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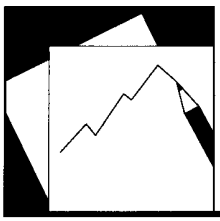

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That Squeezing Feeling: The Interest Burden and Public Debt Stabilization

Xavier Debrun and Tidiane Kinda

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That Squeezing Feeling: The Interest Burden and Public Debt Stabilization

Prepared by Xavier Debrun and Tidiane Kinda[1]

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Abstract

The paper explores the extent to which the pressure of debt service on other spending items may push governments to embark on fiscal consolidation beyond what is strictly necessary to secure solvency. The empirical analysis identifies thresholds of interest bill indicators beyond which governments appear to shift to policies aimed at durably curbing the debt trajectory. Hence, in the current context of high inherited public debts, countries experiencing rising borrowing costs and interest payments would be more likely to enact more aggressive fiscal consolidations than warranted by strict solvency concerns. Conversely, those benefiting from persistently low interest rates despite rising debt stocks would likely opt for a more gradual fiscal consolidation path than what solvency considerations would normally dictate.

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Authors' E-Mail Addresses: xdebrun@imf.org, tkinda@imf.org.

[1] Without implications in remaining errors or omissions, comments by Carlo Cottarelli, Martine Guerguil, Atish Ghosh, Suman Basu, Marcos de Carvalho Chamon, Sergio Sola, and seminar participants at the IMF and CERDI (Université d'Auvergne-Clermont 1) led to substantial improvements in the paper.

Contents

"I am doing this because each year France pays 49 billion euros as interest on its debt"

Nicolas Sarkozy, French President (2007-2012) announcing an austerity package in 2011, when the interest bill became for the first time the budget's largest spending item.

I. INTRODUCTION

For most advanced economies, high public debt will remain a lasting legacy of the global economic and financial crisis. Confronted to a sluggish recovery, governments face the challenging task of credibly dealing with large fiscal adjustment needs, while avoiding excessive fiscal retrenchments that could derail growth. As for all aspects of fiscal policy, however, governments view that trade-off in light of other objectives than stabilizing short-term growth, including the provision of a stable stream of public goods and services over time. These objectives motivate the quote reported above: debt service diverts taxpayers' money from items governments consider useful; and because any new debt issued to fund present primary spending ultimately curtails future fiscal space, there is a limit to the annual debt burden a politician can tolerate. This argument goes beyond the mere avoidance of continuously paying interests with new borrowing (the no-Ponzi condition) or the need to remain solvent, it reflects a conscious choice to secure the provision of public goods and services now and in the future.

A simple theoretical illustration helps clarify the reasoning. Under the rather weak assumption that debt service outlays do not directly generate social utility (and implicitly, that taxes are distortionary), the optimal fiscal policy path depends on current and future costs of servicing the debt (inherited and new). Specifically, if the bulk of service costs falls on future periods (which is generally the case), a higher inherited debt level increases the optimal primary balance in the current period to make space for future outlays on items governments consider useful. Hence, even in the absence of uncertainty,[2] an optimizing government effectively keeps public debt below levels that would raise solvency concerns. Indeed, the argument does not presume any binding constraint on the borrowing capacity (in which case the government would obviously have to cut present primary spending to service the debt), nor does it assume away the government's capacity or willingness to face its financial obligations in full. In that, the effect of debt service on optimal policy is not a mechanical result of the solvency constraint.[3]

The aim of this paper is to test empirically whether high and rising debt service can lead to a more ambitious adjustment than what is sufficient to secure solvency. To do so, we augment the regression-based solvency test proposed by Bohn (1998) with indicators of the pressure

[2] Under uncertainty, risk aversion and upper bounds on the primary surplus that can realistically be maintained would encourage governments to keep debt below the upper limits implied by the solvency constraint.

[3] Formally, the argument emanates from an interior solution.

that interest payments exert on fiscal space. Estimates are performed using a large panel of 29 advanced and 27 emerging economies from 1980 to 2010. The analysis also formally explores whether policymakers' response to the interest-payment squeeze is smooth or whether it is subject to non-linearities or threshold effects.

Our findings generally suggest that all else equal—including the debt level—a larger interest bill is associated with higher primary balances. The first implication is that the average policy response to rising interest payments takes the form of higher primary budget balances. This mitigates the conventional interpretation of high and rising debt service as an indicator of a greater risk of default or debt restructuring. The second implication is that in the current context of high inherited debt, the breach of politically sensitive thresholds for interest payments could trigger a pace of consolidation that is more aggressive than warranted by strict solvency concerns. The third implication—and mere symmetric of the second one—is that periods of persistently low interest rates despite rising debt stocks may on average encourage a more gradual fiscal consolidation path than what solvency considerations would normally dictate.

The rest of the paper is organized as follows. Section II illustrates the basic economics of the relationship between debt service and optimal fiscal policy. Section III describes the empirical approach and presents some simple correlations between public debt and various indicators of interest payments. Section IV discusses the results and their robustness. The fifth and last section concludes.

II. High Debt Legacy, The Rate of Interest and Optimal Fiscal Policy

To understand the basic relationship between inherited debt levels, the rate of interest and optimal fiscal policy, we consider the simplest possible two-period deterministic model of fiscal policy, featuring a utility function and budget identities.[4] Total utility U is separable over time (the two periods are indexed by 1 and 2):

$$U = u(q_1) + \frac{1}{1+\delta}u(q_2), \tag{1}$$

with δ, the subjective discount rate of the government, and q_i $(i = 1; 2)$, the quantity of public goods and services delivered in period i. The period utility functions are twice-continuously differentiable with the conventional properties: $u' > 0$ and $u" < 0$.

At the beginning of the first period, the government is hit by an exogenous shock on public debt—e.g. implicit or contingent liabilities materialize—leaving an initial debt level b_0.

[4] See for instance Alesina and Tabellini (1990).

Taking as given a proportional tax rate (τ) on a predetermined output level (y),[5] a real rate of interest (r) paid on government paper, and a fixed proportion $0 \leq \omega \leq 1$ of the initial debt to be amortized during the first period, the budget identities write as follows:

$$\begin{cases} q_1 = \tau y - (r+\omega)b_0 + b_1 \\ q_2 = \tau y - (1+r)((1-\omega)b_0 + b_1) \end{cases} \tag{2}$$

In period 1, the government chooses q_1 to maximize equation (1). Since all debts are repaid in period 2 (when the world ends), this decision simultaneously determines the quantity of public goods provided in period 2, the new debt issued (or repayment made) in period 1, and implicitly, the amount of obligations maturing in period 1 that is refinanced. Using the intertemporal budget constraint to substitute for q_2, the maximization program is:

$$\max_{q_1} u(q_1) + \frac{1}{1+\delta} u\big((2+r)\tau y - (1+r)q_1 - (1+r)^2 b_0\big) \tag{3}$$

