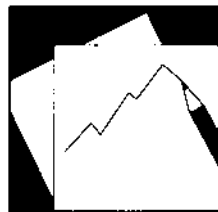


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Fiscal Deficits, Public Debt, and Sovereign Bond Yields

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IMF Working Paper

Fiscal Affairs Department

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Abstract

The recent sharp increase in fiscal deficits and government debt in many countries raises questions regarding their impact on long-term sovereign bond yields. While economic theory suggests that this impact is likely to be adverse, empirical results have been less clear cut, have generally ignored nonlinear effects of deficits and debt through some other key determinants of yields, and have been mostly confined to advanced economies. This paper reexamines the impact of fiscal deficits and public debt on long-term interest rates during 1980–2008, taking into account a wide range of country-specific factors, for a panel of 31 advanced and emerging market economies. It finds that higher deficits and public debt lead to a significant increase in long-term interest rates, with the precise magnitude dependent on initial fiscal, institutional and other structural conditions, as well as spillovers from global financial markets. Taking into account these factors suggests that large fiscal deficits and public debts are likely to put substantial upward pressures on sovereign bond yields in many advanced economies over the medium term.

This Working Paper should not be reported as representing the views of the IMF.

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I. INTRODUCTION

The recent sharp increase in fiscal deficits and public debt, particularly in advanced economies, raises a number of important issues regarding their impact on long-term interest rates. These relate to the magnitude of the impact and the extent to which it is influenced by other factors such as private savings rate, demographics, quality of institutions, and international financial integration. Although there is a significant existing literature exploring the relationship between deficits, public debt, and interest rates, there is a diversity of findings, and several of the specific issues explored in this paper have not been examined before.

The main objective of this paper is to reassess the effect of fiscal deficits and public debt on long-term government bond yields. It complements and extends the existing literature by exploring in particular the nonlinear effects of large fiscal deterioration and initial fiscal conditions, the impact of countries' institutional set up, and the likely spillovers from global financial markets. The evidence shows that large deficits and debt can have a marked adverse impact on bond yields, but that a variety of domestic and international factors are likely to determine the magnitude of this impact.

The rest of the paper is organized as follows: Section II notes the channels through which large deficits and debts are likely to impact bond yields and provides a summary of the existing findings. This is followed in Sections III and IV, respectively, by a discussion of the econometric model used in the analysis, and data and descriptive statistics. The main empirical results are reported in Section V, and the paper concludes with some policy implications of the findings.

II. CHANNELS OF IMPACT AND EXISTING STUDIES

Channels of impact

A key channel through which large fiscal deficits could be expected to have an impact on long-term interest rates occurs via the impact on national savings. In the standard neoclassical model, fiscal deficits (other things given) reduce national savings and increase aggregate demand (Elmendorf and Mankiw, 1998). This creates an excess supply of government debt, leading to higher real interest rates.

The yield curve is also expected to become positively sloped in anticipation of continuing large fiscal deficits. Although short-term real interest rates reflect cyclical conditions and the

stance of monetary policy, and influence real medium- and long-term rates,² the latter are likely to rise more in response to the anticipated worsening of fiscal deficits and debt (Blanchard, 1984). Large deficits and debt, particularly if combined with uncertainties relating to the pace of economic activity, could also raise concerns about the government's ability to service its debts. This would raise credit risk premia and government bond yields. In addition, the emergence of contingent fiscal risks emanating, say, from the financial sector could exacerbate sustainability concerns.

Nominal yields on sovereign securities could also increase due to higher inflation expectations, particularly in an environment where output gaps are positive, or where there are concerns about monetization of debt.³ Such expectations may increase the inflation premia embodied in the nominal rates;⁴ they may also generate macroeconomic uncertainty leading to higher country risk premia and aggravating fiscal solvency concerns (Baldacci, Gupta, and Mati, 2010).

These results may not hold fully when assumptions about agents' behavior are modified (Rebelein, 2006). If agents are forward looking, there may be some "Ricardian equivalence" with private saving increasing, as fiscal deficits increase, in anticipation of future tax hikes to fulfill the intertemporal budget constraint. This may reduce the impact on interest rates. If taxes are nondistortionary and individuals are heterogeneous (Mankiw, 2000), debt accumulation can be consistent with a short-run rise in interest rates, but may not have a pronounced impact on bond yields in the long run.⁵

Additional factors may weaken the link between debt, deficits, and interest rates. For instance, in an open economy, domestic savings may be complemented over a period of time by capital inflows (Feldstein, 1986a) leading to real exchange rate appreciation rather than higher real interest rates in response to lower government savings. It is unclear, however, to

² In the "expectations theory," current long real rates are determined by a weighted average of future short-term rates; while empirical analyses tend to reject the view that expectations about future short-term rates are fully rational—implying that the current long rates are also dependent on other factors—this does not rule out a positive correlation between future short rates and current long rates.

³ Real interest rates are a better gauge of the borrowing cost and therefore the implications of interest rates for investment. Nonetheless, nominal interest rates determine the debt service cost in the budget.

⁴ They may also be considered likely to trigger a monetary policy response that would raise short-term rates with implications for the long-term rates via the term structure of interest rates.

⁵ In his model with heterogeneous individuals, temporary tax cuts initially crowd out capital accumulation as agents' disposable incomes rise, leading to higher private consumption. However, with investment falling as a result of lower savings, the marginal product of capital and interest rate would rise. This provides incentives for higher savings until the optimal level of the marginal product of capital is restored. Therefore, in the medium term, interest rates return to the optimal level even if public debt is permanently higher.

what extent large deficits and debts could be financed by foreign savings on a sustained basis, so that eventually higher deficits may still have an impact on domestic bond yields.

Existing studies

Given the above a priori considerations, it is perhaps not surprising that there has been a heterogeneity of findings regarding the impact of fiscal deterioration on interest rates. Many country-specific and cross-country studies have found a diversity of results. In an earlier comprehensive survey, Gale and Orszag (2002) summarized the conclusions of almost 60 studies: of these, around one-half found a “predominantly positive significant” effect of fiscal deficits on interest rates and the other half a “mixed” or “predominantly insignificant” effect.⁶ A similar conclusion was reached by Engel and Hubbard (2004). Concerning the magnitude of the effect, the broad finding appears to be that an increase in deficits by 1 percent of GDP raises long-term interest rates by 30–60 basis points, while an increase in the debt-to-GDP ratio of 1 percentage point is associated with an increase in interest rates of between 2 and 7 basis points (see also in particular Engen and Hubbard, 2004; and Reinhart and Sack, 2000 and Kinoshita, 2006).⁷

In addition to differences arising due to model specification, explanatory variables and sample and time periods, the effect of fiscal policy on bond yields also appears to depend to some extent on the budget variable used. It is considerably larger and found more frequently when expected deficits (Feldstein, 1986b)⁸ are used.⁹ Results also point to a positive relation between fiscal deficits and long-term interest rates when there is uncertainty on the composition of fiscal policy (Balduzzi, Corsetti, and Foresi, 2007).¹⁰ Ardagna (2009) explores the behavior of government (and corporate) bond yields in times of large changes in the fiscal stance for the OECD countries (over the period 1960–2002). She finds that 10-year

⁶ Gale and Orszag (2002) argue that even when interest rates do not increase as a result of fiscal expansions (e.g., because of foreign capital savings replacing domestic savings) economic performance may still be negatively affected by persistent fiscal imbalances as capital stock accumulation declines (either because of a fall in domestic or foreign net investment).

⁷ See also Kumar and Woo (2010) for a complementary analysis of the adverse impact of large public debt on potential growth (in part due to the impact of debt on interest rates).

⁸ These studies have been mostly based on the United States and a few other advanced economies due to data constraints. VAR-based estimates of future deficits have weaker results than deficit expectations based on budget medium-term forecasts 5-years and 10-years ahead.

