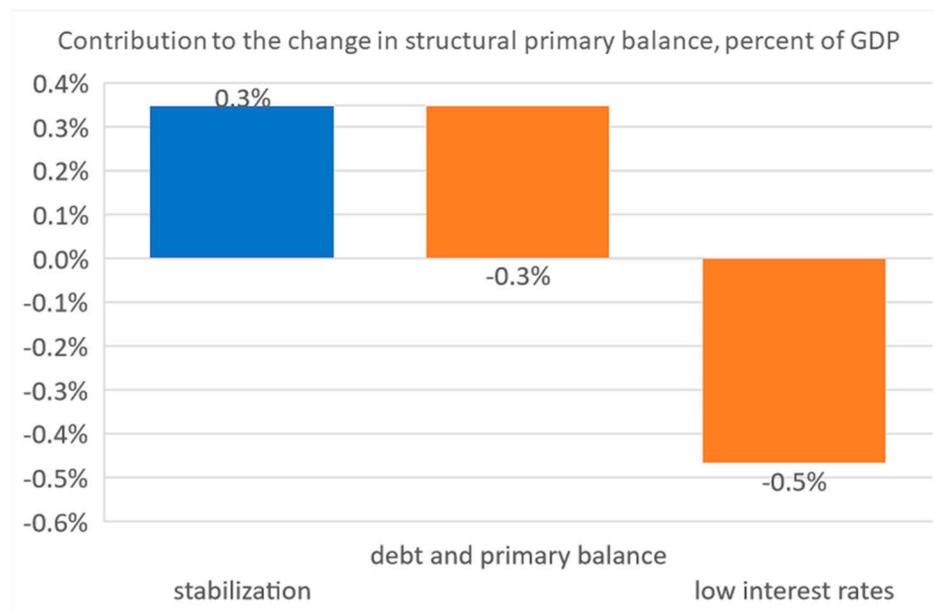
Note: Dotted black line reports the 90% confidence interval of Monte Carlo simulations. WEO projection is staff assessed authorities' plan.

discount the signal provided by a positive output gap in 2019. The factors that dominate are thus the lagged structural primary balance level, the moderate debt level and the low interest rate, all converging toward an easing of the fiscal stance. This is largely in line with IMF recommendations to ease fiscal stance and with the government plan for 2020. In the

medium-run, the government should stabilize the fiscal stance as interest rate conditions are expected to normalize.

The recommended easing of the fiscal stance over three years is more pronounced than the government planned (according to the WEO forecast) and quite close to the recommendation following Carnot (2014). The WEO forecast features essentially no change in the fiscal stance over the upcoming years, equivalent to a substantially positive primary balance and a rapid consolidation. At the same time, the WEO forecast also assumes a significantly positive output gap, despite the relatively tight fiscal stance. Even if the model recommends a fiscal easing, the optimal debt path remains on a downward path. The easing is thus more moderate than one that would match with the random walk result found by Barro (1979) even if Germany is far away from its debt limit. The main reason here is that with a very low interest rate, the primary balance that would stabilize debt is quite a sizeable deficit which would widen the positive output gap and hence increase distortions.

**Figure 4. Decomposition of Fiscal Stance Advice in 2020 in Germany**



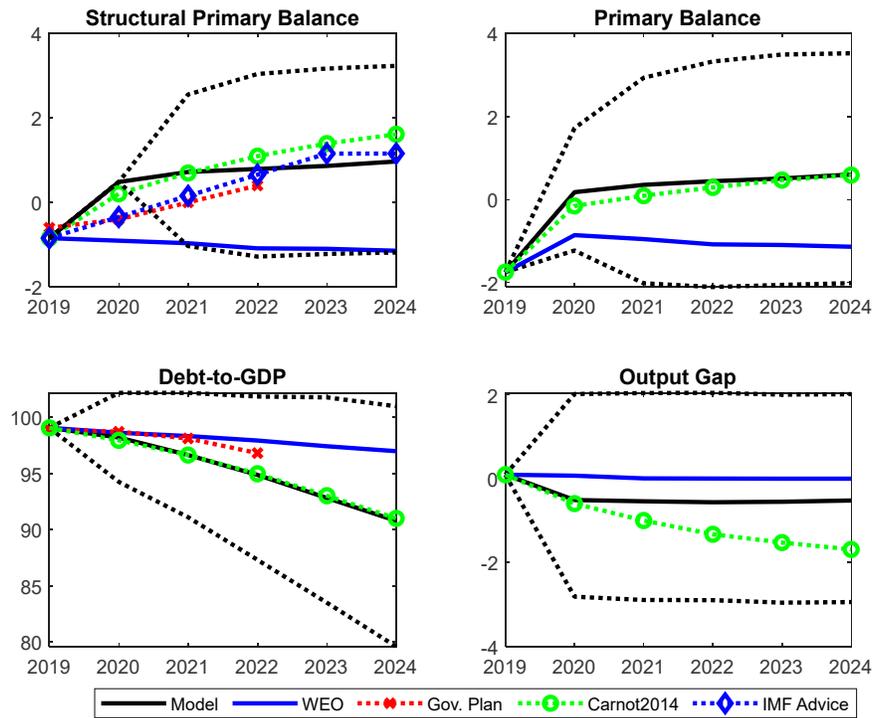
Note: Decomposition as explained in section 3.2.

