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Ratings, Debt, and Deficits: An Exploration

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ABSTRACT: We look at the effects of debt and primary fiscal balances on sovereign credit ratings through the lens of a simple model. We find that the ratings differ from the implications of the model in three important ways. They give much more weight to debt relative to forecast primary balances. They understate the effects of the difference between the interest rate and the growth rate. They give a very large role to country effects. For the same level of debt and forecast primary balances, they imply extremely different ratings across countries, and imply extremely different levels of debt needed to reach a given rating.

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WORKING PAPERS

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1 Introduction

The explicit goal of sovereign debt ratings is to assess the probability of default on sovereign bonds. To quote from Standard & Poor's (S&P): "[Ratings reflect] the ability and willingness to service financial obligations to non-official (commercial) creditors [...] Our sovereign rating criteria incorporate the factors that we believe affect a sovereign's willingness and ability to service its financial obligations to non-official creditors on time and in full" (S&P Global, 2017).[1]

Ratings matter a lot for governments as they largely determine the premium that governments have to offer on their debt. This raises an obvious question: What weight do the rating agencies put on debt, on primary deficits, and on other factors? Put another way: How much does the past (embodied in the current debt level) matter? How much does the anticipated future (embodied in the forecast distribution of future primary balances) matter? How much do other factors matter? These are the questions we take up in this paper.[2]

In Section 2, to organize thoughts and get a sense of the magnitudes suggested by theory, we offer a model that is simple but yields basic conclusions we believe to be more general. We take ratings to capture the probability of non-default on sovereign debt. Using the debt accumulation equation, and taking into account of uncertainty, we show how current debt, forecast primary balances, and forecast interest rates and growth rates affect the distribution of debt over time. We then assume that the probability of default is an increasing function of the likelihood that debt growth exceeds a threshold over a given horizon.

We show in particular how the current debt level affects this probability in two ways. The first depends on the sign and the magnitude of the forecast difference between the interest rate on debt and the growth rate, the forecast of "$r - g$" for short. The second depends on the interaction between debt and the uncertainty associated with the distribution of $r - g$,

[1] Investors care not only about the probability of default, but also about the size of the loss upon default, the size of the haircut. For sovereign bonds, rating agencies focus however only on the probability of default.

[2] There is a large literature on the determinants of ratings. For example, see the survey by Gaillard (2012), or more recently Ardagna (2018). The general approach is to regress ratings on a number of macroeconomic variables, such as GDP per capita, growth, inflation, current account, debt, and so on. We differ from this reduced form approach by looking at the evidence through the lens of a structural model.

with the level of debt magnifying the effect of uncertainty on the distribution of future debt, thus increasing the probability of default.

Through calibrations, we show how the probability of default—or, equivalently, the probability of no-default (the rating)—depends on the level of debt, the distribution of future primary balances, interest rates and growth rates. This gives us a benchmark against which to compare our empirical estimates.

We then turn in Section 3 to the empirical evidence. We do so by looking at ratings from S&P, Moody's, and Fitch for 35 advanced economies and, separately, 97 emerging market and developing economies, annually from 1995 to 2025. We use IMF data on debt as well as on five-year-ahead forecasts of primary balances, interest rates and growth rates. As ratings come in ordinal categories, we use ordered probit regressions. Our baseline specification regresses ratings on debt, forecast primary balances, and year- and country-fixed effects. We obtain three initial findings:

First, debt is a highly significant determinant of ratings. The effect of forecast primary balances is positive, but less statistically significant. Importantly, the effect of forecast primary balances relative to debt is substantially smaller than our model suggests. Second, estimated year-fixed effects are rather flat, a somewhat surprising finding given the substantial decrease in $r - g$ over the sample, at least in advanced economies. Third, estimated country-fixed effects are surprisingly large.

We look into each of these findings further in the following three sections.

Section 4 focuses on the relative estimated effect of forecast primary balances versus debt. One plausible explanation for our initial finding is that our data on forecasts, which as mentioned come from the IMF WEO, are noisy proxies for the true expectations of rating agencies. Indeed, by regressing actual outcomes of primary balances on the forecasts, we find that forecasts tend to be very noisy compared to rational expectations. If one believes that rating agencies have rational expectations, this result implies that our estimates of the effect of expected primary balances are downward biased. Correcting for these biases, we find that the gap between the implications of the model and empirical estimates narrows significantly

but remains wide. In short, relative to our model, ratings appear to put too little weight on primary balances relative to debt.

Section 5 focuses on the role of forecasts of $r - g$ versus other shifts in ratings over time. We extend the baseline specification to allow for an effect of $r - g$, and allow for three types of effects: Year effects as in the baseline, interaction between year effects and debt, and interaction between $r - g$ and debt. We focus on AEs, and because of data limitations, only on the subset of 25 EMDEs included in the J.P. Morgan Emerging Market Bond Index. We find that the flat year effects in the baseline hide a more complex story, namely more favorable ratings over time given debt and expected primary balances, but tougher ratings on debt increases relative to expected primary balances. The latter effect more than offsets the favorable effect of the decrease in $r - g$ observed in many economies in recent decades. Importantly, the effect of $r - g$ on ratings appears much smaller than implied by our model.

Section 6 focuses on country effects, that is, the effect of fixed country characteristics on ratings for a given level of debt and primary balance forecasts. We translate them into two more intuitive statistics. First, we translate them into differences in predicted ratings for the same given level of debt and primary balance forecasts. Second, we translate them into the level of debt required to achieve a given rating with a given probability. The differences across countries are extremely large, and appear larger than can plausibly be explained by country-specific factors we have left out of our regression, such as the nature of the investors holding the debt, political dynamics, or the degree of uncertainty associated with the forecasts.

Section 7 concludes. There is a clear gap between the implications of our model and the rules implicitly used by ratings agencies. We believe that, while our model is simple, its broad implications are straightforward and more general. Still, it may be that our model is missing some essential aspect of what determines default. Alternatively, it may be that rating agencies should revisit their rules. This is why we have chosen "An Exploration" as part of the title of our paper. We end by discussing potential ways to make further progress.