⁹ Results are also stronger when monetary policy effects on short-term real interest rates are accounted for. Impacts are larger when measured over a 10-year span using macroeconomic models: a primary deficit increase by 1 percent of GDP raises the 10-year bond yield by 50 basis points after one year and about 100 basis points after 10 years (Ardagna, Caselli, and Lane, 2007).

¹⁰ However, Dai and Philippon (2004) show that fiscal policy shocks also affect interest rates through higher risk premia on both short and long rates.

nominal yields on government bonds increased by more than 180 basis points during years in which the primary fiscal deficit widened by more than 1½ percent of GDP in one year or 1 percent of GDP per year in two consecutive years (the definition of “large change” in fiscal stance is consistent with Alesina and Perotti, 1995).¹¹

Laubach (2009) explores the relationship between long-horizon expectations of both fiscal variables and interest rates in the United States. Expectations of future fiscal policy are proxied by projections published by the CBO for the federal government’s unified budget deficit and other fiscal variables. These are then related to forward rates five years ahead embedded in the term structure of interest rates. The results show that a percentage-point increase in the projected deficit to GDP ratio raises the 5-year-ahead 10-year-forward rate by 20–29 basis points while a percentage point increase in the projected debt-to-GDP ratio raises the forward rate by about 3–4 basis points.

Laubach’s (op. cit.) results that flow fiscal variables have typically found much larger effects than those considering stock fiscal variables are echoed in other studies (Gale and Orszag op. cit, and Haugh, Olivaud, and Turner, 2009). Generally, estimated impact ranges from a minimum of 10 basis points up to 60 basis points for a percentage point of GDP increase in fiscal deficit, while a percentage point increase in the debt ratio raises yields by about 3–7 basis points. For example, Thomas and Wu (2009) in a study for the United States find that a 1 percent of GDP deterioration in the 5-year-ahead projected fiscal deficit raises long-term interest rates by 30–60 basis points, while a similar study using current and projected public debt as the fiscal variable suggested an estimated impact of 5 basis points (Chinn and Frankel, 2005).

How plausible is it that the estimated coefficients on the deficit tend to be orders of magnitude larger than the one on the debt ratio? Laubach (op. cit) notes that, if on one extreme, the changes in deficits were serially uncorrelated, a projected 1 percent of GDP increase in the deficit would raise public debt in subsequent years by 1 percentage point of GDP, and the coefficients on the deficit and debt ratios should be the same. But if, on the other extreme, every increase in projected deficits is assumed to be permanent, the steady-state effect on the debt ratio of a permanent 1 percentage point increase in the deficit ratio is $(1+g)/g$ percent, where g is the growth rate in nominal GDP. For the United States, over the sample 1976 to 2006, output growth was 7 percent, implying that the coefficient on the deficit ratio ought to be 15 times as large as the coefficient on the debt ratio. The estimates results then suggest that investors “perceive increases in projected deficit ratio as highly persistent but not strictly permanent.”

¹¹ For a related discussion of the impact of credibility of policies on interest rate spreads, see Hauner, Jonas, and Kumar (2010).

Studies for a cross-section of economies indicate a smaller impact than analysis of individual countries. This may be because in the pooling of data, country-specific coefficients tend to be heterogeneously affected by institutional and structural factors, which are generally not explicitly taken into account in many of the studies. Ardagna, Caselli, and Lane (2007) find that a deterioration of 1 percent of GDP in the primary balance for a sample of 16 OECD countries leads to an increase in government bond yields by 10 basis points. This is lower than the estimated coefficient found by Dai and Philippon (2005) for the United States using the same fiscal indicator. The latter study points to an impact on interest rates ranging from 20 to 60 basis points for each 1 percentage point reduction in the primary balance, consistent with Thomas and Wu results noted above.¹²

Ardagna et al. (op. cit) for a sample of 16 OECD countries and Conway and Orr (2000) for seven major advanced economies also find that the impact of public debt on long-term bond yields depends on initial debt levels. Higher public debt raises the perception that governments will be less able to service their liabilities and therefore increase credit risk. Also, countries with large debt accumulation tend to be more at risk of inflationary pressures raising nominal short-term interest rates. These factors affect the long end of the term structure and raise borrowing cost for long-term government securities nonlinearly.¹³

A number of studies have considered the impact of public debt on credit risk spreads in countries sharing the same currency to avoid the risk that expectations regarding exchange rates may affect the results. For instance, some studies have examined the spread of EU sovereign yields over the German bonds, and found that an increase in public debt has a significant but small impact on bond yields. However, this result holds only in countries with high debt levels (Paesani, Strauch, and Kremer, 2006).¹⁴

Financial globalization in recent years has allowed more capital to flow into sovereign bond markets. The access to foreign savings has benefited in particular emerging market sovereigns, although larger capital inflows also helped keep long-term sovereign bond yields low in industrial countries such as the United States despite higher bond supply (Hauner and Kumar, 2009). Integration of government bond markets has also stimulated better pricing of sovereign credit risk in many countries, as the development of a deeper secondary market for government securities has enhanced price discovery. Moreover, reduced home bias is likely to have reduced crowding out in domestic credit markets.

¹² Reinhart and Sack (op. cit) find that for a sample of OECD countries, the impact of a deterioration in fiscal balance by 1 percent of GDP in the current and the following year raises government bond yields by 9 basis points, while for G7 countries only, presumably a less heterogenous sample, the increase is 12 basis points.

¹³ For the OECD countries, an increase in public debt affects bond yields significantly only when initial debt levels are above 60 percent of GDP.

¹⁴ In addition to the impact on spreads for countries in a monetary union, enhanced credibility of policies for countries likely to join a monetary union may also have an impact. See Hauner et al. (2010).

In the largest advanced economies, in particular, long-term government bond yields have become increasingly more dependent on global conditions. The availability of global savings has made the price of these securities (and hence yields) increasingly dependent on global investors' preferences, while country specific risk factors have been playing a more limited role (Kumar and Okimoto, 2009). This means that factors such as global risk appetite, global savings, and investment have become more important in pricing of longer debt maturities with the result that cross-country correlation of long-term government bond yields has increased over the last two decades. National deficits and debts and other country specific factors would still however be expected to play a role.

The term structure of the government yield curve has also changed. With higher correlation across advanced economies of the returns at the long end of the government bond yield curve than at the short end of the curve, differences in the steepness of the bond yield curve reflected largely diverging trends across countries in inflationary pressures. In fact, nominal short-term rates continue to be dominated by monetary policy that has continued to diverge across countries (e.g., in the United States and the European Union) despite the increase in bond market integration, with changes in short-term rates only transmitted marginally to the long end of the yields curve.

III. MODEL SPECIFICATION

The above wide range of results reflects in large part the focus of individual studies on specific aspects of the relationship between the fiscal variables and bond yields. None of these studies has considered the combination of nonlinear effects, initial conditions, institutional features, and spillovers, potentially imparting some bias to the empirical findings.

- First, nonlinear effect of fiscal deterioration can be sizeable. As shown by Ardagna (op. cit), episodes of large fiscal deficit increases led to significantly higher nominal and real long-term yields on government bonds (*in proportionate terms*) than episodes where the deficits rose more modestly. Countries with higher initial debt levels may also experience sharper increases in interest rates.
- Second, differences in structural and institutional features may play a significant role: countries with structural high domestic savings and financial systems that rely on bank financing more than capital markets for funding investment may be more readily able to absorb an increase in public bond supply (IMF, 2006).