The first-order condition is the familiar Euler equation (4):

$$u'(q_1^*) = \rho u'(q_2^*), \text{ with } \rho = \frac{1+r}{1+\delta}\ , \tag{4}$$

and where star superscripts denote optimal values. Equation (4) implies that the optimal gross debt issuance (or repayment if $b_1^* < 0$) is entirely determined by the desired time profile of public good delivery (q_1^*, q_2^*). Since inherited liabilities affect the time path of available non-borrowed resources, they will impact gross (and net) issuances in period 1. The marginal effect of inherited liabilities b_0 on primary spending (or equivalently, on the borrowing requirement) is obtained by totally differentiating the Euler equation and rearranging:

$$\frac{dq_1^*}{db_0} = \frac{db_1^*}{db_0} = \frac{(r+\omega)u"_1 - \rho(1+r)(1-\omega)u"_2}{u"_1 + \rho(1+r)u"_2}. \tag{5}$$

The sign of the above expression is ambiguous. It is negative if ω is sufficiently small (essentially values around 0.5 or below). Hence if the pressure stemming from inherited debt (interest and amortization) falls mainly on future budgets, present primary expenditure will be negatively related to b_0. This adjustment takes place regardless of the need to preserve solvency because the intertemporal budget constraint is assumed to hold for all levels of b_0. It is an interior solution that solely reflects government's decision to preserve its preferred path of public good delivery. Expression (5) can be positive if amortizations of the inherited

[5] The assumption of exogenous output is immaterial for our results, but it greatly simplifies the algebra.

liabilities fall mostly in the current period, in which case it is optimal to raise the current public debt in response to a higher b_0 to maintain primary spending in the current period *and* shift part of the debt burden to the future. Of course, a government that completely neglects the future ($\rho \to 0$) would fully rollover any maturing debt and borrow to pay interest, in which case $\frac{db_1^*}{db_0} = r + \omega > 0$.

A similar comparative statics exercise can be done for r.

$$\frac{dq_1^*}{dr} = \frac{db_1^*}{dr} = \frac{(1+\delta)^{-1}u'_1 - \rho(b_1^* + (1-\omega)b_0)u"_2 + b_0 u"_1}{u"_1 + \rho(1+r)u"_2} \tag{6}$$

Equation (6) shows that an increase in the real cost of borrowing reduces current period borrowing through its first-order impact on the optimal path of public spending—the first term of the numerator in (6), or pure substitution effect—and the effects related to increased servicing costs. Specifically, if higher interest costs are felt mainly in the future, there will be an additional incentive for the government to cut present primary spending and correspondingly raise the primary balance (second term in the numerator). The only potential source of ambiguity stems from the last term in the numerator, which captures the optimality of smoothing the immediate impact of a change in the interest rate. In the extreme case of an infinitely impatient government ($\delta \to \infty$ and $\rho \to 0$), only that effect would materialize and the additional interest payments would be fully financed with new borrowing. (This is clear from the fact that under these assumptions, (6) would simply be $\frac{db_1^*}{dr} = b_0 > 0$).

To summarize, equations (5) and (6) show that variations in the interest bill can affect the primary balance through two channels. The first is the intertemporal substitution effect resulting from a change in borrowing costs, and the second, the response to the crowding out of socially useful expenditure by the interest bill. Awareness that public debt impinges on resources available for funding future policies is likely to encourage present savings. The empirical implication is that optimizing governments would be expected to respond to the interest bill independently of "pure" solvency concerns.

III. Empirical Analysis

A. Methodology

To test the model's prediction, we "augment" the regression-based solvency test proposed by Bohn (1998) to explore the existence of a separate effect of the interest bill on fiscal behavior. Bohn's test relies on estimating a "fiscal reaction function" linking the primary budget balance to potential determinants, including the business cycle and (lagged) public debt. Bohn (1998) demonstrates that a positive response of the primary balance to an increase in debt is a sufficient condition for solvency. Although the empirical validity of the Bohn test

ultimately rests on the long-term time-series properties of debt and the primary balance, many studies have estimated similar relationships using fixed-effect panel regressions (Gali and Perotti, 2003; IMF, 2003; Debrun and others, 2008, or Mendoza and Ostry, 2008). A general formulation of our empirical model is described by equation (7). It explains the primary balance by the lagged gross debt to capture the impact of the long-term solvency constraint on current policy (the Bohn test), a measure of the interest burden[6] (our proposed "augmentation"), an AR(1) term to allow for persistence, and control variables, including the output gap, a crisis variable that captures the fiscal impact of banking crises, a measure of global risk aversion (VIX), and an external default dummy.

$$PB_{i,t} = \lambda PB_{i,t-1} + \sum_k \beta_k X_{k,i,t} + \gamma DEBT_{i,t-1} + \delta INTEREST_{i,t} + \mu_i + \varepsilon_{i,t}, \qquad (7)$$

where *i* and *t* represent countries and years respectively; *PB* denotes the primary balance in percent of GDP; *DEBT* is the gross public debt in percent of GDP; the *X*s' symbolize control variables; *INTEREST* is a measure of the budgetary footprint of the interest bill (it is the ratio of interest payments in percent of government revenue, tax revenue, or GDP); μ_i represents country fixed effects; while $\varepsilon_{i,t}$ is the error term. To the extent that they are available, all fiscal variables are measured for the general government.[7]

Under the null hypothesis of solvency, the estimated debt coefficient ($\hat{\gamma}$) is positive. As shown in Section II, the sign of $\hat{\delta}$ is a priori ambiguous. It will be positive if a growing pressure of the interest bill tends to encourage current savings to preserve future fiscal space. However, $\hat{\delta}$ could also be negative if the government heavily discounts the future or if the average maturity of public debt is very short. It is also important to note that if the theoretical argument of Section II holds, omitting interest payments in (7) would imply a bias in $\hat{\gamma}$ (the bias would be positive if $\hat{\delta} > 0$). Among the control variables, the sign of the output gap coefficient is of interest, as it indicates whether fiscal policy is countercyclical (positive sign) or procyclical (negative sign).

Estimating dynamic panel data models with standard techniques, such as the least squares dummy variable (LSDV) estimator, is not consistent when N is large and T is finite. We therefore use the bias-corrected Least Square Dummy Variable (LSDVC) dynamic panel estimator suggested by Bruno (2005)[8], which approximates the bias inherent to dynamic

[6] Note that for a given GDP growth rate, this approach is equivalent to testing for a link between the actual primary balance and its debt-stabilizing level only when the interest-bill to GDP ratio is used as an indicator (see Faini, 2006).

[7] Appendix A describes data sources. Stationarity tests in Table A.1 strongly reject the null of a unit root.

[8] Bruno's (2005) bias approximation of the LSDV estimator for dynamic unbalanced panel data extends the results of Bun and Kiviet (2003), Kiviet (1999), and Kiviet (1995).

unbalanced panels and constructs a consistent estimator. That estimator performs better than other methods, such as the Generalized Method of Moments (GMM) estimators, when N is moderately large and T relatively small, as in this paper (Judson and Owen, 1999).[9]

Prior to estimating equation (7), the next subsection describes the relationship between the debt level and the interest bill. If, as we conjecture, interest payments influence government's incentives to stabilize or reduce public debt—through consolidation or other means—we should observe a strong non-linearity pointing to a debt limit related to the size of interest payments.