2 A Simple Model

Start with a simple formulation of debt dynamics over some period:

$$\Delta b = (r - g)\, b - s \tag{1}$$

Having in mind the data limitations on forecast horizons in the next section, think of the period as five years.[3] Variables are defined as follows: b is the ratio of debt to output ("debt" for short, whenever the context is clear, in what follows), so Δb is the change in the debt ratio over the period, r is the real interest rate paid on debt, g is the growth rate of output, and s is the primary fiscal balance.[4]

The change in the debt ratio thus depends on two terms, the own debt dynamics, depending on $r - g$, and the primary balance, s. Under certainty, a higher primary balance leads to a one for one decrease in debt accumulation. Whether higher debt leads to higher debt accumulation, all else equal, depends on the sign of $r - g$.

Under uncertainty, the outcome is more complex:

Assume that $r - g$ and s are joint normal, with standard deviations σ_{r-g} and σ_s, and correlation ρ. Then, Δb is normally distributed with mean (equation (2)) and standard deviation (equation (3)):

$$E\Delta b = E(r - g)b - Es \tag{2}$$

and

$$\sigma_{\Delta b} = \sqrt{b^2\sigma_{r-g}^2 + \sigma_s^2 - 2\rho b\sigma_{r-g}\sigma_s} \tag{3}$$

Note that, relative to the case of certainty, debt now plays a second role in equation (3). It magnifies the effect of uncertainty about $r - g$. Higher debt widens the distribution of the change in debt, and by widening the upper tail of the distribution, increases the probability a large debt increase.

[3] Obviously, investors are likely to be concerned about debt evolutions over a longer horizon. But we do not have forecasts beyond 5 years for a wide range of economies.

[4] The exact expression has $(r - g)/(1 + g)$ multiplying b. For small g, the difference is small, and ignoring $(1 + g)$ implies that, if r, g and s are joint normal, the right hand side is normally distributed, allowing for simpler analytics.

Assume that default takes place if the increase in the debt ratio, Δb, exceeds some threshold x.[5] And assume that the rating (R) is equal to the probability of no-default Then:

$$R = P(x > \Delta b) = P((x - E\Delta b)/\sigma_{\Delta b} > (\Delta b - E\Delta b)/\sigma_{\Delta b}) \tag{4}$$

Define $z \equiv (x - E\Delta b)/\sigma_{\Delta b}$. Note that $(\Delta b - E\Delta b)/\sigma_{\Delta b}$ is normally distributed with mean 0 and standard deviation equal to one. So, equation (4) becomes:

$$R = \Phi(z) \tag{5}$$

where $\Phi(\cdot)$ is the cumulative normal distribution.

To get a sense of the effects of debt and forecast primary balances on the rating (equation (5)), it is useful to do calibrations, and look at the effects of variations in the various parameters. So, recalling that we are looking at a period of five years (this is the longest horizon for which we have forecasts in the next section), we assume the following baseline:

Except for x, the parameters for the baseline correspond to the (rounded) statistics for AEs for the period 1995-2025 in the next section. (The statistics for EMDEs are largely similar, with two differences, a lower debt ratio, and a lower value of $r - g$. The implications are discussed in the sensitivity analysis below. Summary statistics for both AEs and EMDEs are given in Appendix Table A10, and the construction of $r - g$ is described in Section 2 of the Data Appendix.)

We assume a debt ratio of 0.7 (70 percent of GDP), a value of $E(r - g)$ of 0.00 (which is the average value of $r - g$ in the sample), a value of Es of 0.05 (recall that we are looking at a period of five years, so this corresponds to an annual primary surplus of 1 percent a year). Note that, under these values, if there were no uncertainty, the debt ratio would be declining, and thus the probability of default would be zero. Uncertainty is important however. We assume a value of σ_{r-g} of 0.10, a value of σ_s of 0.10, a value of ρ of 0.00.

The choice of x is largely arbitrary in our model, and surely varies across countries,

[5]The natural assumption would be that default takes place if the debt ratio explodes over time. Since our data do not include debt forecasts beyond a five-year horizon however, we have to adopt a more limited criterion, i.e. an excessively large increase in the debt ratio over five years.

depending on the nature of investors, the political dynamics, the potential role of the central bank, and so on. The simulation assumes a value of x equal to 0.10. Default thus takes place if the debt ratio increases by more than 10 percentage points over 5 years.

Table 1: Sensitivity Analysis: Baseline Parameter Values

Parameter	Value	z	R	dz/db	dz/dEs	dR/db	dR/dEs	(dR/dEs)/(dR/db)
Baseline		1.23	0.89	-0.58	8.19	-0.11	1.54	-14.19
b (baseline = 0.70)								
min	0.50	1.34	0.91	-0.54	8.94	-0.09	1.45	-16.67
max	1.50	0.83	0.80	-0.38	5.55	-0.11	1.57	-14.44
$E(r-g)$ (baseline = 0.00)								
min	-0.10	1.80	0.96	-0.03	8.19	-0.002	0.64	-298.00
max	0.10	0.66	0.74	-1.13	8.19	-0.36	2.64	-7.27
Es (baseline = 0.05)								
min	0.00	0.82	0.79	-0.38	8.19	-0.11	2.34	-21.29
max	0.10	1.64	0.95	-0.77	8.19	-0.08	0.85	-10.64
σ_{r-g} (baseline = 0.10)								
min	0.07	1.35	0.91	-0.37	8.98	-0.06	1.45	-24.10
max	0.13	1.11	0.87	-0.72	7.40	-0.15	1.59	-10.30
σ_s (baseline = 0.10)								
min	0.07	1.52	0.94	-1.08	10.10	-0.14	1.28	-9.33
max	0.13	1.02	0.85	-0.33	6.77	-0.08	1.61	-20.76
ρ (baseline = 0.00)								
min	-0.10	1.29	0.90	-0.67	8.61	-0.12	1.49	-12.86
max	0.10	1.17	0.88	-0.50	7.83	-0.10	1.57	-15.52

Results are presented in Table 1, which gives the values of z, R, the derivatives of z with respect to b and Es, the derivatives of R with respect to b and Es, and the ratio of the effect of primary balances to the effect of debt on R ("the ratio" for short.)