- Third, accounting for the impact of capital inflows (Hauner and Kumar, op. cit) and spillovers from global sovereign bond markets can be important (Faini, 2006).¹⁵

The econometric specification proposed for the study takes into account these considerations. The basic reduced-form model, estimated for a panel of 31 advanced and emerging market economies, consists of the following:

$$r^{10Y}_{it} = \alpha_i + \beta_1 r^M_{it} + \beta_2 \pi_{it} + \delta_1 b_{it} + \delta_2 D_{it-1} + \delta_3 D^2_{it-1} + \rho_1 z_{it-1} + \varepsilon_{it} \quad [1]$$

where r^{10Y}_{it} denotes nominal yields on 10-year government bonds for country i , period t (1980–2007);¹⁶ r^M is the short-term nominal interest rate (to control for the effects of monetary policy on the term structure); π is CPI inflation; b is the fiscal balance in percent of GDP;¹⁷ D is the level of gross general government debt in percent of GDP; z is output growth (to control for the country's cyclical position); and ε is the error term. Results are based on fixed effects' least squares estimates.¹⁸

While time series data limitations confined us to the above specification, we also estimated a lagged dependent variable version of the model to separate short- and long-run effects using a system GMM estimation. The results (available from the authors) show that the overall effect is similar to that found in the static model with the size of the short-run impact of government deficits being less than one-third of the overall effect. In the rest of the paper, we adopt this static specification as a description of the bond yield implications of persistently higher deficits.

Based on results in the previous section and the above, it is plausible to argue that a variety of factors can magnify the impact of fiscal imbalances on sovereign bond yields: in particular, the overall impact of higher deficits on interest rates could be greater in countries with the following characteristics:

¹⁵ There is also evidence that in crisis times, the cross-country correlation between market returns across a wide range of instruments tends to increase sharply (Gonzales-Hermosillo, 2008).

¹⁶ Data were available for 2008 also but we excluded this year to eliminate the impact of the financial crisis. However, including 2008 data does not affect significantly the results in the regressions. Results for regressions presented in the text including the year 2008 are available from the authors.

¹⁷ Alternatively we also use the primary fiscal balance and the change in debt in percent of GDP in this specification. We also specify the following model to estimate the direct impact on bond yields of an increase in the average stock of debt in year t (D^*_{it}):

$$r^{10Y}_{it} = \alpha_i + \beta_1 r^M_{it} + \beta_2 \pi_{it} + \delta_1 D^*_{it} + \rho_1 z_{it-1} + \varepsilon_{it}$$

¹⁸ All variables are found to be stationary on the basis of Pesaran's ADF test for panel data, except public debt which is found to be I(1). Standard Hausman test results rejected a random effect assumption. Results are robust to common deviations from standard assumptions about residuals' serial correlation and heterogeneity. Results are also robust to adding to the basic specification an index of global risk perception in financial markets (as measured by the VIX index).

- weak initial fiscal conditions;
- weak or inadequate institutions;
- structural factors (such as low domestic savings); and
- limited access to global capital.

These effects are compounded in periods of global risk aversion and uncertainty. We used an augmented specification of the baseline model to account for these factors. The following model allows for an additional interactive term between the fiscal balance and a dummy variable (d) reflecting countries' characteristics (see below and Appendix Table 2):¹⁹

$$r^{10Y}_{it} = \alpha_i + \beta_1 r^M_{it} + \beta_2 \pi_{it} + \delta_1 b_{it} + \delta_2 D_{it-1} + \delta_3 D^2_{it-1} + \delta_4 d_{it} * b_{it} + \rho_1 z_{it-1} + \varepsilon_{it} \quad [2]$$

IV. DATA AND DESCRIPTIVE ANALYSIS

The data on interest rates, on an annual frequency, were primarily obtained from the IFS database, but checked for consistency from two alternative sources including Bloomberg and the World Bank's Global Financial Dataset. Data on fiscal and macroeconomic variables are obtained largely from the IMF's World Economic Outlook Database supplemented by data from national sources, while financial market indicators are based on annual averages of monthly data from Bloomberg. The sample comprises all G20 countries, supplemented by other advanced and emerging economies for which data were available for the period 1980–2008. Appendix 1 provides a list of the countries in the sample and the basic descriptive statistics for the variables used in the baseline model.

Simple bivariate correlations suggest a consistent pattern in the links between fiscal variables and various measures of yields on government securities (Table 1). The overall fiscal balance is negatively correlated with nominal and real long-term yields, T-bill rate, and is associated with a steeper term structure of the yield curve. However, results for primary fiscal balance and public debt are less robust, or appear counterintuitive. This suggests the importance of other factors determining the relationship between fiscal indicators and interest rates.

To take into account other factors, as a first step, we control for both the direct impact of inflation on nominal long-term interest rates and its indirect impact through higher short-term

¹⁹ This specification was dictated by data availability (e.g., lack of time-series data on fiscal institutions); but analysis using an alternative approach where time-series data were available generally yielded similar results. In this alternative approach, we assessed the robustness of the results from equation [2] by interacting, where available, the fiscal balance with the variable representing the countries' specific characteristics (e.g., initial public debt size) as opposed to a dummy. Results are consistent with those reported in the text.

²⁰ This model is again estimated for the panel using fixed effects least squares. We also checked for the significance of including dummy directly in the regression, but the data reject the hypothesis of a different intercept for countries. Also, excluding time dummies does not change the results.

policy rates: we present below the results of a fixed effect regression of the nominal long-term interest rate on inflation and short-term interest rates to obtain the adjusted long-term rate (the residual from the regression), and plot it against trends in various fiscal indicators over the sample period using medians across countries (to eliminate the potential impact of outliers).

Table 1. Bivariate Correlation of Interest Rates and Fiscal Variables

Nominal long-term interest rate on government bond (in percent)	1.00							
Short-term interest rate (in percent)	0.87 (***)	1.00						
Interest rate on treasury bills (in percent)	0.97 (***)	0.98 (***)	1.00					
Long term minus short term rate (in percent)	-0.09 (**)	-0.29 (***)	-0.34 (***)	1.00				
Real long-term interest rate on government bonds (in percent)	0.38 (***)	0.36 (**)	0.34 (***)	0.00	1.00			
Fiscal balance in percent of GDP	-0.25 (***)	0.00	-0.34 (***)	0.09 (**)	-0.17 (***)	1.00		
Public debt in percent of GDP	-0.12 (***)	-0.02	-0.11 (***)	0.08 (*)	0.08 (**)	-0.43 (***)	1.00	
Primary fiscal balance in percent of GDP	-0.04	0.00	0.14 (**)	0.04	-0.10 (**)	0.75 (***)	-0.13 (***)	1.00

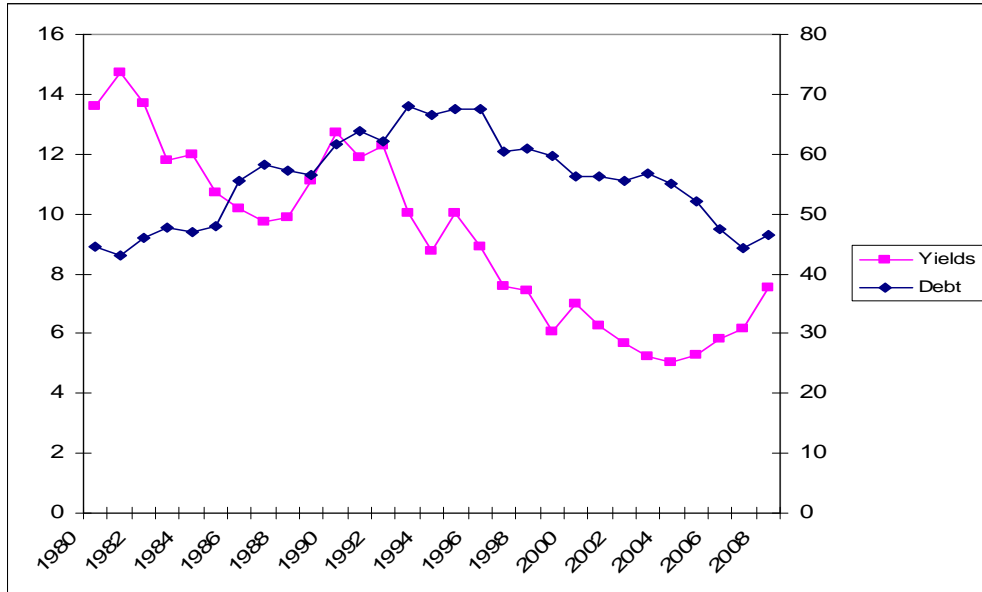
Source: Authors' calculations.