B. Interest Payments and Debt: Stylized Facts

Under the assumption of constant interest rate, interest payments should be directly proportional to the debt level. In practice, however, ever rising debt-to-GDP ratios are known to be unsustainable, while interest payments cannot be allowed to eat up the entire budget. Hence financial markets, governments or both are bound to respond when either the debt ratio or interest payments near certain critical thresholds. Market participants may suddenly sell government bonds considered as unsafe, leading to explosive refinancing costs, while governments may embark on an aggressive consolidation aimed at stabilizing and ultimately lowering the debt ratio. In both cases, the existence of debt or interest-payment thresholds triggering such actions would entail a non-linear relationship between the two.

Simply plotting the data on interest payments against public debt between 1980 and 2010 (for advanced and emerging economies) reveals an inverted U shaped relationship (Figure 1). These non-linear correlations are consistent either with financial markets punishing harshly those countries that exceed certain debt thresholds (eyeballing the charts suggest about 100 percent of GDP for advanced economies and 60 percent for emerging markets), or with governments actively stabilizing the debt ratio once interest payments absorb an excessive share of budgetary resources.

This exercise shows the interest of implementing our proposed test for the entire spectrum of interest burden indicators, using tax revenues, total revenues, and GDP as denominators. Indeed, the non-linearity appears much better defined when the interest-payment ratio is measured in terms of total government (or tax) revenue. This would suggest that governments with greater room to raise revenues—i.e. those collecting a relatively small share of GDP in revenues—may choose to delay the adjustment, whereas those faced with a

[9] Celasun and Kang (2006) show that the quality of fiscal reaction function estimations, using the least squares dummy variable or the Arellano and Bond (1991) and Blundell and Bond (1998) GMM methods, depends on the variable and coefficient estimate of interest. While LSDV methods are preferable for tests of intertemporal solvency, GMM methods using exogenous instruments for the output gap would be preferable to test fiscal policy procyclicality or countercyclicality.

fixed revenue pool—as conjectured in Section II—would be forced to respond quickly to prevent the crowding out of socially useful spending by interest payments.

Of course, these simple non-linear correlations do not necessarily mean that the induced action to reduce the debt would exclusively take the form of stronger primary balances. Breaching certain interest payment thresholds might as well motivate heterodox strategies to reduce the debt burden, including inflation surprises, financial repression, and debt restructuring (see IMF, 2012), which are all beyond the scope of this paper.

Underlying our discussion is the idea that the share of budgetary resources allocated to interest payment determines the time when a government concludes that it cannot afford additional debt and must "do something" about it. Taking that argument for granted, simple "spline" fixed-effect regressions allow identifying thresholds of interest payments coinciding with a significant change in the relationship with the debt-to-GDP ratio.[10] This procedure confirms the strong non-linearity evident from Figure 1, with the most precise estimates obtained for the interest payments to total revenue ratio.[11] It appears that interest payments in excess of 5 percent of total revenue coincide with a significant deceleration in debt accumulation (both in advanced and emerging market economies) and that interest bills in excess of 11 percent of total revenue for advanced economies and 20 percent for emerging markets exhibit a negative association with debt-to-GDP ratios, suggesting that measures are indeed adopted to stabilize or reduce public debt when interest payments rise beyond certain levels.

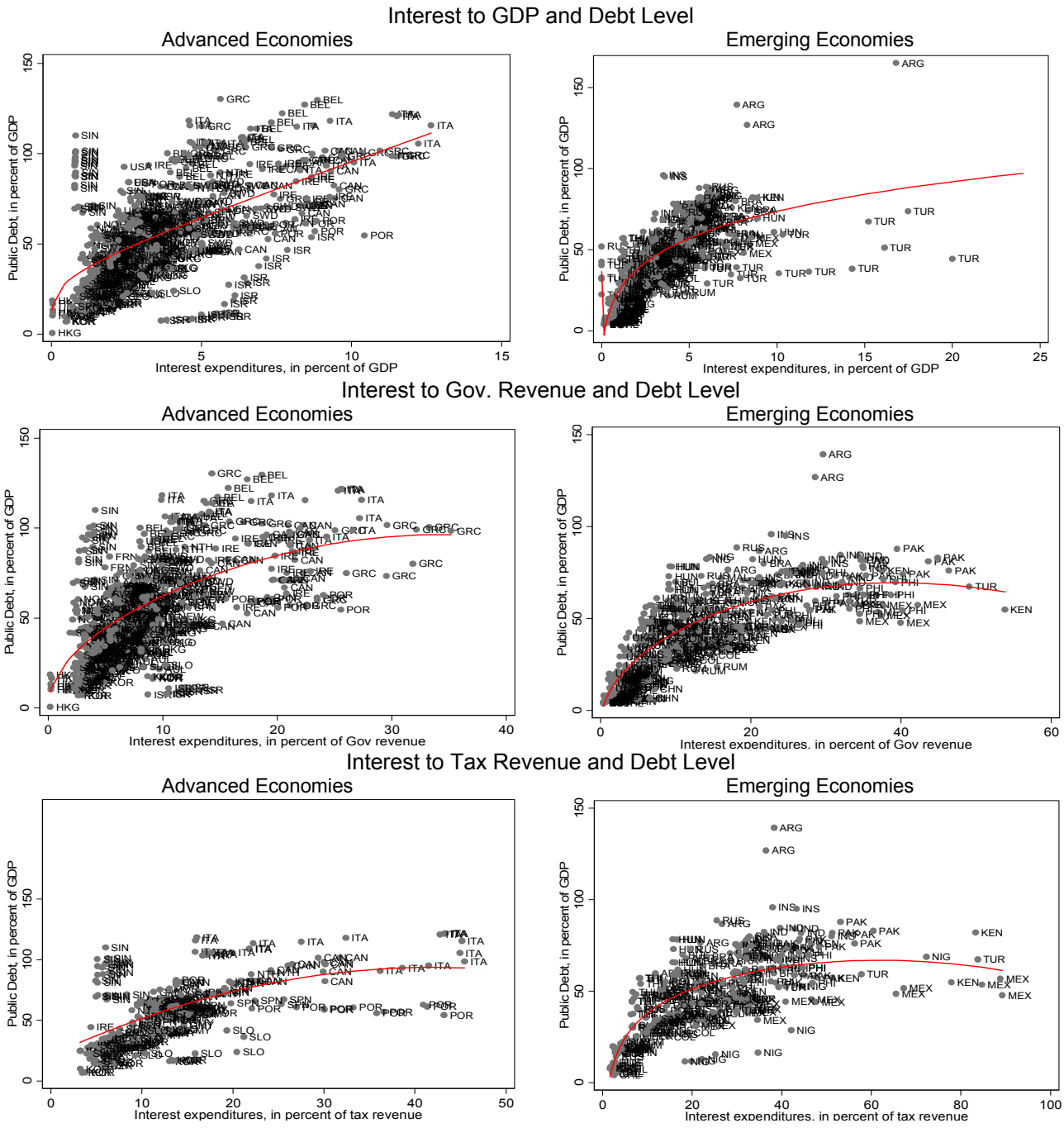
Although the evidence in Table 1 remains descriptive, market analysts and rating agencies often interpret high interest burdens as signaling a greater risk of government actions aimed at eroding the real value of the debt, including inflation, restructuring or default (Moody's, 2009). In all three cases, the impact on the primary balance is a priori unclear and likely to depend on the initial position. On the one hand, countries with a sizable primary surplus could be led to relax the fiscal effort as the pressure from solvency concerns would wane and inflation would at least temporarily deteriorate the nominal balance as tax revenues lag the rise in nominal primary spending (the Oliveira-Tanzi effect). On the other hand, countries with low or negative primary balances would probably not escape an aggressive consolidation because access to financing would be lost or constrained. That said, the policy signal emanating from a high and rising interest bill is all but clear, as this could also trigger