The first line gives the baseline results. The probability of no-default is equal to 0.89. The number in the last column is the important one for our purposes. The value of the ratio, -14.19, implies that a one percentage point increase in the ratio of the primary balance to GDP has 14.19 times the effect of a one percentage point decrease in the ratio of debt to GDP on the rating.

One may question the sensitivity of these results to the specific assumptions about the parameters. The rest of the table shows the results over plausible ranges of alternative values

for each of the parameters.

The two central variations involve $r - g$ and σ_{r-g}, and the two effects of debt on the probability of non-default.

While $r-g$ is now currently close to zero in most AEs, some worry that it may actually be higher in the future. Conversely, $r - g$ has been consistently negative on average in EMDEs, equal on average to -2 percent annually and remains negative today. The table shows the implications of two values. A negative value of -0.10 (so -2 percent a year), and a positive value of 0.10 (so 2 percent a year). In the first case, the ratio becomes extremely large (in absolute value), reflecting a nearly zero weight on debt: the negative direct effect on debt accumulation being only slightly lower in magnitude than the indirect effect of higher uncertainty. (A larger negative value for $r - g$ would eventually change the sign, implying that higher debt actually *decreases* the probability of no-default). In the second case, both the direct and indirect effects go in the same direction, the effect of debt is substantially larger, and the ratio is lower, although still equal to -7.27.

The two rows showing the effects of uncertainty about $r - g$ show the importance of the indirect effect of debt. A low value of 0.07 for σ_{r-g} decreases uncertainty, thus decreasing the indirect effect of debt, leading to a ratio of -24.10. A high value of 0.13 strengthens the indirect effect of debt, leading to a smaller ratio (in absolute value) of -10.30.

These simulations are obviously crude. They suggest, however, that, across a wide set of plausible parameters, the effect of primary balances relative to debt should be high, typically above 10 in absolute value. The intuition for it is straightforward. These simulation results will be our guide in looking at the empirical evidence in the next sections.

3 Baseline Estimation Results

We look in this section at the actual relation between ratings, debt, and primary deficits, in 35 advanced economies (AEs) and 97 emerging market and developing economies (EMDEs), over the 1995 to 2025 period, for which we have ratings from S&P, Fitch, and Moody's, and the other data. The complete lists of countries are provided in Appendix Tables A11 and

A12.

As ratings come in the form of letters, we map each of them to a numerical scale, from 11 down to 1. 11 corresponds to the highest rating (AAA for S&P and Fitch, Aaa for Moody's), and 1 corresponds to the lowest rating that we consider, that is, "below investment grade." (Details of the mapping, sources and construction of the various variables are given in Appendix Tables A1 and A2). The ratings are highly correlated across the three agencies, with correlation coefficients above 0.94 for AEs, and above 0.90 for EMDEs.

For 37 percent of AE observations, the rating is 11 and only 11 percent of observations with a rating below 4. In contrast, for 73 percent of EMDE observations, the rating is 1 and there are no observations with a rating above 9. Although we allow for country-fixed effects, the differences between the two groups are so large that we prefer to estimate the relation separately for AEs and EMDEs.

We use (end-of-year) debt ratios from the IMF *World Economic Outlook* (WEO) database.[6] We use forecasts of primary balances from the Spring IMF WEO vintage of each year. We construct the primary balance forecast variable as the mean of forecasts for the primary fiscal balance over years t to year $t+5$. Summary statistics for all variables used in the analysis are reported in Appendix Table A10. In this section, we do not use forecasts of interest and growth rates in the estimation, but we do so in Section 5 for a smaller set of economies for which forecasts of this variable are also available in the Spring IMF WEO vintage of each year.

Our baseline specification is:

$$\begin{aligned} R^*_{i,t} &= \beta_b\, b_{i,t-1} + \beta_{Fs}\, Fs_{i,t} + \alpha_i + \gamma_t + \epsilon_{i,t} \\ R_{i,t} &= j \ \text{ if } \mu_{j-1} \leq R^*_{i,t} \leq \mu_j,\ j = 2, ...10 \\ R_{i,t} &= 1 \ \text{ if } R^*_{i,t} \leq \mu_1 \\ R_{i,t} &= 11 \ \text{ if } R^*_{i,t} \geq \mu_{10} \end{aligned} \tag{6}$$

where $b_{i,t-1}$ is the debt ratio for country i at the end of year $t-1$, $Fs_{i,t}$ is the mean forecast

[6]The debt data are for the general government in percent of fiscal-year GDP. We fill missing observations with data from the IMF Global Debt Database.

primary balance over years t to $t+5$ as of year t for country i (F denotes the forecast), $R^*_{i,t}$ and $R_{i,t}$ are the latent and actual ratings for country i in year t, and the μ_j's are the cut-off points for the different rating categories. (R^* is the equivalent to z in the earlier model, and the set of cut-off points is the discrete approximation to the $\Phi(\cdot)$ in the model). α_i and γ_t are country and year fixed effects. The inclusion of country fixed effects is consistent with the structure of our simple model, and could reflect a number of country-specific factors that our model consigns to x, such as the nature of investors, political dynamics, or the potential role of the central bank. Year fixed effects capture all time-varying factors that are common across countries.

Results are presented in Table 2 for AEs and Table 3 for EMDEs. Columns (1)–(3) report results for S&P ratings: Column (1) includes no country or time fixed effects, Column (2) adds time fixed effects, and Column (3) includes both country and time fixed effects. Columns (4) and (5) replicate the preferred specification from Column (3) for Moody's and Fitch, respectively. Column (6) presents results from a pooled model combining all three rating agencies at the rating agency–country–year level, with rating agency fixed effects included alongside country and time fixed effects. To account for serial correlation, standard errors are clustered at the country level in Columns (1)–(5) and at the rating agency–country level in Column (6).