(***) denotes significance at the 1 percent level; (**) at the 5 percent level; and (*) at the 10 percent level.

Figure 1 shows that gross public debt tends to be weakly correlated with the adjusted long-term bond yields. Beyond the initial decade or so when the rise in the debt ratio did not appear to be systematically related to interest rates, the correlation strengthens in the following years when a decline in public debt is associated with a clear downward trend in interest rates. The correlation of adjusted bond yields with the overall fiscal balance is stronger: except for a few years, particularly in the mid-1990s, in periods when there were large declines in deficits, interest rates also tended to fall sharply (Figure 2). The strongest correlation is that between long-term rates and the adjusted primary fiscal balance (Figure 3), which is a better measure of the fiscal policy stance as it is not affected by changes in debt service obligations that depend on changes in interest rates.

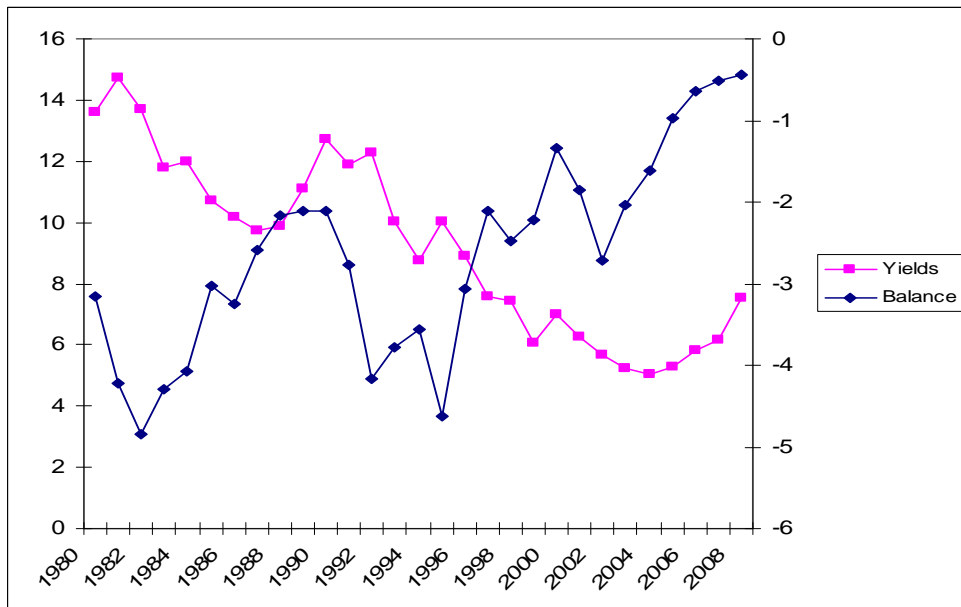
The basic conclusion is that while simple bivariate correlations and regressions do not capture a robust link between long-term nominal bond yields and fiscal variables in a consistent way, they do suggest an adverse impact of fiscal deterioration on interest rates; they also suggest the likelihood that the correlation may have strengthened since the second half of the 1990s. The latter may possibly reflect greater scrutiny by market participants with the expansion and deepening of global bond markets. The results also highlight that, beyond inflation, a variety of other factors are likely to have had an impact on bond yields. This is investigated in the following section.

Figure 1. Public Debt to GDP Ratio and Adjusted Long-Term Bond Yields 1/
(In percent)



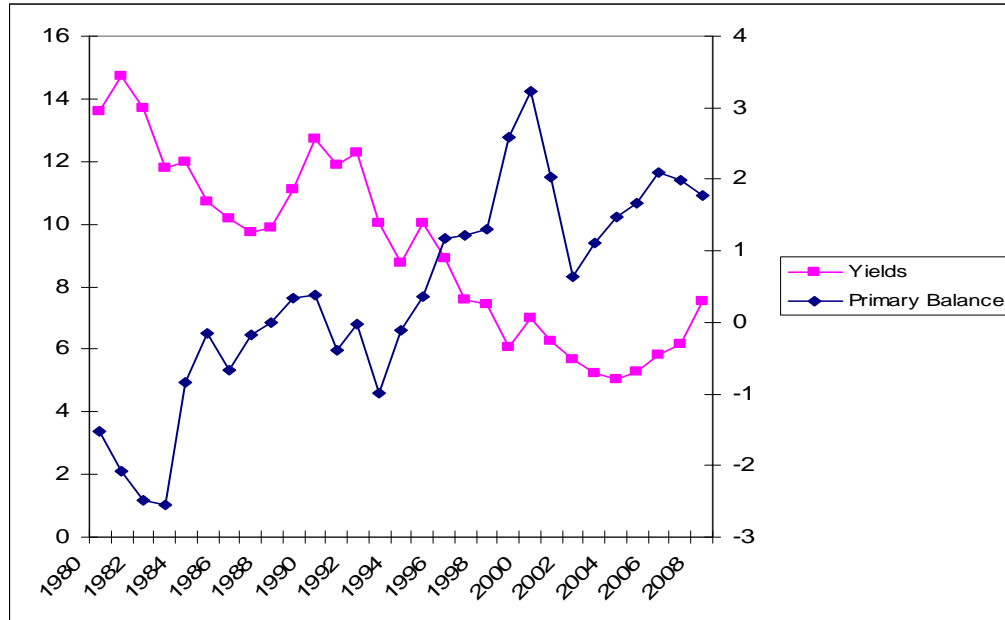
Source: Authors' calculations.
 1/ Median data for 31 advanced and emerging economies over 1980–2008. Bond yields based on residual of regressions of nominal 10-year bond yields on short-term rates and inflation with country-specific fixed effects. (Bond yield results reported on the left axis.)

Figure 2. Fiscal Balance as a Ratio to GDP and Long-Term Bond Yields 1/
(In percent)



Source: Authors' calculations.
 1/ Median data for 31 advanced and emerging economies over 1980–2008. Bond yields based on residual of regressions of nominal 10-year bond yields on short-term rates and inflation with country-specific fixed effects. (Bond yield results reported on the left axis.)

Figure 3. Primary Fiscal Balance as a Ratio to GDP and Long-Term Bond Yields 1/
(In percent)



Source: Authors' calculations.

1/ Median data for 31 advanced and emerging economies over 1980–2008. Bond yields based on residual of regressions of nominal 10-year bond yields on short-term rates and inflation with country-specific fixed effects. (Bond yield results reported on the left axis.)

V. MODEL ESTIMATES

The econometric analysis adopts a two-step approach: in step one, we estimate a baseline version of the reduced-form specification (equation [1]) that omits the interaction terms accounting for nonlinear impact of fiscal policy on bond yields. In step two, we estimate equation [2] and include the interaction terms. We focus on three different fiscal indicators to measure the impact on long-term interest rates: the overall balance, the primary balance, and public debt, all expressed as a percent of GDP.