#### D. Case Study 2: France

The fiscal Taylor rule proposes a frontloaded consolidation in France over the medium run (Figure 5). As debt to GDP is higher than in Germany and the structural primary balance is lower, France should build buffers to ensure it will be able to face the next crisis with more room for maneuver. The sustainability consideration is indeed the main driver of the advice for 2020 (Figure 6). The fiscal Taylor rule therefore recommends a tighter fiscal stance. The recommended consolidation is broadly in line with IMF and Carnot (2014) advice. It

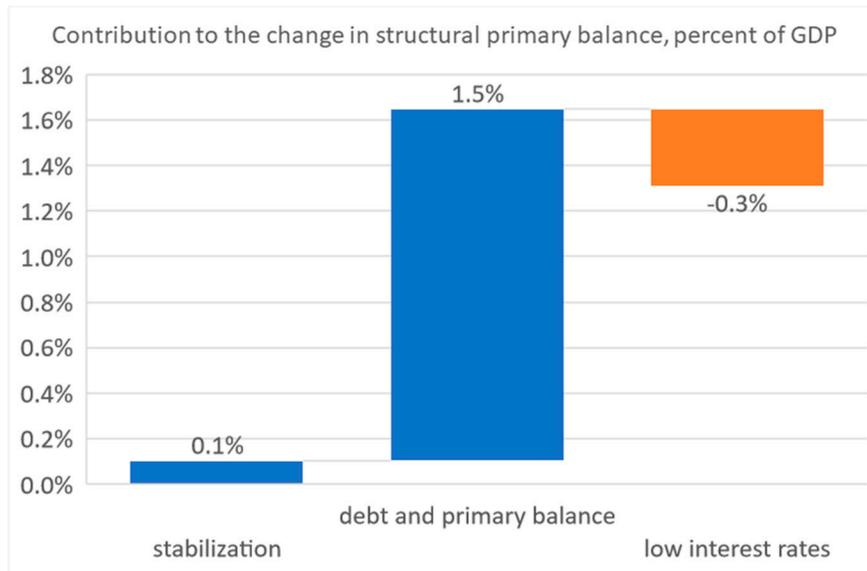
recommends more frontloading although tightening is moderate because of the adjustment cost assumed in the model. The 90% confidence interval surrounding the recommended fiscal stance is not far from the one observed for Germany (dashed line). In the comparison between France and Germany on the appropriate reaction to shocks, two mechanisms offset each other's. As debt is higher than in Germany, France should react less to shocks. Conversely, because shocks are more persistent in France, lagged output gap position provide more information on the cyclical position in the next year, increasing the sensitivity to shocks.

**Figure 5: Forward-Looking Simulation for France**



Source: July 2019 WEO, model simulations and Carnot 2014 based on WEO data.

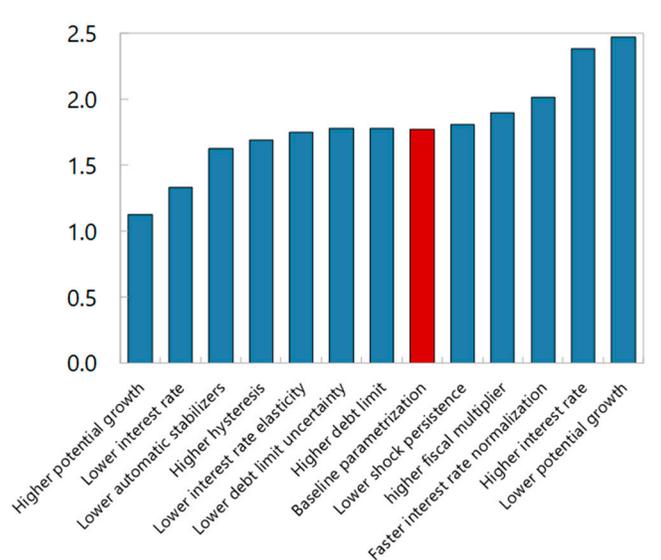
Dotted black line report the 90% confidence interval of Monte Carlo simulations. WEO projection is staff assessed authorities' plan.