Table 2: Advanced Economies: Baseline Estimation Results

	(1) S&P	(2) S&P	(3) S&P	(4) Moody's	(5) Fitch	(6) Pooled
Debt-to-GDP	−0.0071*	−0.0070*	−0.0479***	−0.0494***	−0.0524***	−0.0470***
	(0.0038)	(0.0039)	(0.0076)	(0.0089)	(0.0065)	(0.0042)
Forecast primary balance-to-GDP	0.0646*	0.0727	0.0910	0.0752	0.0686	0.0709**
	(0.0339)	(0.0472)	(0.0624)	(0.0500)	(0.0503)	(0.0291)
Observations	1,019	1,019	1,019	1,019	1,019	3,057
Pseudo R^2	0.0271	0.0321	0.458	0.448	0.449	0.426
Year FE	N	Y	Y	Y	Y	Y
Country FE	N	N	Y	Y	Y	Y
Agency FE	N	N	N	N	N	Y
Number of countries	35	35	35	35	35	35
Sample period			1995–2025			
Ratio of coefficients: primary balance to debt	−9.112	−10.42	−1.899	−1.524	−1.309	−1.510

*Notes. Table reports results from an ordered probit regression of sovereign ratings on the lagged debt-to-GDP ratio and forecast primary balances (average forecast for years t to t+5). Columns 1–5 report results for individual agency ratings at the country-year level, while Column 6 reports results from a pooled model at the rating agency–country–year level. Standard errors in parentheses, clustered at the country level in Columns 1–5 and at the rating agency–country level in Column 6. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.*

The first feature of the results is the importance of country effects: the R^2 increases from about 0.03 in the first two columns to 0.46 in the third. Results are similar for the other two sources of ratings, so, in columns 4 and 5, we just report the results with time and country effects for Moody's and Fitch ratings. From then on, we allow for both time- and country-fixed effects in all regressions.

The second feature is that while the estimated coefficient on debt is highly significant in all specifications, the coefficient on primary balances is statistically distinguishable from zero at conventional levels only in Columns (1) and (6). Looking at the last four columns, however, the ratio of the effect of the forecast primary balance to debt is much smaller (in absolute value) than could be expected based on the theoretical model: 1.9 for S&P, 1.5 for Moody's, and 1.3 for Fitch, and 1.5 in the pooled model—much smaller than the range of 10 or more, as discussed in the previous section.

The third feature, shown in Figure 1, is that estimated year effects follow a jagged path with some increase over 1995-2025. For Moody's data, there is also a bulge in the 2000s. This overall evolution contrasts with the much stronger rising path (reflecting more lenient ratings) than would have been expected, given the role of $r - g$ in debt dynamics and its steady decrease for most of the sample, as documented later.

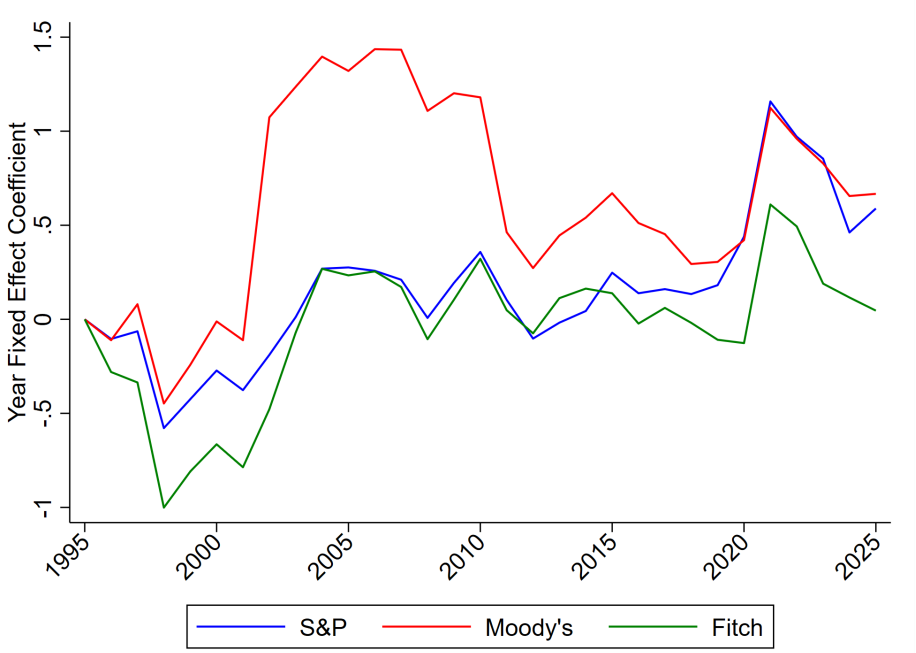

Figure 1: Advanced Economies: Estimated Year-Fixed Effects

Table 3 shows the results for EMDEs, with the same column structure. Country-fixed effects are again very large: the R^2 increases from 0.04-0.05 to 0.57 when country-fixed effects are added to the specification. Debt is highly significant, while the forecast primary balance is not statistically significant (although rather similar across specifications 3 to 6). The ratio of the effect of primary balances to debt is even lower than for AEs at, in absolute terms, only 0.7 for S&P, 0.5 for Fitch, and 0.1 for Moody's. The fact that the ratio is even lower in EMDEs than in AEs is surprising given, as we shall see, that the average value of $r - g$ is lower than for AEs, which should lead to a smaller effect of debt, and thus a higher ratio. Year-fixed effects are different across the three ratings. As shown for each of the three ratings in Figure 2, year-fixed effects for Fitch and Moody's are fairly flat, but are upward sloping, for S&P.