The results presented in Table 2 suggest clearly that higher fiscal deficits and public debt raise long-term nominal bond yields in both advanced and emerging markets. In particular, bond yields increase significantly when the overall fiscal balance or the primary fiscal balance deteriorates: an increase in the overall fiscal deficit of 1 percent of GDP pushes up bond yields by 17 basis points, taking into account inflation, initial public debt and growth (Column 1). Results are robust to controlling for the potential endogeneity of the fiscal balance to changes in debt service, using as instrumental variables the lagged values of the fiscal balance. We also used an alternative indicator of the fiscal balance to reflect the role of expectations about fiscal policy (Blanchard, 1984): this indicator is based on regression of the balance on its lag values and the rate of population aging. Replacing the fiscal balance with this “expected fiscal balance” yielded results that are again significant and suggest an impact on bond yields of about 20 basis points for each 1 percent of GDP deterioration in the

fiscal conditions. The size of the impact has increased somewhat over time but, as the rolling regressions in Figure 4 suggest, it appears quite stable over the last decade or so.

Both flow and stock variables have an impact: using the change in public debt as an explanatory variable suggests that an increase in the debt ratio of 1 percentage point of GDP leads to an increase in bond yields of around 5 basis points. The initial level of public debt also has a similar and statistically significant impact, although its size varies over time.²¹

Table 2. Impact of Deficits and Debt on Long-term Interest Rates
Dependent Variable: 10-year Government Bond Yields

	[1]	[2]	[3]	[4]	[5] 1/
Short-term Interest Rate	0.69** (39.31)	0.73** (43.83)	0.73** (42.23)	0.57** (12.97)	0.67** (36.14)
Inflation	0.09* (1.95)	0.13** (2.71)	0.07 (1.46)	-0.03 (-0.53)	0.11** (2.38)
Initial Public Debt	0.07 (0.07)	2.48** (2.41)	1.76* (1.70)		0.11 (0.11)
(Initial Public Debt) ²	-0.45 (-0.84)	-1.37** (-2.53)	-1.11** (-2.01)		0.11 (2.38)
Initial GDP Growth	-0.02 (-0.86)	-0.07** (-2.39)	-0.07** (-2.34)	-0.08* (-1.71)	0.00 (0.00)
Fiscal Balance	-17.16** (-7.47)				-22.70** (-7.79)
Primary Fiscal Balance		-13.26** (-5.73)			
Change in Public Debt			5.28** (3.33)		
Average Debt				4.25** (4.91)	
Constant	2.54** (5.53)	1.74** (3.61)	2.13** (4.38)	1.01* (1.78)	2.48** (5.28)
<i>Number of observations</i>	565	501	565	176	559
<i>R-squared</i>	0.87	0.88	0.86	0.58	0.87
<i>F</i>	577.96	588.56	526.92	51.70	

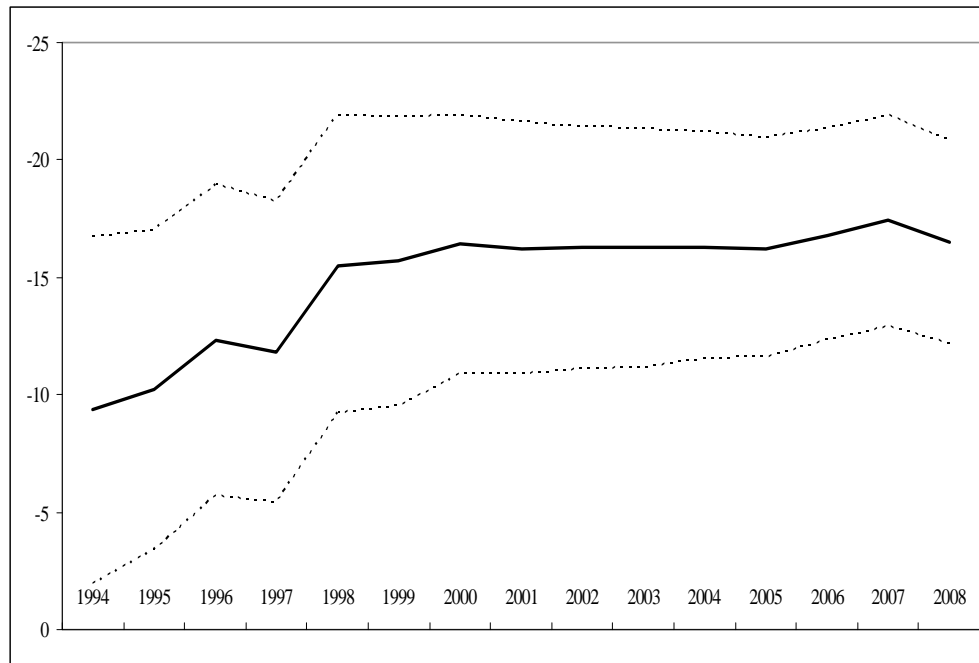
Source: Authors' calculations.

1/Instrumental variable estimation: Fiscal balance instrumented by its lagged values.

Estimation based on fixed effects; sample consists of 31 countries over the period 1980–2007 except for Column 4, where the sample is from 2000–07.

Annual data; *, ** denote statistical significance at the 10 and 5 percent levels, respectively.

²¹ The latter set of results is based on the 2000–07 period. Narrowing the sample to the last five years, the impact reaches 7 basis points, but using the period 1990–2007, the impact is smaller at about 3 basis points but still significant. Some of these variations likely reflect the uneven data coverage in the earlier periods of the sample.

Figure 4. Impact of Fiscal Balance on Bond Yields: Rolling Regression Coefficients 1/

Source: Authors' calculations.

1/ Rolling fixed-effects regressions using model [1]. Coefficients in the solid line, 95 percent confidence interval in the dotted lines.

The impact of other explanatory variables is as expected: higher inflation expectations increasing short-term monetary policy rates in turn raise long-term bond yields by almost 70 basis points for each 100 basis point rate increase. Inflation has an additional effect on yields through the potential impact on volatility which may complicate the conduct of fiscal policy and lead to larger deficits. Economic growth is not significantly related to yields, except when the primary balance is used as a fiscal indicator: in that case, higher growth leads to a compression in yields. This may suggest that, other things equal (particularly inflation and inflationary expectations) higher growth, leading to higher tax revenues and smaller expenditures on social safety net, may be seen to reduce risk of fiscal slippage and fiscal vulnerability, leading to lower risk premia.

The robustness of these baseline results to the use of an alternative indicator—real long-term bond yields—was also investigated (Table 3).²² The impact of fiscal balances on real yields provided results that were quite similar to the baseline, although the size of the estimated coefficients was larger: an increase in the fiscal deficit of 1 percent of GDP was seen to raise real yields by about 30–34 basis points.

²² We also checked whether the results held for selected subsamples of countries, including advanced economies and euro area countries. We also controlled for the introduction of the euro, changes in the exchange rate, and the fiscal consolidation impact in its run-up. In all cases, the above findings are very robust.

Table 3. Impact of Deficits and Debt on Long-term Real Interest Rates
Dependent Variable: Real 10-year Government Bond Yields

	[1]	[2]	[3]	[4]	[5] 1/
Initial Public Debt	1.26 (0.89)	3.85** (2.37)	3.91** (2.69)		1.08 (0.76)
(Initial Public Debt) ²	-0.63 (-0.79)	-1.79** (-2.01)	-1.63** (-2.00)		-0.56 (-0.69)
Initial GDP Growth	0.07* (1.66)	-0.05 (-1.00)	0.06 (1.41)	-0.18** (-3.21)	0.11** (2.35)
Fiscal Balance	-29.71** (-9.75)				-34.28** (-9.42)
Primary Fiscal Balance		-14.95** (-4.09)			
Change in Public Debt			19.55** (8.67)		
Average Debt				2.94** (2.59)	
Constant	2.57 (4.50)	2.80 (4.22)	2.13 (3.58)	1.32* (1.83)	2.45 (4.18)
<i>Number of observations</i>	598	527	598	204	592
<i>R-squared</i>	0.15	0.16	0.19	0.08	0.14
<i>F</i>	6.94	5.11	5.62	9.18	7.10

Source: Authors' calculations.