[10] Spline regressions estimate linear slopes for different ranges of interest payments with the endpoint of each range identified as a "knot." By default, knots are placed at equally spaced centiles of the distribution of the interest bill. The model starts from spline specification with the highest possible number of knots and converges towards the best fitting model by eliminating statistically insignificant knots (at the 5 percent level).

[11] Table A2 in the appendix confirms the strong non-linearity by using squared terms.

successful debt stabilizations through consolidation.[12] The estimation of the augmented fiscal reaction functions (7) will shed new light on this question.

Figure 1. Public Debt to GDP and Interest Expenditure Ratios



[12] For instance, the case studies of Belgium and Italy in IMF (2012) are telling in that regard.

Table 1. Interest Payments Ratios and Debt Level: Spline Fixed-Effect Regressions

	Dependent Variable: Debt to GDP (in Percent)								
	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Interest to GDP1(t-1)	13.157 (17.92)***	4.610 (12.23)***	15.626 (13.69)***						
Interest to GDP2(t-1)	4.604 (7.16)***		8.523 (7.28)***						
Interest to GDP3(t-1)			4.943 (5.06)***						
Interest to Gov rev1(t-1)				12.966 (13.98)***	8.995 (8.32)***	19.203 (14.98)***			
Interest to Gov rev2(t-1)				4.306 (6.56)***	2.938 (3.33)***	7.608 (8.37)***			
Interest to Gov rev3(t-1)				-3.143 (4.53)***	-2.736 (2.96)***	-4.127 (4.76)***			
Interest to tax rev1(t-1)							16.642 (17.23)***	5.707 (5.57)***	22.154 (16.63)***
Interest to tax rev2(t-1)							5.394 (6.73)***	2.527 (3.13)***	9.539 (7.80)***
Interest to tax rev3(t-1)							-4.336 (5.57)***		-8.630 (6.85)***
Constant	52.190 (106.84)***	38.631 (24.73)***	45.157 (57.19)***	51.715 (105.96)***	56.873 (81.30)***	43.248 (76.14)***	53.688 (111.96)***	58.476 (92.37)***	49.690 (73.71)***
First Knot Position	3.158		2.972	4.939	4.856	5.141	9.613	17	13.8
Second Knot Position			4.916	13.81	11.32	19.96	29.92		37.6
R-squared	0.22	0.17	0.35	0.18	0.12	0.40	0.39	0.13	0.52
Observations	1,236	785	451	1046	650	396	523	238	285
Number of countries	56	29	27	56	29	27	36	14	22

T-statistics in parentheses. *** significant at 1%. Interest to Gov rev 1, Interest to Gov rev 2, and Interest to Gov rev 3 illustrate the correlation between interest payments to government revenue and debt level when: interest payments are below or equal to the first knot position (Gov rev 1), interest payments are between the first and the second knot positions (Gov rev 2), and interest payments are beyond the second knot positions (Gov rev 3). A similar approach applies to the ratio of interest payments to GDP (Interest to GDP1-3) and interest payments to tax revenues (Interest to tax rev1-3).

IV. Debt Stabilization: The Role of the Interest Burden

This section formally tests whether the interest burden fosters improvements in the primary balance over and above policymakers' regular concern for solvency. As discussed above, however, a positive relationship between the primary balance and the interest bill may actually hide other policy measures with a stabilizing impact on public debt. In econometric terms, the risk of an omitted variable bias looms large and will need to be taken seriously to conclude that a causal relationship runs from the debt burden to debt dynamics. Before discussing the robustness of the estimations and their interpretations, we present the basic results.

A. The "Augmented" Bohn Regressions

To ease comparability with the existing literature on regression-based solvency tests (Bohn, 1998), we estimate equation (7) excluding interest payments ($\delta = 0$) and using only the output gap and a banking crisis variable as controls. The results obtained for our sample are consistent with many similar studies. The primary balance exhibits fairly strong persistence, while Bohn's sufficient condition for solvency cannot be rejected: the primary balance responds positively to an increase in public debt.[13] In addition, the headline primary balance improves along with the output gap—a countercyclical behavior largely related to the operation of automatic stabilizers (see also Ostry and others, 2010). The crisis variable captures the large fiscal costs of banking crises, particularly in advanced economies.

A recurrent issue with these solvency tests has been that the stabilizing response of the primary balance is generally found to be weak. Specifically, the estimated response cannot rule out debt ratios that may be deemed unrealistically high by historical standards (see IMF, 2003, for an early discussion). Allowing for an independent response to the interest bill along the lines discussed above may partly address this issue and provide a more complete and satisfactory picture as to how debt dynamics shape fiscal behavior.

Adding interest payments ratios to the fiscal reaction function suggests that all else equal, they have a stabilizing influence on debt through higher primary balances (Table 3). Importantly, the impact of the debt level itself remains significantly positive.[14] Even though point estimates of $\hat{\delta}$ are quantitatively smaller in most cases (in line with the likely upward bias mentioned earlier), the difference with the baseline regression reported in Table 2 is in

[13] Our quantitative estimates for the (lagged) debt coefficient are in line with the existing literature, in the range of 0.03 to 0.04 (see Bohn, 1998; and more recently, Gali and Perotti, 2003; and Debrun and others, 2008).

[14] One exception is the advanced economies regression when interest payments are expressed as a share of tax revenue.

most cases not statistically significant, particularly when more direct indicators of debt costs (interest payment as a share of total or tax revenue) are considered. Overall, these results suggest that the impact of the interest burden matters in its own right. Hence, it appears that concerns about the "affordability" of public debt come on top of due regards for long-term solvency. The magnitude of the interest burden effect is also notable. For instance, a 10 percentage-point increase in the debt-to-GDP ratio leads to an average improvement in the primary balance of about ¼ of percentage point of GDP the following year. Assuming that this new debt was contracted at an interest of say 5 percent, the primary balance typically tighten further by an additional 0.1 percentage point of GDP.