Table 3: Emerging Markets: Baseline Estimation Results

	(1) S&P	(2) S&P	(3) S&P	(4) Moody's	(5) Fitch	(6) Pooled
Debt-to-GDP	−0.0144***	−0.0158***	−0.0426**	−0.0661***	−0.0443***	−0.0449***
	(0.0033)	(0.0038)	(0.0179)	(0.0097)	(0.0124)	(0.0085)
Forecast primary balance-to-GDP	0.0569**	0.0648**	0.0304	0.0037	0.0204	0.0161
	(0.0265)	(0.0293)	(0.0200)	(0.0176)	(0.0198)	(0.0106)
Observations	2,294	2,294	2,294	2,393	2,180	6,867
Pseudo R^2	0.0438	0.0476	0.568	0.603	0.653	0.562
Year FE	N	Y	Y	Y	Y	Y
Country FE	N	N	Y	Y	Y	Y
Agency FE	N	N	N	N	N	Y
Number of countries	97	97	97	101	91	112
Sample period			1997–2025			
Ratio of coefficients: primary balance to debt	−3.951	−4.101	−0.713	−0.056	−0.460	−0.359

*Notes. Table reports results from an ordered probit regression of sovereign ratings on the lagged debt-to-GDP ratio and forecast primary balances (average forecast for years t to $t+5$). Columns 1–5 report results for individual agency ratings at the country- year level, while Column 6 reports results from a pooled model at the rating agency–country–year level. Standard errors in parentheses, clustered at the country level in Columns 1–5 and at the rating agency–country level in Column 6. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.*

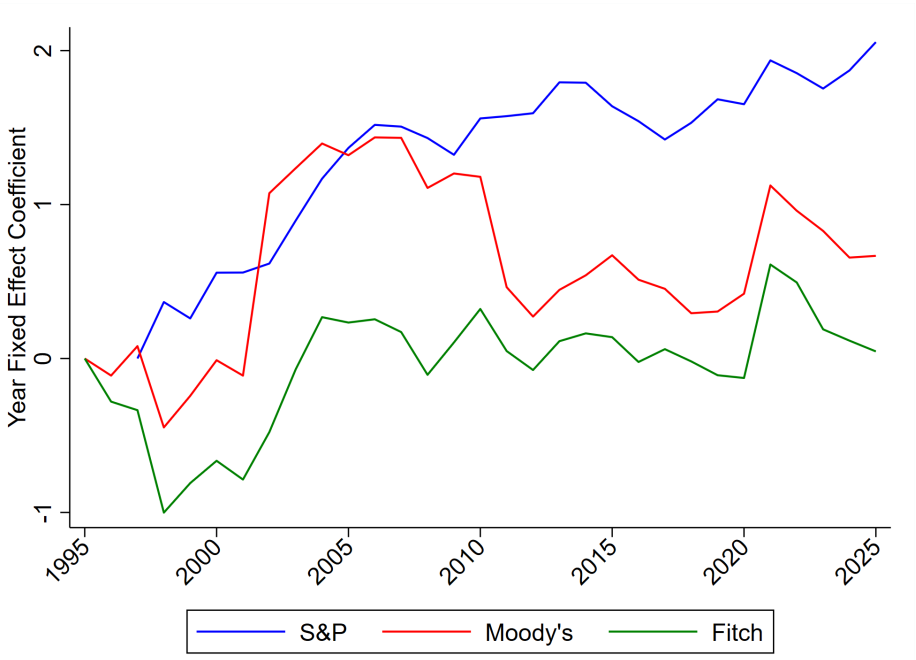

Figure 2: Emerging Market and Developing Economies: Estimated Year-Fixed Effects

We have identified three tensions between the model and the data. The data show a larger role for debt relative to forecast primary balances; a relatively flat path of year-fixed effects despite the decrease in $r - g$ over time; and large country effects. We examine each of

these tensions further in the next three sections.

4 Debt versus Primary Balances

There are at least two hypotheses for why the estimated ratio of the relative effect of the primary balance to debt in Section 3 may be biased toward zero.

The first is that the relatively small ratio may reflect an error-in-variables issue: It may be that rating agencies' forecasts of future primary fiscal balances are more accurate than those in the IMF WEO, and that IMF WEO forecasts we observe are noisy proxies for the true underlying forecasts of rating agencies. In this case, the estimated coefficient on forecast primary balances would be biased downwards, and so would the ratio.

The second hypothesis is different in nature: It is that, the higher is the level of debt, the more likely the forecast of primary balances is to be optimistic, and the more likely the coefficient on b is to be larger (in absolute value) than the true coefficient, leading again to too low a ratio.[7]

To explore these hypotheses, we estimate the following standard forecast evaluation regression, along the lines of Mincer and Zarnowitz (1969):

$$s_{i,t} = \alpha_{FS} Fs_{i,t} + \alpha_b b_{i,t-1} + \alpha_i + \gamma_t + \epsilon_{i,t} \tag{7}$$

where, as before, $Fs_{i,t}$ denotes the mean forecast primary balance over years t to $t+5$ as of year t (from the IMF WEO Spring issue of year t) for country i; and $s_{i,t}$ denotes the actual realized mean of the primary fiscal balance data for the same years years (t to year $t+5$). If the IMF WEO forecasts of primary fiscal balances satisfy rational expectations, then α_{FS} should be equal to 1, and the coefficient on $b_{i,t-1}$, which is in the information set at time t, α_b should be equal to zero. Similarly, country- and year-fixed effects (α_i and γ_t, respectively)

[7]Frankel (2011) finds strong evidence of optimism in government budget balance forecasts of up to three years ahead for 33 countries, implying budget deficits on average larger than projected : "a bias of 0.2 percent of GDP at the 1-year horizon, 0.8 percent 2 years ahead, and a hefty 1.5 percent 3 years ahead." Other studies (for example, Beetsma et al. (2009)) also find evidence of optimism in official fiscal forecasts. We confirm the presence of such bias for the forecasts we take from vintages of the WEO. Our separate but complementary finding of noisiness in fiscal forecasts relates to recent findings of Aktuğ and Rezghi (2025) for WEO forecasts of GDP and other (non-fiscal) variables.

should be equal to zero. The results reported below show that this is not the case.

The estimation results are shown in Table 4, for AEs and EMDEs, with and without outliers.