1/Instrumental variable estimation: Fiscal balance instrumented by its lagged values.

Estimation based on fixed effects; sample consists of 31 countries over the period 1980–2007 except for Column 4, where the sample is from 2000–07.

Annual data; *, ** denote statistical significance at the 10 and 5 percent levels, respectively.

Consistency between estimates regarding the impact of deficits and debt on interest rates

The above results raise an important issue concerning the consistency between the two sets of estimates relating to the impact of deficits, and debt respectively on nominal and real bond yields. Given the clear relationship between deficits and debt, one would expect the two estimates to be closely related. But the empirical results are that the deficit elasticity calculated using nominal rates is around 20 basis points for each percentage point of GDP increase in the deficit ratio, and when calculated using real rates, it is around 30 basis points for each percentage point in the deficit ratio. For the debt ratio, the empirically estimated results are in the range of 3–5 basis points.

How mutually consistent are the two estimates: using the identity that $b = -g/(1+g)d$ where b is the ratio of fiscal balance to GDP; d is the debt ratio; and g is nominal GDP growth (9.6 percent per year for the median country and about 14 percent for the average country in the sample during the period for which we estimated the model). This implies that a 1 percent of GDP increase in the fiscal deficit results in a permanent debt increase of $(0.01 \cdot 1.1)/0.1$ which is about 10 percent of GDP for the median country and $(0.01 \cdot 1.1)/0.14$ which is about 8 percent of GDP for the average country. This implies that the associated debt elasticity

comparable with the deficit elasticity results (between 20 and 30 bps) is about 2–3 basis points using nominal rates and 3–4 basis points using real rates. This gives a range of 2–4 basis points for these elasticities compared to a range of 3–5 bps based on direct regression-based debt elasticity estimates. Thus, the empirical results do appear to be mutually consistent (and complement the premise in Laubach op. cit), and underline the robustness of the findings.

As a further robustness test we used the estimated model results in Table 3 to run simulations of the impact of higher debt on interest rates associated with a (permanent) deterioration of the overall balance by 1 percentage point of GDP over a 50-year period. The simulations took into account the impact on interest rates of higher deficits as well as the effects via growth and initial public debt. The results again pointed to an elasticity of real interest rates to a 1 percent of GDP increase in debt of about 3–4 basis points.

Bond yields and country characteristics

The impact of fiscal variables on bond yields given country characteristics, financial market indicators, and global variables was assessed using equation [2].²³ The results, summarized in Table 4, show a number of important aspects of how fiscal variables interacting with the above elements are likely to impact yields:

- (1) Countries with higher initial deficits appear to experience larger increases in yields, perhaps because pre-existing fiscal problems make the return to fiscal stability following any further deterioration more difficult. Analysis suggests that a deficit above 2 percent of GDP prior to the fiscal worsening raises the impact on bond yields by an additional 14 basis points for each percent of GDP larger current period deficit.
- (2) High levels of general government debt may limit the ability of countries to respond to adverse shocks. Countries with initial high public debt experience sharper increases in interest rates for a given deterioration in the fiscal balance (Figure 5). Initial debt levels above 60 percent of GDP add about 6 basis points to the baseline effect of an increase in fiscal deficits. This could reflect heightened market concerns about solvency risks, as debt levels move towards market-perceived sustainability thresholds.²⁴

²³ See Appendix Table 2 for the definition of the dummy variables.

²⁴ These are commonly used thresholds in the empirical literature. We checked the robustness of the results by using alternative thresholds and by interacting the fiscal balance with the debt and deficit variables as opposed to a dummy. The results were consistent with the findings in the text.

**Table 4. Country Characteristics and Impact of Deficits and Debt
on Long-term Interest Rates 1/**

Dependent Variable: 10-year Government Bond Yields

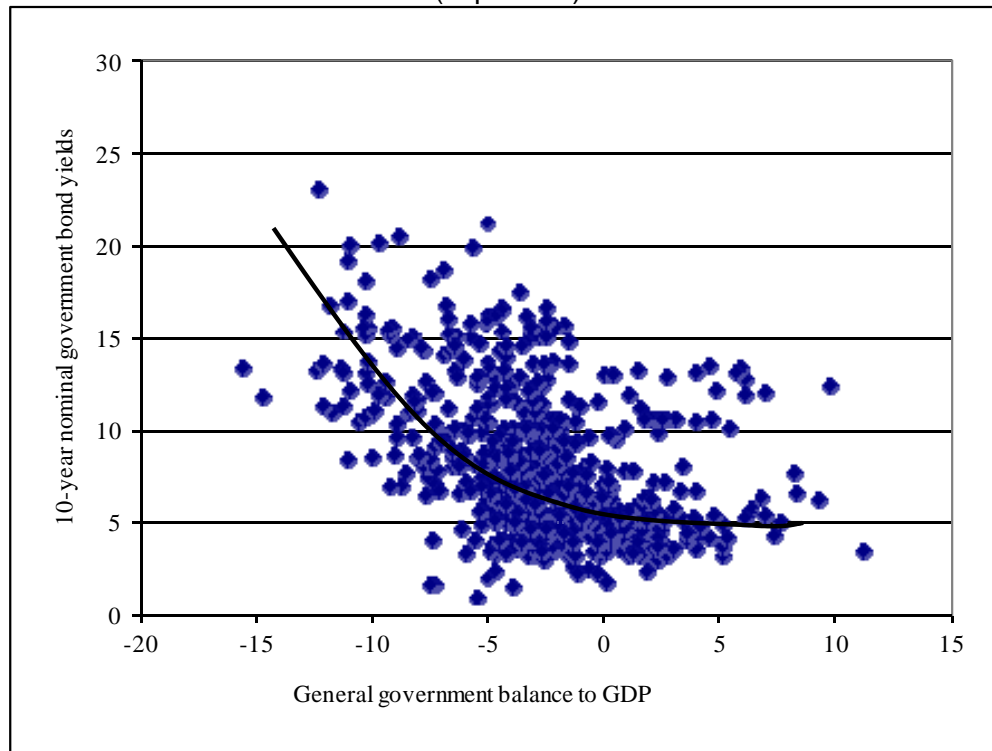
VARIABLE										
Short-term Interest Rate	0.69** (39.54)	0.69** (39.44)	0.69** (39.38)	0.69** (39.36)	0.69** (39.68)	0.69** (39.13)	0.69** (39.26)	0.69** (39.38)	0.71** (36.54)	0.69** (39.19)
Inflation	0.09* (1.95)	0.09** (1.99)	0.09** (2.09)	0.10** (2.23)	0.09** (2.01)	0.09** (2.01)	0.09** (2.13)	0.09** (2.02)	0.03 (0.49)	0.10** (2.19)
Fiscal Balance	-8.12** (-2.19)	-15.24** (-5.79)	-18.08** (-7.86)	-13.95** (-5.16)	-7.57** (-2.40)	-27.44** (-5.02)	-17.55** (-7.66)	-20.12** (-7.65)	-9.65** (-2.89)	-10.05** (-2.95)
Initial Public Debt	0.40 (0.48)	0.21 (0.25)	0.03 (0.03)	0.48 (0.56)	-0.16 (-0.19)	0.23 (0.27)	-0.06 (-0.07)	0.34* (0.40)	2.85** (2.88)	-0.45 (-0.52)
Initial Public Debt ²	-0.66 (-1.48)	-0.46 (-1.02)	-0.44 (-0.98)	-0.53 (-1.18)	-0.23 (-0.51)	-0.56 (-1.24)	-0.41 (-0.91)	-0.61 (-1.35)	-1.47** (-2.96)	-0.30 (-0.65)
Initial GDP Growth	-0.03 (-0.88)	-0.02 (-0.62)	-0.03 (-1.04)	-0.03 (-1.08)	-0.03 (-1.08)	-0.02 (-0.57)	-0.03 (-0.09)	-0.02 (0.78)	-0.01 (-0.21)	-0.02 (-0.80)
High Initial Deficit	-13.89** (-3.28)									
High Initial Debt		-5.78* (-1.90)								
Large Fiscal Adjustment			-0.54* (-1.71)							
High Financial Market Volatility				-6.73** (-2.60)						
High Fed Rates					-13.14** (-4.57)					
High Quality of Institutions						10.02* (1.96)				
Low Private Savings							-53.78* (-1.74)			
High FDI								5.31* (1.86)		
Fast Population Aging									-9.10** (-2.15)	
High Global Bond Supply										-9.22** (-2.51)
Constant	2.28** (5.41)	2.45** (5.81)	2.58** (6.12)	2.33** (5.51)	2.62** (6.35)	2.44** (5.79)	2.60** (6.14)	2.80** (8.74)	2.78** (8.68)	1.29** (2.08)
<i>Number of observations</i>	565	565	565	565	565	565	565	565	565	565
<i>R-squared</i>	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
<i>F</i>	506.74	499.01	498.26	585.5	517.69	499.25	498.36	580.7	581.0	509