**Figure 6. Decomposition of Fiscal Stance Advice in 2020 in France**

Note: Decomposition as explained in section 3.2.

**Figure 7. Fiscal Tightening by 2024 in France – Sensitivity analysis.**

*Percent of GDP*



Source: IMF staff calculations.

Note: In the lower (higher) interest rate scenario, the interest rate is 0.5% lower (higher). In the lower automatic stabilizers' scenario, automatic stabilizers are three fourth of the baseline value. In the lower shock persistence, the persistence parameter is set to 0.4 instead of 0.6. In the faster interest rate normalization, it takes five years after 2024 for the effective interest rate to reach its long-run value. In the lower potential growth scenario, potential growth is 0.5% lower. In the higher hysteresis scenario, hysteresis is 50 percent larger than in the baseline. In the higher debt limit scenario, the debt level at which the risk to lose market access is 50 percent is set at 170 percent of GDP. In the lower debt limit uncertainty scenario,  $d_1 = 4$ .

The recommendation to tighten fiscal stance in France is fairly robust to sensitivity checks (Figure 7). The model recommendation to improve the structural primary balance holds under a broad range of assumptions. In particular, the results are not very sensitive to the elasticity of interest rates to the debt level.<sup>20</sup> The results are also not very sensitive to the parameters governing market-access risk (because the optimal policy reacts preemptively to contain the interest rate burden, before being too constrained by the debt limit); the persistence of output growth shocks; the magnitude of automatic stabilizers; or the extent of hysteresis effects. However, the results are sensitive to assumptions on the average interest rate, potential growth, and—to a lesser extent—fiscal multipliers. If growth were permanently higher (lower), the optimal fiscal stance would be easier (tighter) as debt dynamics would become more (less) favorable. If interest rates were higher (by assuming, for instance, faster normalization of monetary policy rates), the model would recommend a tighter fiscal consolidation to counter the risk of debt snowball effects. The recommended consolidation would also be somewhat larger if fiscal multipliers are higher, as fiscal consolidation entails larger output costs and hence the government is more debt-adverse.

The toolkit can be used to discuss the fiscal stance response to a given scenario, such as a severe recession. This is simulated here with a one-year shock triggering a decline in annual GDP by 1 percent in France.<sup>21</sup> This shock fades out progressively, in line with historical fluctuations. In this scenario, a discretionary stimulus around  $\frac{1}{4}$ –1 percent of GDP could be considered,<sup>22</sup> which can help to reduce both short-term and long-term costs (hysteresis) of the recession. The size of the stimulus varies depending on macroeconomic circumstances, such as the fiscal multiplier of the instruments used, the hysteresis associated with the downturn, or the cost of financing. In particular, if the government can use an instrument with a higher fiscal multiplier, it can achieve the stabilization objective with a smaller stimulus. In any case, the adverse shock and the stimulus have a permanent effect on debt. There is thus a cost in terms of future consolidation, as the adjustment effort needs to be sustained for a longer period after the shock dissipates. Conversely, fiscal tightening is unambiguously desirable when debt is high, and the economy is booming: it reduces debt and avoids overheating at the same time.

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<sup>20</sup> The reason for the low sensitivity is that a higher elasticity of interest rates to the debt level has two effects that, in this specific exercise, broadly offset each other: (i) it raises the marginal cost of a given increase in debt (leading the government to target a lower debt level); but (ii) it lessens the surplus needed to reduce debt (dampening the debt-aversion effect induced by (i)) because the interest rate burden drops faster when debt declines.