Table 4: Actual Primary Balance Outturns vs. Forecasts and Initial Debt

	(1) AE	(2) AE	(3) EMDE	(4) EMDE
Forecast primary balance-to-GDP	0.336***	0.385***	0.324***	0.304***
	(0.070)	(0.038)	(0.063)	(0.031)
Debt-to-GDP	0.039***	0.034***	0.013	0.018***
	(0.005)	(0.004)	(0.008)	(0.005)
Observations	774	735	1,390	1,318
R^2	0.787	0.844	0.578	0.736
Outliers removed	No	Yes	No	Yes

*Notes: All equations estimated include year- and country-fixed effects. Results excluding outliers based on discarding observations for which Cook's distance exceeds 4/N, where N is the sample size (Cook 1979). Newey West standard errors with a lag truncation parameter of six are reported in parentheses (Newey and West 1987). ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.*

The table yields two conclusions. The coefficient on $Fs_{i,t}$ in equation (7) is significantly less than 1, namely about 0.3 for both AEs and EMDEs (with and without outliers). Additionally, there is some suggestive evidence, mainly for AEs, that, for a given forecast primary balance, higher debt is associated with higher-than-expected primary balance outcomes.

If we are willing to assume that rating agencies have rational expectations, then we can measure the attenuation effect due to our use of the observed IMF WEO forecasts, rather than the rating agencies' true underlying forecasts, in our baseline regressions. In this case, the true model is given by:

$$R^*_{i,t} = \beta_b b_{i,t-1} + \beta_{Es} Es_{i,t} + \alpha_i + \gamma_t + \epsilon_{i,t} \tag{8}$$

where Es is the rational, but unobservable forecast of primary balances. We observe instead:

$$R^*_{i,t} = \beta_b b_{i,t-1} + \beta_{Fs} Fs_{i,t} + \alpha_i + \gamma_t + \epsilon_{i,t} \tag{9}$$

Assume that the forecasts of the primary balance ($Fs_{i,t}$) that we observe (from the IMF WEO) are a noisy measure of the actual expectations of rating agencies, so that $Fs_{i,t} = Es_{i,t} + \eta_{i,t}$ (ignoring for simplicity the effect of debt, which makes little quantitative difference), with η being white noise. In this case, the relation of the true coefficient β_{Es} in equation (8) to our estimated coefficient β_{FS} in equation (9) is approximately given by $\beta_{Es} = \beta_{Fs}/\alpha_{Fs}$. This adjustment, using estimates of α_{Fs} from Column 1 of Table 4 for AEs and Column 3 of Table 4 for EMDEs, implies an increase in the ratio of the effect of primary balances relative to debt from a range (in absolute value) of 1.3 to 1.9 for AEs in Table 2 (Columns 3–6) to a range of 3.9 to 5.7. For EMDEs, the adjustment implies an increase in this ratio from a range of 0.1 to 0.7 in Table 3 (Columns 3–6) to a range of 0.2 to 2.2. This higher range is closer to, but still well below, the range suggested by the model earlier.

Overall, taking into account errors in variables reduces the difference between the model and the data, but still leaves a substantial gap. Ratings still appear to put too much weight on debt relative to forecast primary balances.

5 The Role of $r - g$

Our baseline regressions yielded relatively flat year effects, a surprising finding given the global decrease in $r - g$, documented elsewhere, at least until the COVID-19 crisis. We explore this issue further in this section.

We first construct measures of forecasts of $r - g$. The data we need exist for AEs (see Appendix Table A13 for the list of included economies), but only for a limited set of EMDEs (we call this limited set of EMDEs Emerging Markets, or EMs, throughout the paper), so we focus on the economies in the JP Morgan Emerging Markets Bond Index (EMBI) for which the data exist. The index includes 30 EMDEs; because of data limitations, we exclude five countries, reducing the sample to 25 countries. The resulting list is in Appendix Table A14.

Following Mauro and Zhou (2021), we construct the nominal interest rate as the sum of two components. The first is the forecast of the average interest rate paid on the debt, constructed as the mean of the forecasts for years t to $t + 5$ of the ratio of interest payments

to debt, with the forecasts taken again from successive spring vintages of the IMF WEO. The second is the increase in debt due to the change in the exchange rate, constructed as the share of foreign currency debt times the forecast depreciation of the currency with respect to the US dollar. To approximate this forecast depreciation rate on average over the next five years, we use the forecast of the inflation differential relative to the United States on average during years t to $t+5$, from the same IMF WEO vintage. See Section 2 of the Data Appendix for details on construction of $r-g$.

Figure 3 reports country-group medians for the forecasts of $r-g$ for AEs and EMs. While the two groups diverge in their earlier trends, since 2000 they have moved more in tandem.

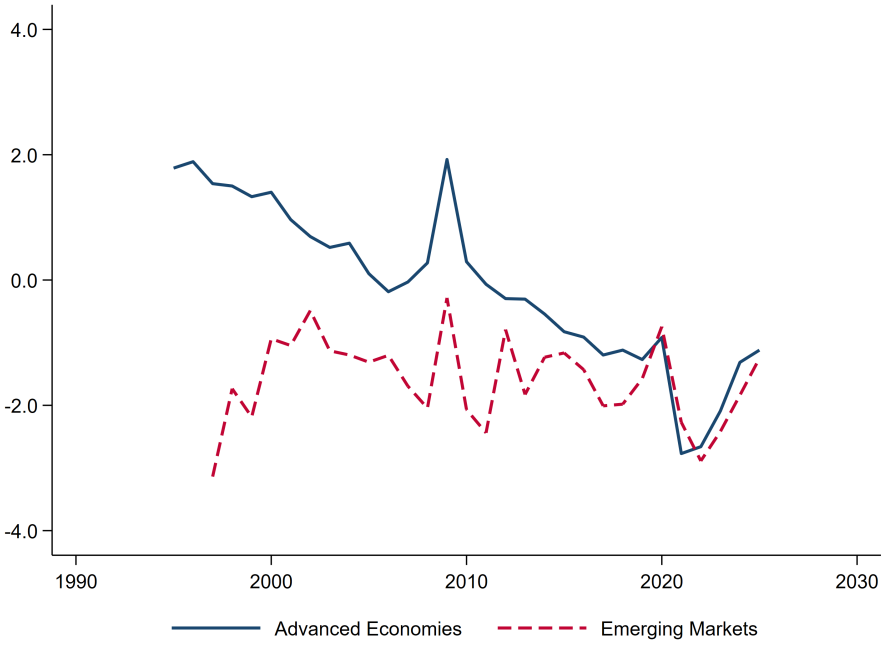

Figure 3: Forecasts of $r-g$

Notes: Figure reports effective interest rate minus nominal growth rate, adjusted for valuation effects, forecasted on average for years t through $t+5$, with forecasts taken from the IMF WEO. Figure reports country-group medians AE and EM samples, where EM sample includes countries in the J.P. Morgan EMBI.