Source: Authors' calculations.

Note: Fixed effects estimates.

1/ Interaction of fiscal balance with dummy variables for countries' characteristics in bold.

Figure 5. Long-Term Bond Yields and Fiscal Balance 1/
(in percent)



Source: Authors' calculations.

1/ Excluding values exceeding three standard deviation from the mean.

- (3) When changes in fiscal balances are large enough to be perceived to trigger a shift in the conduct of fiscal policy, they can lead to higher long-term yields.²⁵
- (4) Differences in institutional features and domestic private saving rates also play a role in determining the impact of deficits on interest rates. The quality of governance is important, as better institutions signal the credibility of economic policies, thereby reducing risks about policy implementation. For countries with *weaker institutions* and higher *political risks* (measured by the ICRG political risk index), the impact of a fiscal deterioration is about 10 basis points higher than in other countries.
- (5) Economies with structurally high domestic private savings and systems that rely on bank financing more than capital markets for funding investment have also been seen to be more able to absorb an increase in the public bond supply.²⁶ In countries with

²⁵ Expansion in the primary fiscal deficit above 1½ percent of GDP.

²⁶ Home bias in investment can also be beneficial as it channels domestic savings to the government securities market. In Japan, the higher share of domestic purchases of government securities may be linked to lower spread volatility. However, this could come at the cost of reduced credit availability for the corporate sector and may be reflected in lower productivity and overall growth over the medium to long run.

- low saving ratios, bond yields rise significantly more than in other countries—by as much as 50 basis points for one percentage point of GDP increase in the deficit ratio.
- (6) As discussed above, global factors increasingly have a pronounced effect on government securities markets (Kumar and Okimoto, 2010). In the last decade, capital inflows have been found to increase sovereign bond market liquidity and lower yields (Hauner and Kumar, 2010). Empirically, higher foreign investment flows (above 10 percent of GDP) limit the increase in bond yields due to fiscal expansions (reducing the impact of a 1 percentage point of GDP deficit increase by about 5 basis points relative to the baseline), as countries with capital inflows are more able to roll over maturing debt and finance new borrowing more readily.
 - (7) Even before the crisis, issuance of new sovereign securities was increasing on a global basis primarily as a result of the deficit financing requirements. Higher global bond supply (as measured by gross financing needs in the sample) raises the impact on bond yields of a 1 percent of GDP deficit increase by an additional 10 basis points, with the effect likely to be larger for countries with higher credit risks.
 - (8) In periods of *financial distress* as measured by large stock market volatility (based on high levels of the VIX index) markets react less favorably to debt buildup. In such periods, the additional impact on bond yields of a one percent of GDP deficit expansion is about 7 basis points.
 - (9) Similarly, in periods of high inflationary pressures and more adverse global liquidity conditions (as measured by Fed rates above 4 percent), fiscal deterioration has a larger additional impact (about 13 basis points) on bond yields.
 - (10) Finally, in countries with faster population aging, bond yields rise by about 10 basis points more than in the other countries for each one percent of GDP increase in the fiscal deficit. This likely reflects expectations about stronger spending pressures over the medium term, limiting the space for fiscal adjustment.

The above results are robust to alternative model specifications, including the use of real interest rates on public debt as a dependent variable. In particular, the role of initial deficits and debt, fast population aging, and financial market volatility are confirmed in these regressions:

- in high-deficit countries, a 1 percent of GDP increase in deficits raises real interest rates by about 30 basis points compared to a 20 basis points impact found for nominal interest rates and a 22 basis point impact for countries with low initial deficits;
- in countries with initial levels of debt (above 80 percent of GDP), a 1 percent increase in the fiscal deficit raises real interest rates by about 30 basis points. This implies an

additional impact on real rates of about 2 basis points for high-debt countries compared to countries with lower initial debt levels;

- in countries subject to fast population aging pressures, the elasticity of real interest rates to a 1 percent increase in the fiscal deficit is 15 basis points higher than in countries with more limited aging speed;
- in periods of high financial market volatility, an increase in fiscal deficits by 1 percent of GDP raises real rates by almost 8 basis points more than in normal times.

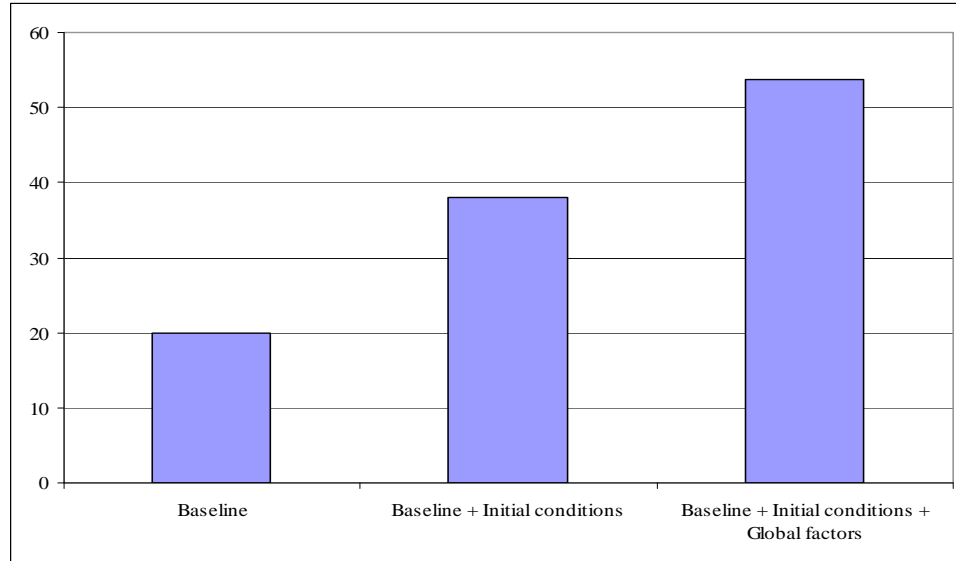
However, results of nonlinear impact of other factors on real rates (e.g., the impact of global bond supply, high FDI and private savings) were generally found to have low statistical significance. In these regressions the impact of a 1 percent increase in the fiscal deficit raised real rates by about 30 basis points but with no significant nonlinear impacts.