Table 2. Conventional Fiscal Reaction Function (1980-2010, unbalanced panel)

	Dependent Variable: Primary Balance in percent of GDP					
	Fixed Effects			Bias Corrected LSDV Dynamic Panel		
	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging
	(1)	(2)	(3)	(4)	(5)	(6)
Primary Balance(t-1)	0.682 (30.75)***	0.704 (27.63)***	0.549 (12.76)***	0.740 (28.13)***	0.752 (27.50)***	0.620 (12.84)***
Debt(t-1)	0.038 (9.79)***	0.035 (6.48)***	0.040 (7.72)***	0.035 (7.67)***	0.032 (5.38)***	0.037 (5.52)***
Output Gap	0.214 (6.46)***	0.353 (6.74)***	0.166 (4.06)***	0.206 (5.35)***	0.343 (6.87)***	0.159 (3.84)***
Crisis	-1.541 (6.64)***	-2.560 (8.48)***	-0.172 (0.50)	-1.494 (5.91)***	-2.505 (6.91)***	-0.171 (0.47)
Constant	-1.725 (8.31)***	-1.645 (5.41)***	-1.587 (6.14)***			
R-squared	0.71	0.75	0.64			
Observations	1,122	723	399	1,122	723	399
Number of countries	54	28	26	54	28	26

Bootstrapped t-statistics in parentheses for Bias Corrected LSDV Dynamic Panel Models.
** significant at 5%; *** significant at 1%.

We now look at the robustness of our results and their interpretations. We first investigate whether the positive effect of the interest bill on the primary balance reflects a response to the effective cost of borrowing or a reaction to the size of public debt through its budgetary footprint. Second, we add selected control variables whose omission could potentially bias the results. Finally, we test for threshold effects in the manifestation of debt affordability concerns.

Table 3. Augmented Fiscal Reaction Function with Interest Payments Ratios
Bias Corrected LSDV Dynamic Panel Model

	Dependent Variable: Primary Balance in percent of GDP								
	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Primary Balance(t-1)	0.739 (28.22)***	0.761 (27.48)***	0.595 (12.44)***	0.752 (26.29)***	0.764 (22.48)***	0.635 (12.47)***	0.675 (17.70)***	0.707 (16.12)***	0.604 (11.01)***
Debt (t-1)	0.024 (4.68)***	0.022 (3.06)***	0.026 (3.62)***	0.024 (3.37)***	0.021 (2.94)***	0.037 (3.38)***	0.027 (2.65)***	0.012 (0.87)	0.039 (3.86)***
Output Gap	0.209 (5.46)***	0.344 (6.89)***	0.165 (4.01)***	0.210 (6.07)***	0.349 (5.54)***	0.163 (3.83)***	0.292 (6.21)***	0.460 (6.42)***	0.239 (4.23)***
Crisis	-1.472 (5.89)***	-2.384 (6.68)***	-0.283 (0.76)	-1.608 (6.99)***	-2.498 (6.91)***	-0.282 (0.84)	-1.199 (3.52)***	-2.126 (4.61)***	-0.293 (0.68)
Interest to GDP (t-1)	0.175 (3.07)***	0.167 (2.30)**	0.172 (2.21)**						
Interest to Gov rev (t-1)				0.070 (3.61)***	0.078 (2.95)***	0.041 (2.04)**			
Interest to Tax rev (t-1)							0.039 (3.80)***	0.097 (3.21)***	0.020 (1.74)*
Test of coef. Equality† [p-value]	4.69 [0.03]	3.67 [0.05]	1.48 [0.22]	2.27 [0.13]	2.20 [0.14]	0.00 [0.99]	0.68 [0.41]	2.68 [0.11]	0.19 [0.67]
Observations	1,122	723	399	988	611	377	507	237	270
Number of countries	54	28	26	54	28	26	35	14	21

Bootstrapped t-statistics in parentheses.
†Tests of coefficient equality compare Debt (t-1) coefficients between Table 2 (conventional fiscal reaction function) and Table 3 (augmented fiscal reaction function).
** significant at 5%; *** significant at 1%.

B. Borrowing Costs or Debt Overhang?

As the interest bill is the product of borrowing costs and the debt level, it is a priori unclear whether its impact on the primary balance captures a response to effective borrowing costs—which could point to "benign" intertemporal substitution motivated by variations in interest rates—or a reaction to the crowding out of future primary spending by debt service costs, which could be the sign of a looming debt overhang. The theoretical framework discussed in Section II does not suggest a direct test of these competing interpretations. Indeed, equation (6), which characterizes the impact of a change in the rate of interest on optimal fiscal policy does not disentangle the pure intertemporal substitution from the potential crowding out effect of the interest bill.

However, differences in the response of the primary balance to a change in effective borrowing costs versus a change in the interest bill could provide useful information on the underlying determinants of policy-driven debt stabilizations. First, an increase in the effective interest rate has a first-order impact on optimal fiscal policy (intertemporal substitution), suggesting that a positive response of the primary balance should be expected from optimizing governments. Second, the absence of such reaction would point to strong myopia—and a correspondingly large deficit bias, possibly reflecting political factors—with governments simply trying to preserve present primary spending in the face of rising debt service costs. Third, the combination of a positive response to the interest bill and no significant response to the interest rate would point to more constrained policy-making in which a myopic government can be forced to adjust the primary balance when facing debt overhang—for instance because of credit rationing.

It is therefore useful to re-estimate equation (7), replacing the interest bill by the effective rate of interest on public debt—i.e. interest payments in the current period divided by the lagged value of the debt stock (Table 4). Although this measure of the interest rate is less subject to reverse causality than bond yields, the regression uses the lagged value of the effective interest rate to minimize that risk.

Interestingly there is a marked difference between the estimates obtained for emerging markets and for advanced economies. While the effective rate of interest on public debt has no meaningful impact on fiscal behavior in emerging markets, it has a positive and statistically significant influence on the primary balance in advanced economies.[15] Specifically, a 100 basis points increase in the effective interest rate leads to an average

[15] Mauro and others (2013) also show that a higher sovereign borrowing cost increases mildly fiscal prudence. Beyond the standard intertemporal substitution argument, active consolidation in response to rising borrowing costs could be a deliberate signal of commitment to solvency and avoidance of liquidity problem.

improvement in the primary balance of about 0.1 percent of GDP. This comes on top of the response to the debt level itself, whose estimate is very close to the results of the conventional Bohn test. These contrasting results are consistent with the existence of more pronounced policy biases in terms of excessive deficits and delayed adjustments among emerging markets than among advanced economies during our sample period. The finding that interest payments in proportion of revenue nevertheless lead to consolidation suggests that debt *levels* matter more than borrowing costs, which could indicate that the perception of debt overhang—especially when certain thresholds are crossed—could constrain available financing and force higher primary balances.

Table 4. Augmented Fiscal Reaction Function with Effective Interest Rate
Bias Corrected LSDV Dynamic Panel Model

	Dependent Variable: Primary Balance in percent of GDP		
	Advanced & Emerging	Advanced	Emerging
	(1)	(2)	(3)
Primary Balance(t-1)	0.740 (32.04)***	0.782 (28.34)***	0.598 (13.54)***
Debt (t-1)	0.035 (6.17)***	0.030 (4.50)***	0.041 (6.13)***
Output Gap	0.196 (6.83)***	0.328 (6.53)***	0.160 (4.19)***
Crisis	-1.704 (5.95)***	-2.594 (7.24)***	-0.384 (1.07)
Interest Rate(t-1)	0.003 (1.27)	0.077 (2.18)**	0.002 (0.91)
Observations	1,075	690	385
Number of countries	54	28	26

Bootstrapped t-statistics in parentheses for Bias Corrected LSDV Dynamic Panel Models.
** significant at 5%; *** significant at 1%.