The decrease in $r-g$ in AEs from about 2 percent in 1995 to -3 percent in 2021 is particularly striking. Since then, forecasted $r-g$ has increased but, in our data set, it

remains negative, around -1 percent. This level reflects, in part, the fact that many bonds were issued when nominal interest rates were very low, so that the increase in the interest paid on the debt lags and is forecast to keep lagging the increase in current interest rates over the next five years. For the EMs, we find (in line with Mauro and Zhou (2021)) on average a more stable but deeply negative level of $r - g$.

As shown in Section 2, theory suggests that $r-g$ should strongly influence how debt affects ratings relative to how primary surpluses do. We therefore extend the baseline specification (6) to allow the coefficient on debt to vary with $r - g$.

We consider three parameterizations, which differ in how they treat time variation in the debt coefficient. The first includes year fixed effects, a Debt $\times$ Year interaction, and a Debt $\times(r - g)$ interaction; the potential problem is that Debt $\times$ Year may partly absorb the effect of $r - g$. The second retains year fixed effects and the Debt $\times(r - g)$ interaction but drops Debt $\times$ Year; the potential problem is it risks attributing to $r - g$ other, unrelated reasons why the debt coefficient has evolved over time. The third omits year fixed effects and the Debt $\times$ Year interaction altogether, attributing all such variation to Debt $\times(r - g)$, an extreme specification, since other factors plausibly also matter.

$$R^*_{i,t} = \beta_b b_{i,t-1} + \beta_{Fs} Fs_{i,t} + \beta_{brg} \left(b_{i,t-1} \cdot (r_{i,t} - g_{i,t})\right) + \delta_t \left(b_{i,t-1} \cdot \gamma_t\right) + \alpha_i + \tau_t + \epsilon_{i,t} \qquad (10)$$

Appendix Tables A7 and A8 report results from estimating equation (10) for AEs and EMDEs, respectively. Because results are nearly identical across the three rating agencies, we pool the sample at the rating agency–country–year level and include rating agency fixed effects alongside country fixed effects. Column (1) reports the most flexible specification, with year fixed effects and the Debt-to-GDP $\times$ Year interaction; Column (2) the intermediate specification, which retains year fixed effects but omits the Debt-to-GDP $\times$ Year interaction; and Column (3) the most demanding specification, which excludes year fixed effects entirely and so attributes all time variation in ratings to $r - g$. Across all three specifications, the coefficient on Debt-to-GDP $\times(r - g)$ is negative and statistically significant, indicating that rating agencies penalize a given level of debt more heavily when $r - g$ is higher, though the

economic magnitude of this effect is small.

The implications of the estimation results are most clearly conveyed graphically. As the results are nearly identical across all three rating agencies, we present those for S&P only. Figure 4 (AE) and Figure 5 (EM) show the decomposition implied by the first specification which includes time effects, Debt × Year, and Debt $\times(r-g)$. The figure plots the estimated year effects, the debt–year interaction, and the implied contribution of the debt $\times(r-g)$ interaction, using the average $r-g$ across countries in each year.

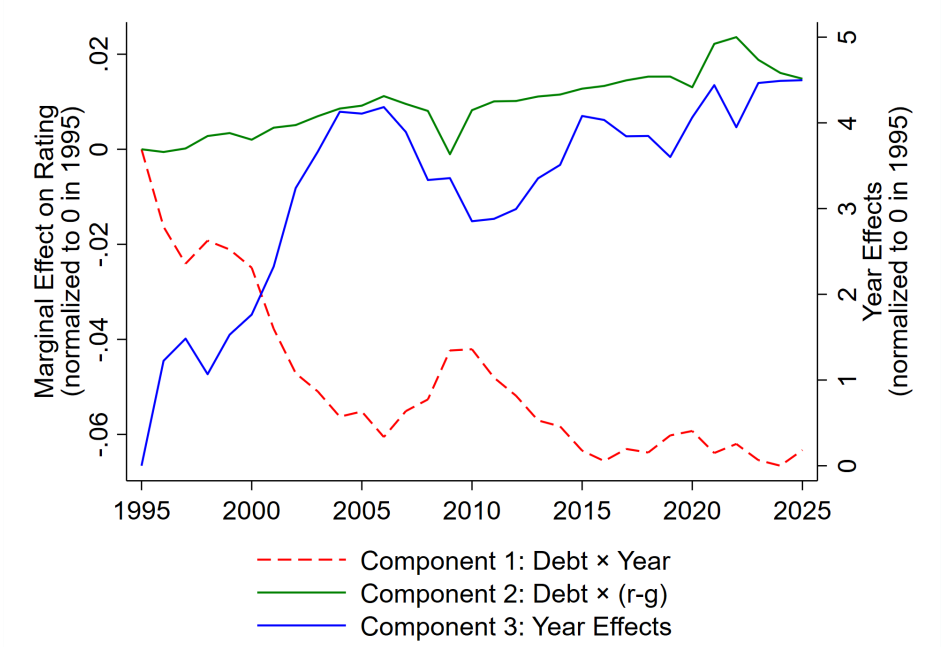

Figure 4: AEs: S&P Ratings Relation: Time Effects, Debt, and $r-g$

Figure 4 shows the three time series for AEs, and yields two conclusions. The first one is the rotation from year effects to debt effects. Put another way, rankings, for given debt and primary balances, have become generally more generous (the blue line), but debt itself has become more penalized relative to primary balances (the red line). We have no obvious explanation for this rotation. The second, more important for our purposes, is the weak effect of $r-g$ on ratings. While the coefficients on the interaction term between debt and $r-g$ are significant at the 1 percent level for all three ratings (see Appendix Tables A7 and A8),

and, as shown in Figure 3, $r-g$ has substantially decreased over the sample, the effect of the interaction term is very small on ratings—much smaller than the interaction term between debt and year effects. Thus, the conclusion is that the effect of $r-g$ on ratings, while having the expected sign, is much smaller than our theoretical model suggests.