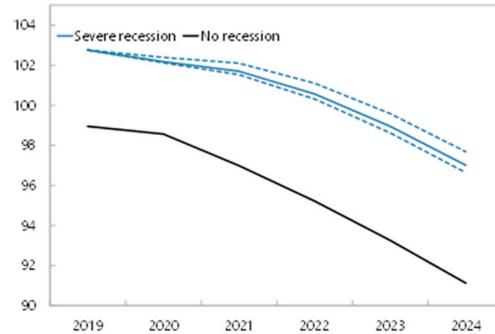
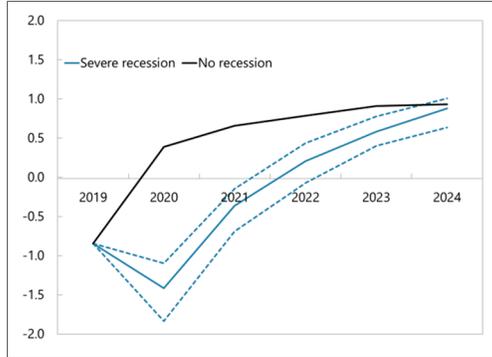
<sup>21</sup> The process  $v_t$  is subject to a one-off exogenous shock of about 4 percent of GDP in 2019. It is dampened by automatic stabilizers, so that growth is 2.3 percent below the baseline. About 40 percent of this shock dissipates each year (autoregressive term in  $v_t$ ). The government reacts in 2020, reflecting implementation delays.

<sup>22</sup> In 2009, output fell by almost 3 percent and the government implemented a fiscal stimulus of 2.2 percent of GDP.

### Figure 8. Severe Recession in France

Structural primary balance, percent of potential GDP

Government debt, percent of GDP



Source: Model simulations.

Note: Dashed lines denote range of model simulation under different fiscal multiplier assumptions.

### E. Scenario Analysis with growth-enhancing Reforms

The toolkit can be used to gauge the effect of growth-enhancing policies on the appropriate fiscal path. The potential growth path is an input used to calculate the appropriate fiscal stance. With higher growth, future debt burden is lower, this gives more for an easier fiscal stance. This key channel is captured in the model. An alternative simulation with an alternative exogenous growth path reflecting a public investment plan or a structural reform package would thus illustrate the additional fiscal margin provided by higher growth. The practitioner would need specific information on the size, schedule and expected returns of possible investment plans to calibrate the potential growth implications of a public investment scenario. A comparison of recommended fiscal stance in the alternative scenario to the recommended fiscal stance in the baseline scenario would illustrate the extent to which additional growth should change fiscal stance decisions.

This is illustrated here with alternative simulations in which the France government successfully implements growth-enhancing measures. For the sake of exposition, an illustrative and sizeable increase in potential growth (0.25% each year) is considered, so that implications on the fiscal stance are large and hence easier to observe.<sup>23</sup> In practice, implementation of a large investment plan or of an ambitious package of structural reforms is difficult and can take time. At the same time, growth of GDP per capita in France is lagging a frontier country like the United States by about 0.25%. This suggests there is large room for improvement. One can regard the contrast between the baseline and this alternative

<sup>23</sup> In practice, users can use estimates of growth effects of structural reforms (see for instance IMF, 2019) to gauge the growth implications of structural reforms discussed in a given country.

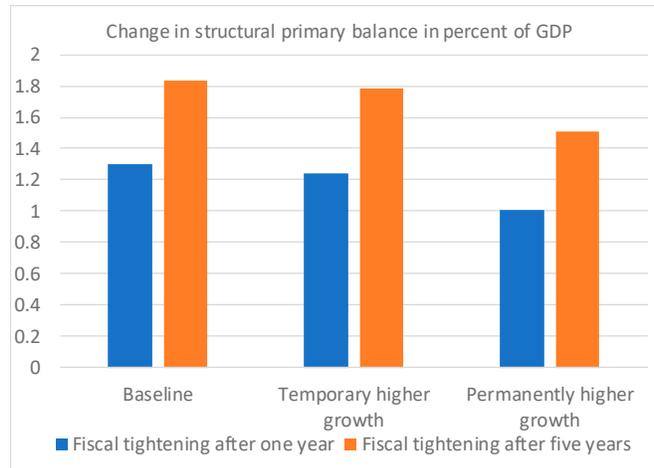
simulation as an illustrative comparison of the case in which sluggish growth continues against the case in which France succeeds to unlock deep impediments to growth.

With a permanently higher potential growth, France can afford less fiscal tightening, but the gain in term of smaller consolidation is moderate (Figure 9). Higher growth reduces the future debt ratio.

However, the model still recommends quite a sizeable tightening. In addition, this crucially hinges on the major assumption that the growth effect is permanent, changing the debt dynamic permanently and hence giving room for a higher debt target. Boosting growth permanently requires reforms that generate a change in the pace of technology gains, such as innovation reforms.