C. Omitted Variables

We check the robustness of our key results to potential bias stemming from omitted variables. We focus on fairly strong candidates, i.e. variables that could have simultaneously affected our indicators of interest burden and fiscal policy in addition to the controls already included in the estimated models.

First, our results may be influenced by global risk appetite, with benign environments being favorable to low risk premia and easy access to financing at favorable conditions. To do so, we include a proxy for near-term uncertainty: the Chicago Board Options Exchange Volatility Index (VIX). The VIX is a measure of the market's expectation of stock market volatility over the next 30-day period. It is a weighted blend of prices for a range of options on the S&P 500 index. Controlling for short-term uncertainty with the VIX index does not alter the main result: the interest burden triggers fiscal adjustment over and above what solvency requires. Testing the different indicators of interest burden confirms that the ratio of interest payments to government revenue has the strongest and

most precisely estimated impact on the primary balance. The rest of the analysis focuses on the latter (Table 5), although results for all indicators are available upon request.

Second, we look at whether the results hold when we take into account unusual events that may lead to large changes in debts and interest payments and directly affect fiscal policy by encouraging or forcing policy changes. These events include banking crises, inflation shocks as well as the defaults and restructuring that affected a number of emerging economies in our sample and constrained available financing.

In general, the results hold (Table 6). Unsurprisingly, all those global/external variables (VIX, banking crisis, and external default) are fairly highly correlated. As the external default variable is not statistically significant, we keep only two global indicators in the ensuing regressions: the VIX and the banking crisis indicator. Both are relevant for advanced and emerging economies. Because the effective interest rate already reflects expected inflation[16], we control for inflation shocks which could erode the value of existing nominal liabilities. Introducing a simple proxy for inflation shocks—deviations from the HP-filtered trend—does not alter our main results. The interest bill still matter beyond the solvency concern, and in some cases the impact on the primary balance is more precisely estimated. Deviations from inflation trends seem to have played a role only in emerging economies.

Third, several countries in our sample simultaneously undertook deliberate consolidations and debt reductions (through asset sales) to secure accession to the European Monetary Union (EMU). The corresponding convergence in borrowing costs and fall in interest burdens, particularly in countries like Spain and Italy, may affect our results. We constructed a dummy taking a value of one three years before each country's accession to the monetary union and the year of the accession, and zero otherwise. Introducing that variable[17] in the model does not affect the main results. While consolidation prior to EMU accession significantly explains fiscal developments in advanced economies, the estimated coefficients on debt service indicators remain positive and statistically significant (Table 7).

[16] The correlation between inflation and the effective interest rate is 0.97 and statistically significant at 1 percent. Hence, inserting the inflation rate as a control variable leads to severe multicollinearity.

[17] Alternative definitions of the euro-consolidation dummy (longer consolidation periods) were also tested but were found to have a much weaker impact.

Table 5. Augmented Fiscal Reaction Function: Control for Global Risk Appetite
Bias Corrected LSDV Dynamic Panel Model

	Dependent Variable: Primary Balance in percent of GDP								
	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Primary Balance(t-1)	0.829 (26.96)***	0.819 (23.20)***	0.702 (12.51)***	0.725 (15.72)***	0.737 (11.39)***	0.658 (10.42)***	0.812 (27.87)***	0.821 (23.42)***	0.627 (11.36)***
Debt (t-1)	0.036 (4.39)***	0.042 (3.63)***	0.025 (2.47)**	0.041 (4.60)***	0.065 (3.75)***	0.032 (3.07)***	0.03 (4.83)***	0.035 (3.03)***	0.024 (3.45)***
Output Gap	0.295 (5.52)***	0.54 (6.43)***	0.187 (4.01)***	0.233 (4.70)***	0.501 (3.93)***	0.194 (3.53)***	0.267 (5.35)***	0.501 (5.13)***	0.193 (3.79)***
Crisis	-1.348 (4.68)***	-2.447 (5.66)***	0.341 (0.99)	-1.151 (3.42)***	-3.561 (5.45)***	0.26 (0.55)	-1.445 (5.19)***	-2.533 (5.60)***	0.182 (0.52)
VIX Index	-0.023 (2.11)**	-0.022 (1.29)	-0.042 (3.44)***	-0.027 (2.06)**	-0.012 (0.46)	-0.034 (2.10)**	-0.015 (1.31)	-0.013 (0.83)	-0.038 (2.44)**
Interest to Gov rev(t-1)	0.05 (2.69)***	0.07 (2.36)**	0.043 (2.25)**						
Interest to Tax rev(t-1)				0.019 (1.73)*	0.033 (1.17)	0.015 (1.33)			
Interest to GDP(t-1)							0.096 (1.84)*	0.094 (1.23)	0.108 (1.74)*
Observations	635	366	269	360	146	214	681	394	287
Number of Countries	37	19	18	26	9	17	37	19	18

Bootstrapped t-statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6. Augmented Fiscal Reaction Functions: Control for External Default
Bias Corrected LSDV Dynamic Panel Model

	Dependent Variable: Primary Balance in percent of GDP								
	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging
	(1)	(2)	(3)	(4)	(5)	(6)			
Primary Balance(t-1)	0.830 (28.96)***	0.819 (23.20)***	0.701 (11.98)***	0.863 (28.33)***	0.889 (23.02)***	0.697 (12.16)***	0.827 (26.65)***	0.827 (23.82)***	0.688 (12.26)***
Debt (t-1)	0.035 (4.05)***	0.042 (3.63)***	0.024 (2.20)**	0.037 (4.13)***	0.048 (3.74)***	0.024 (2.19)**	0.036 (4.40)***	0.045 (4.00)***	0.025 (2.55)**
Output Gap	0.303 (5.28)***	0.540 (6.43)***	0.183 (3.16)***	0.344 (6.00)***	0.644 (7.40)***	0.176 (3.11)***	0.301 (5.59)***	0.510 (6.22)***	0.206 (4.39)***
Interest to Gov rev(t-1)	0.042 (1.99)**	0.070 (2.36)**	0.031 (1.69)*	0.042 (1.92)*	0.071 (2.18)**	0.031 (1.69)*	0.050 (2.66)***	0.063 (2.14)**	0.044 (2.36)**
Crisis	-1.400 (5.42)***	-2.447 (5.66)***	0.293 (0.79)				-1.294 (4.40)***	-2.395 (5.70)***	0.518 (1.50)
VIX Index	-0.024 (1.75)*	-0.022 (1.29)	-0.045 (3.25)***	-0.040 (2.92)***	-0.061 (3.40)***	-0.043 (3.15)***	-0.024 (2.25)**	-0.029 (1.68)*	-0.046 (3.80)***
External Default	0.884 (1.48)		0.407 (0.82)	0.506 (0.83)		0.491 (1.03)			
Inflation Deviation							0.015 (1.60)	0.202 (1.49)	0.021 (2.98)***
Observations	609	366	243	609	366	243	635	366	269
Number of Countries	35	19	16	35	19	16	37	19	18