VI. CONCLUSIONS AND POLICY IMPLICATIONS

This paper has assessed empirically the impact of fiscal deficits and public debt on long-term interest rates over almost three decades. The analysis took into account a wide range of country-specific factors, for a panel of 31 advanced and emerging market economies. The key finding is that the impact of fiscal deterioration on long-term interest rates is significant and robust but nonlinear. Moreover, the magnitude of the impact reflects initial fiscal, institutional and structural conditions, as well as spillovers from global financial markets. These results complement the existing literature in a number of important dimensions, and also help explain the diversity of findings since existing studies generally focus on subsets of the variables considered in the analysis.

The results also suggest that given the extent of the recent fiscal deterioration experienced in many economies, particularly advanced ones, the impact of the crisis on bond yields may be sizable. This is particularly so for countries that entered the crisis with weak fundamentals. For a country experiencing an increase in the fiscal deficit of 5 percentage points of GDP, long-term interest rates could rise by 100 basis points using the baseline result of interest rate increases by 20 basis points for each percentage point increase in the fiscal deficit (Figure 6). This effect could be compounded by a combination of adverse factors (e.g., unfavorable initial fiscal conditions, weak institutions, and elevated global risk aversion): these could raise the impact of 1 percentage point increase in fiscal deficits to above 50 basis points (equivalent to a calculated debt elasticity of 5–6 basis points).

Figure 6. Impact of Fiscal Deficits and Country Features 1/
(In basis points)

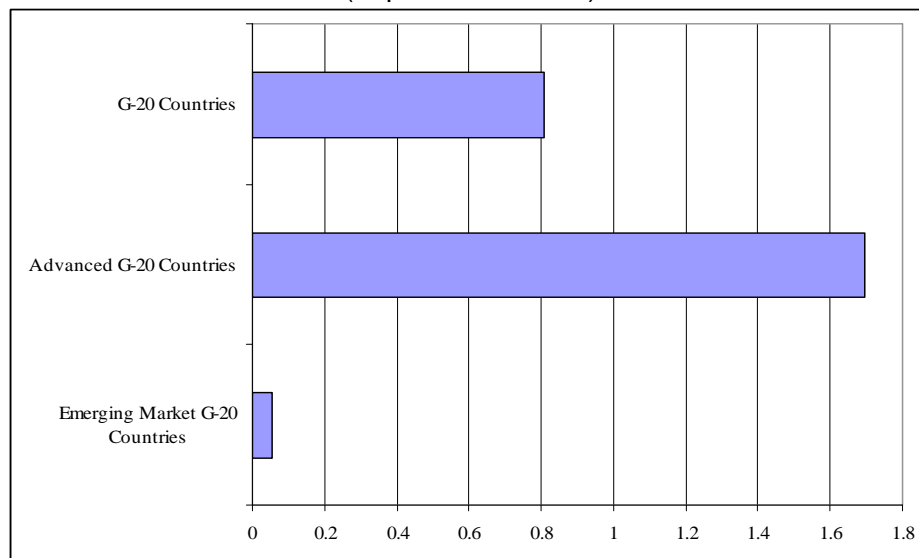


Source: IMF staff estimates.

1/ Estimated impact on 10-year bond yields for each 1 percent of GDP increase in fiscal deficits, taking into account the simultaneous effect of selected factors: initial conditions include fiscal (i.e., initial debt levels) and other structural characteristics (i.e., quality of institutions). Global factors include global risk aversion and global bond supply.

To explore the implications of such increases in long-term interest rates, a simulation analysis was undertaken, using the above estimates of the elasticity of bond yields to debt increase (based on the IMF projections for debt in 2010 compared to 2007) for advanced and emerging economies separately. The results suggest a pronounced increase in debt service costs over the medium term for the advanced G20 economies: given the average increase in debt of about 20 percent of GDP, debt service costs are likely to increase by more than 1½ percent of GDP in these countries (Figure 7). The impact is likely to be markedly lower in emerging markets, given the significantly smaller increase in their debt, despite higher elasticities of bond yields to fiscal deficits and debt in this group of economies (assuming no pronounced spillover effects from advanced economies).

Figure 7. Impact of Public Debt Increase on Debt Service 1/
(In percent of GDP)



Source: IMF staff estimates.

1/ Results measure the impact of the increase in debt on interest spending as a share of GDP. The estimated impact is based on the projected increase in debt between the pre-crisis year and 2010 and the estimated elasticity for the impact of debt on bond yields.

An appropriate policy response will therefore be essential to contain the upward pressure on interest rates over the medium term in the advanced economies (IMF, 2009a). This is particularly so given the evidence that credible fiscal consolidation strategies that reduce uncertainty about sustainability can help cut borrowing costs for governments with large debt levels. In this context, entitlement reforms that reduce spending growth, say, for pensions and tackle cost-inflation in health care services can play a key role. At the same time, measures to ensure continued access to global savings, underpinning investor risk appetite by anchoring medium-term expectations of fiscal sustainability, and supporting economic growth could pay significant dividends in restraining the rise in long-term interest rates.

Strengthening fiscal frameworks can also help anchor fiscal policy to credible fiscal consolidation. Fiscal rules with a medium-term orientation and backed by political commitment could play an important role in this regard by buttressing fiscal consolidation strategies with credible long-term commitments to debt sustainability (Kumar et al., 2009). An improvement in institutional quality possibly combined with the operation of independent fiscal agencies that provide objective analysis and assessment of fiscal developments, while leaving fiscal policy in the hands of elected representatives, can also be useful in this regard. Structural reforms to stimulate economic growth can also support fiscal adjustment efforts by enhancing revenue mobilization, and thereby restrain the increase in long-term interest rates and debt-servicing costs (IMF, 2009b).

Appendix 1. List of Countries used in the Regressions

1. Australia
2. Austria
3. Belgium
4. Brazil
5. Bulgaria
6. Canada
7. Colombia
8. Denmark
9. Finland
10. France
11. Germany
12. Greece
13. Ireland
14. Italy
15. Japan
16. Korea
17. Malaysia
18. Mexico
19. Netherlands
20. Norway
21. Philippines
22. Portugal
23. South Africa
24. Spain
25. Sweden
26. Switzerland
27. Thailand
28. Turkey
29. United Kingdom
30. United States
31. Venezuela, Bolivarian Rep.

Appendix Table 1. Descriptive Statistics

	Observations	Mean	Standard deviation	Coefficient of variation
Nominal long-term interest rate on government bond (in percent)	798	9.09	6.34	69.7
Short-term interest rate (in percent)	978	11.30	31.31	277.1
Interest rate on treasury bills (in percent)	693	11.38	13.54	119.0
Long term minus short term rate (in percent)	548	1.01	1.49	147.3
Real long-term interest rate on government bonds (in percent)	795	3.85	3.97	103.1
Inflation (in percent)	1281	9.19	13.56	147.5
Fiscal balance in percent of GDP	1242	-0.03	0.05	171.8
Public debt in percent of GDP	942	58.48	28.70	49.1
Primary fiscal balance in percent of GDP	1012	0.01	0.04	575.4
Output growth rate (in percent)	1322	3.33	3.69	110.8

Source: Authors' calculations.

Appendix Table 2. Definition of Dummy Variables

Variable	Definition
Large Initial Fiscal Deficit	Fiscal deficit above 2 percent of GDP in the previous year
High Initial Debt	General government debt above 60 percent of GDP in the previous year
Large Fiscal Expansion	Reduction in the primary fiscal balance above 1.5 percent of GDP in the previous year
Fast Population Aging	Growth above 1 percent in the share of the population aged 65 or more
Quality of Institutions	ICRG political risk index above sample average
Low Private Savings	Private domestic savings lower than 10 percent of GDP
High FDI	Annual FDI higher than 10 percent of GDP
Global Bond Supply	Average gross financing needs above 20 percent of GDP
Financial Market Volatility	VIX index above 25
High Fed Rates	US Fed rate above 4 percent

Source: Authors' calculations.

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