Many structural reforms rather have an effect on the output level (e.g. a labor market reform which reduces structural unemployment).<sup>24</sup> Reflecting this, assuming that the effect of the package is effective in boosting potential growth over 5 years only would deliver much less in terms of fiscal stance. In addition, it is worth highlighting that the simulations assume that the growth effect of the reform package is known with certainty. In practice, such effects are very delicate to quantify, and hence policy makers may consider a prudent quantification ex ante to be on a safer side.

**Figure 9. Fiscal Implications of Higher Potential Growth Boost in France**



Source: Calculations based on July 2019 WEO.

Note: Higher growth simulations assume potential growth that is 0.25% above the baseline simulation reported in Figure 5, everything else equal.

## V. CONCLUSION

This paper presents a simple fiscal Taylor rule based on a tractable toolkit to assess a country's fiscal stance. This is designed as an evenhanded tool for practitioners who want to identify the change in the structural primary balance that balances economic stability and debt sustainability. The toolkit is based on a fiscal buffer-stock model featuring an optimizing government and key relevant channels capturing the interaction between economy

<sup>24</sup> See IMF (2019) for estimates of the effect of structural reforms on output levels.

and fiscal stance. In contrast to the existing literature for practitioners (e.g. Carnot 2014), the appropriate reaction to shocks depends on the debt level as the model features rising marginal costs of debt.

The toolkit can be used in several ways to assess issues related to the fiscal stance. First, a fiscal Taylor rule provides a simple guidance of the appropriate fiscal stance. Second, the model-implied fiscal stance can be compared to actual historical fiscal stances. This provides an assessment of the appropriateness of past government behavior. Third, the toolkit can be used to recommend the appropriate fiscal stance in the short- and the medium-run based on current data and economic forecasts. Decompositions illustrate the extent to which the recommendation reflects debt or economic cycle considerations. Fourth, alternative scenarios with output shocks can show the extent to which fiscal stance should react to economic fluctuations. Fifth, the toolkit can be used to gauge the effect of growth-enhancing policies on the appropriate fiscal path. To this end, the practitioner can specify different assumptions on the growth rate of potential output.

The tool presented here should be seen as a starting point for an analysis of complementarity and relative merits of structural reforms and fiscal stance to tame the adverse effects of recessions. Structural reforms may change structural parameters. For instance, labor market reforms can reduce hysteresis. With various hysteresis scenarios, the model could be used to compare welfare gains of structural reforms reducing hysteresis and of counter-cyclical fiscal stance. Structural reforms can also have an effect of fiscal balance and its elasticity to the cycle (e.g. tax and unemployment benefits reforms). They can also have a different effect depending on the position in the cycle (IMF 2019). To discuss appropriate policy package, further research could embed these mechanisms.

The toolkit allows for several user adjustments with respect to the various economic channels and specific scenarios. This includes a low interest rate environment, and country-specific features such as fiscal multiplier, automatic stabilizers, hysteresis, shock size, and persistence to adjust fiscal advices in each specific case. Users can easily adjust parameters. Various scenarios can be compared to understand the mechanisms that are driving the prescriptions. For instance, should one consider that spending consolidation plans are associated with lower fiscal multipliers (as found in Alesina et al, 2015), such lower fiscal multipliers could be assumed to calculate optimal fiscal stance implications. All this can be help to tailor and explain fiscal stance advices.

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## VII. APPENDIX

The presented formula for the output gap is a simplified version of the actual formula used in the model. We allow multipliers to be cycle-dependent following Auerbach and Gorodnichenko (2013):

$$\frac{\partial gap_t}{\partial pb_t} = -m_1 (1 - m_2 gap_t)$$

where  $m_2$  governs the sensitivity of the multiplier to the output gap. Integrating this equation yields:

$$gap_t = m_2^{-1} + (v_t - m_2^{-1}) \exp(m_1 m_2 pb_t)$$

Then, we explicitly allow for the presence of fiscal stabilizers that react automatically to the business cycle:

$$pb_t = pb_t^{st} + a gap_t$$

Combining these equations yields the expression for the output gap

$$gap_t = -\frac{W(am_1(1 - m_2 v_t) \exp(m_1(a + m_2 pb_t^{st})))}{am_1 m_2} + m_2^{-1}$$

where  $W$  is the Lambert function.