Bootstrapped t-statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7. Augmented Fiscal Reaction Functions:
Control for Pre-Euro Accession Fiscal Consolidation

	Dependent Variable: Primary Balance in percent of GDP		
	Advanced & Emerging	Advanced	Emerging
	(1)	(2)	(3)
Primary Balance(t-1)	0.845 (28.43)***	0.838 (24.27)***	0.731 (14.38)***
Debt (t-1)	0.033 (3.85)***	0.038 (3.00)***	0.027 (2.35)**
Output Gap	0.313 (6.28)***	0.582 (6.41)***	0.190 (3.68)***
Interest to Gov rev(t-1)	0.048 (2.51)**	0.066 (2.05)**	0.040 (1.76)*
Crisis	-1.262 (4.61)***	-2.259 (5.33)***	0.303 (0.86)
VIX Index	-0.031 (2.60)***	-0.037 (2.11)**	-0.042 (3.02)***
Euro Accession	1.170 (3.13)***	1.133 (2.65)***	
Observations	635	366	269
Number of Countries	37	19	18

Bootstrapped t-statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Even though the results seem robust to variables capturing events likely to have simultaneously affected all or several countries in our sample, we might still miss other unspecified global trends or shocks—global growth or asset price trends—that could also bias the estimates. One straightforward "acid test" for these omitted contemporaneous developments is to introduce time dummies, instead of the variables tested above. The results collected in Table A3 in the appendix confirm the robustness of our basic results.[18]

D. Debt Targeting

As indicated earlier, the ratio between interest payments and GDP is a proxy for the debt-stabilizing primary balance (which is indeed approximately equal to the growth-adjusted interest rate multiplied by the lagged debt ratio). The argument is that for a given debt stabilization objective (and a given inherited debt level), the required primary balance to hit a specific debt target increases proportionally with borrowing costs (both in ratio to GDP). Thus in that conjecture, our result could be the mechanical implication of a pre-set debt target. Although the simple model in Section II yields an outcome that is

[18] Notice that as fiscal consolidation related to the Euro accession happened around the same period across a number of countries, the estimated impact of "Euro Accession" loses its statistical significance (see Table A3 and A4 in the Appendix).

observationally similar to strict debt targeting, it shows that the target itself would be adjusted in response to changes in interest payments.

Again, we take comfort in the fact that our estimates are generally more precise when narrower indicators of the budgetary footprint of interest payments are considered. These capture the argument embedded in the theoretical model better than the ratio to GDP. In fact, if the empirical regularity studied in this paper was mostly reflecting strict debt targeting, our results should have been turned on their head, with the greatest statistical precision obtained for the interest bill to GDP ratio, which is the best proxy of the debt-stabilizing primary balance.

E. Threshold Analysis

The simple comparative statics exercises in section II suggest that the optimal response of fiscal policy to a debt or interest rate shock will depend on the equilibrium level of debt itself, as derivatives are evaluated at the optimum. The implication for our empirical analysis is that it should explore the possibility of a non-linear relationship between the interest bill and fiscal policy. One pragmatic approach to searching for such non-linearity is to identify thresholds of interest payments beyond which the sensitivity of the primary balance to a given variation in the interest bill changes significantly.

The results in Table 8 suggest that additional fiscal adjustments motivated by the size of the interest bill tend to materialize when the latter exceeds 12 percent of government revenue for advanced economies and 26 percent of government revenue for emerging economies.[19] Below such thresholds, the results are quantitatively identical, but not statistically significant, pointing to a more determined fiscal policy response to an interest payments shock when these payments are already absorbing a large share of revenues. While there is no non-linearity to speak of in a quantitative sense, it is interesting to note that advanced economies tend to become more systematically responsive to interest payments at a much lower level (12 percent of revenue) than the average emerging market. This contrast in average fiscal behavior between the two groups echoes the results displayed in Table 4 which point to more severe myopia—and greater deficit biases—among emerging markets than among advanced economies.

[19] These results are confirmed with the introduction of time effects (Table A4).

Table 8. Threshold Effect: Augmented Fiscal Reaction Function with Interest Payments to Government Revenue
Bias Corrected LSDV Dynamic Panel Model

	Dependent Variable: Primary Balance in percent of GDP					
	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging
Primary Balance(t-1)	0.845 (28.66)***	0.838 (24.22)***	0.702 (13.54)***	0.847 (28.93)***	0.836 (23.40)***	0.702 (13.45)***
Debt(t-1)	0.033 (3.89)***	0.038 (3.04)***	0.025 (2.47)**	0.033 (3.90)***	0.038 (3.05)***	0.024 (2.34)**
Output Gap	0.313 (6.14)***	0.582 (6.42)***	0.187 (3.94)***	0.312 (6.11)***	0.583 (6.44)***	0.188 (3.89)***
Crisis	-1.262 (4.56)***	-2.259 (5.39)***	0.341 (1.00)	-1.261 (4.53)***	-2.268 (5.41)***	0.333 (0.98)
VIX Index	-0.031 (2.59)***	-0.037 (2.05)**	-0.042 (3.34)***	-0.031 (2.59)***	-0.036 (2.01)**	-0.042 (3.31)***
Euro Accession	1.170 (3.13)***	1.133 (2.66)***		1.170 (3.14)***	1.136 (2.66)***	
Interest to Gov rev(t-1) 1/	0.048 (2.47)**	0.066 (2.06)**	0.043 (2.15)**			
Interest to Gov rev1 (t-1) 1/				0.047 (1.20)	0.063 (1.04)	0.050 (1.40)
Interest to Gov rev2 (t-1) 1/				0.048 (2.27)**	0.065 (1.96)**	0.046 (2.03)**
Observations	635	366	269	635	366	269
Number of Countries	37	19	18	37	19	18

Bootstrapped t-statistics in parentheses. ** significant at 5%; *** significant at 1%.
1/ "Interest to Gov rev 1" and "Interest to Gov rev 2" differentiate the coefficients for interest payments to government revenue depending on whether the latter are either below (Gov rev 1) or strictly above (Gov rev 2) certain thresholds. These thresholds are 12 percent of government revenue for advanced economies and 26 percent of government revenue for emerging economies.

V. Summary and Conclusion

This paper estimates fiscal reaction functions à la Bohn (1998) to explore whether the footprint of public debt on the annual budget affects policymakers' concern for debt dynamics. Using a large sample of emerging and advanced economies, we find that a higher share of government revenue absorbed by interest payments tends to trigger a positive response of the primary balance beyond what is needed to achieve solvency. There are two potential reasons for this. The first is that governments set a specific target in terms of the debt-to-GDP ratio, forcing the actual primary balance to move in sync with its debt-stabilizing level. The second interpretation is that unless they are subject to extreme myopia, optimizing governments have a limited tolerance for the gradual crowding-out of socially useful spending by rising debt service. Regardless of the interpretation, this identifies a critical channel through which market discipline can operate, as higher borrowing and debt service costs tend to increase the primary balance.

While the empirical analysis cannot fully ascribe the results to one or the other interpretation, there are strong indications that the crowding out argument is a meaningful part of the story. Indeed, the impact of the interest bill on the primary balance is much more precisely estimated when interest payments are expressed as a share of revenue, which is a narrower indicator of the pressure exerted on the budget. A strict dominance of the first interpretation would have led to stronger results being obtained for the interest-payments-to-GDP ratio.

The results appear to be statistically robust, but they differ in two important dimensions between emerging and advanced economies. First, when aiming to disentangle the intertemporal substitution effect of borrowing costs from the mere size of the budgetary footprint of debt service, we find that only advanced economies show the expected positive response to the effective rate of interest, whereas the latter does not systematically affect fiscal policy in emerging markets. Second, the effect of the interest bill on debt stabilization efforts can only be precisely estimated when the ratio between interest payments and revenues exceed certain thresholds: 12 percent of government revenue for advanced economies, and 26 percent for emerging economies. These two striking differences between emerging and advanced economies are consistent with stronger deficit biases in the former than in the latter group during the sample period.

The main policy implication of the analysis is that in the current context of high inherited debt, the breach of politically sensitive thresholds for interest payments could trigger a pace of consolidation that is more aggressive than warranted by strict solvency concerns. Symmetrically, persistently low interest rates despite rising debt stocks are effective in encouraging a more gradual pace of fiscal consolidation, as governments would be inclined to tolerate higher debt levels. That said, the argument ignores uncertainty and asymmetric information, which could prompt governments to aggressively consolidate to signal commitment despite low rates.

APPENDIX

A. Data Sources

The analysis covers a large panel of 29 advanced and 27 emerging economies from 1980 to 2010. Advanced economies include Australia; Austria; Belgium; Canada; China,P.R.:Hong Kong; Czech Republic; Denmark; Finland; France; Germany; Greece; Iceland; Ireland; Israel; Italy; Japan; Republic of Korea; Netherlands; New Zealand; Norway; Portugal; Singapore; Slovak Republic; Slovenia; Spain; Sweden; Switzerland; United Kingdom; United States. Emerging economies include Argentina; Brazil; Bulgaria; Chile; China, P.R.: Mainland; Colombia; Estonia; Hungary; India; Indonesia; Kenya; Latvia; Lithuania; Malaysia; Mexico; Nigeria; Pakistan; Peru; Philippines; Poland; Romania; Russian Federation; Saudi Arabia; South Africa; Thailand; Turkey; Ukraine.

Debt data is from Abbas and others (2010) and the WEO. Banking crisis data is from Laeven and Valencia (2010) and external default data from Reinhart and Rogoff (2011). The global risk aversion variable (VIX index) is from Bloomberg. The primary balance, interest payments, and output gap variables are from the WEO, the OECD, and the WDI databases.

Table A.1. Unit Root Tests

	Augmented Dickey-Fuller	
	Statistics	P-value
Primary balance	221.2	0.000
Output gap	1037.0	0.000
Debt	148.2	0.001
Interest to Gov rev	390.7	0.000
Interest to Tax rev	380.6	0.000
Interest to GDP	240.1	0.000
Interest rate	205.4	0.000
VIX	229.3	0.000

Table A.2. Interest Payments Ratios and Debt Level: Non-linearity with Squared Term

	Dependent Variable: Debt to GDP (in Percent)								
	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging	Advanced & Emerging	Advanced	Emerging
Interest to GDP(t-1)	7.937 (13.59)***	5.682 (4.95)***	9.734 (11.31)***						
Interest to GDP(t-1)^2	-0.251 (7.16)***	-0.096 (0.99)	-0.328 (7.48)***						
Interest to Gov rev(t-1)				2.191 (10.06)***	2.553 (5.16)***	2.593 (10.02)***			
Interest to Gov rev(t-1)^2				-0.019 (4.87)***	-0.038 (2.49)**	-0.024 (5.99)***			
Interest to tax rev(t-1)							0.677 (11.05)***	1.561 (4.45)***	0.699 (9.45)***
Interest to tax rev(t-1)^2							-0.001 (4.10)***	-0.022 (3.09)***	-0.001 (3.74)***
Constant	27.952 (17.36)***	36.526 (13.84)***	17.727 (7.55)***	31.664 (17.83)***	38.478 (13.14)***	14.581 (5.78)***	38.528 (29.36)***	42.821 (13.73)***	29.043 (14.39)***
R-squared	0.22	0.17	0.30	0.16	0.10	0.34	0.34	0.13	0.43
Observations	1,236	785	451	1,046	650	396	523	238	285
Number of countries	56	29	27	56	29	27	36	14	22

T-statistics in parentheses. *** significant at 1%.

Table A 3. Augmented Fiscal Reaction Functions: introducing time dummies

	Dependent Variable: Primary Balance in percent of GDP		
	Advanced & Emerging	Advanced	Emerging
Primary Balance(t-1)	0.794 (30.95)***	0.825 (25.53)***	0.633 (12.68)***
Debt (t-1)	0.022 (3.37)***	0.019 (2.32)**	0.027 (2.45)**
Output Gap	0.121 (3.38)***	0.310 (5.07)***	0.056 (1.29)
Interest to Gov rev(t-1)	0.044 (2.52)**	0.064 (2.26)**	0.032 (1.69)*
Crisis	-0.769 (3.12)***	-0.984 (2.82)***	-0.063 (0.20)
Euro Accession	0.272 (0.81)	0.067 (0.19)	
Time Dummies	Yes	Yes	Yes
Observations	988	611	377
Number of Countries	54	28	26

Bootstrapped t-statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table A 4. Threshold Effect: Augmented Fiscal Reaction Function with Interest Payments to Government Revenue (including time dummies)

	Dependent Variable: Primary Balance in percent of GDP		
	Advanced & Emerging	Advanced	Emerging
Primary Balance(t-1)	0.810 (33.66)***	0.849 (25.65)***	0.629 (12.70)***
Debt (t-1)	0.023 (2.54)**	0.021 (2.62)***	0.025 (2.44)**
Output Gap	0.121 (2.99)***	0.305 (4.87)***	0.060 (1.44)
Interest to Gov rev1(t-1) 1/	0.056 (1.64)	0.090 (1.59)	0.056 (1.49)
Interest to Gov rev2(t-1) 1/	0.047 (2.43)**	0.075 (2.28)**	0.039 (1.71)*
Crisis	-0.787 (3.09)***	-0.975 (2.73)***	-0.081 (0.25)
Euro Accession	0.271 (0.88)	0.053 (0.15)	
Time Dummies	Yes	Yes	Yes
Observations	988	611	377
Number of Countries	54	28	26

Bootstrapped t-statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.
1/ “Interest to Gov rev 1” and “Interest to Gov rev 2” differentiate the coefficients for interest payments to government revenue depending on whether the latter are either below (Gov rev 1) or strictly above (Gov rev 2) certain thresholds. These thresholds are 12 percent of government revenue for advanced economies and 26 percent of government revenue for emerging economies.

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