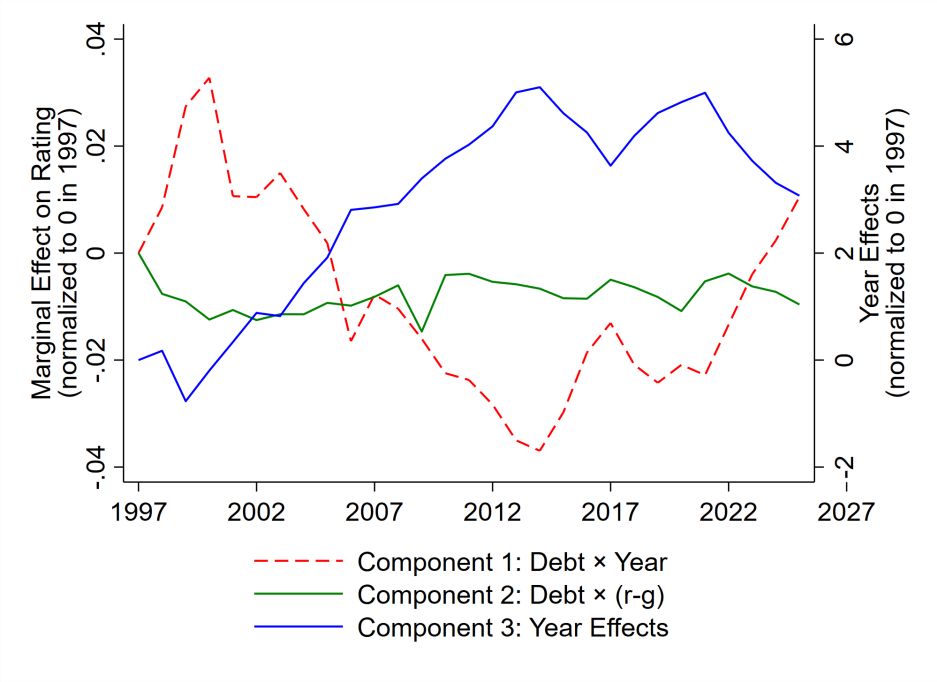

Figure 5: EMs: S&P Ratings Relation: Time Effects, Debt, and $r-g$

Figure 5 does the same decomposition for our sample of EMs (those in the J.P. Morgan EMBI). The decomposition looks broadly similar to that for AEs for year effects (the blue line): for given debt and primary balances, ratings have become generally more generous over the past two decades. Up to the mid-2010s, there is also the sharp rotation we observed for AEs, with an increased adverse effect of debt on ratings, although this rotation subsequently unwinds, with a less punitive effect of debt on ratings. There is also no visible trend in the effect of $r-g$.

6 Country Effects

Section 3 showed the importance of country effects in explaining differences across countries given debt, primary balances, and year effects. As noted above, there are sound theoretical reasons for including country effects in the empirical specification, even within the structure of our simple model. What puzzles us, however, is their size and importance. The interpretation of the country effects, in an ordered probit regression, is difficult. In this section, we offer two interpretations.

The first is the implication of country effects in terms of expected rating for each country, for given common values of debt, b, forecast primary balances Fs, and year effects γ. It is derived as follows:

Consider country i. From equation 6, write

$$ER_i = \beta_b b + \beta_{Fs} Fs + \gamma_t + \alpha_i \tag{11}$$

Then, using ER_i from equation (11), the probability that country i has a rating equal to j is given by:

$$\begin{aligned} P(R_i = 1) &= \Phi(\mu_1 - ER_i) \\ P(R_i = j) &= \Phi(\mu_j - ER_i) - \Phi(\mu_{j-1} - ER_i) \quad ; \quad j = 2, \ldots, 10 \\ P(R_i = 11) &= 1 - \Phi(\mu_{10} - ER_i) \end{aligned} \tag{12}$$

Combining the rating probabilities in equation (12), the expected rating is then given by:

$$1 \cdot \Phi(\mu_1 - ER_i) + \sum_{2}^{10} j \cdot (\Phi(\mu_j - ER_i) - \Phi(\mu_{j-1} - ER_i)) + 11 \cdot (1 - \Phi(\mu_{10} - ER_i)) \tag{13}$$

The second is the implication in terms of the debt ratio consistent with a rating at least equal to j with probability P, for given values of forecast primary balances, and year effects. It is derived as follows:

We want to find the debt ratio of country i such that

$$\begin{aligned} 1-P &= P\left(R_i \leq j-1\right) \\ 1-P &= P\left(R_i^* \leq \mu_{j-1}\right) \\ 1-P &= P\left(\epsilon \leq \mu_{j-1} - \beta_b b_i - \beta_{Fs} Fs - \alpha_i - \gamma\right) \\ 1-P &= \Phi\left(\mu_{j-1} - \beta_b b_i - \beta_{Fs} Fs - \alpha_i - \gamma\right) \end{aligned} \tag{14}$$

Solving equation (14) for b_i gives

$$b_i = \left[\mu_{j-1} - \beta_{Fs} Fs - \alpha_i - \gamma - \Phi^{-1}(1-P)\right] / \beta_b \tag{15}$$

We use the baseline regressions associated with the S&P rating. For the computation of expected ratings (equation (13)), we use the sample average values of debt and forecast primary balances, and the 2020 value of the year effect. For the computation of debt ratios (equation (15)), we use a value of zero for the forecast primary balance, and the 2020 year effect. For AEs, we use a threshold rating of 9. For EMs, we use a lower threshold, 2, to reflect the lower range of the distribution of ratings. In both cases, we take P to be 0.5 (so that $\Phi^{-1}(1-P) = 0$.

The results are given in the figures below.

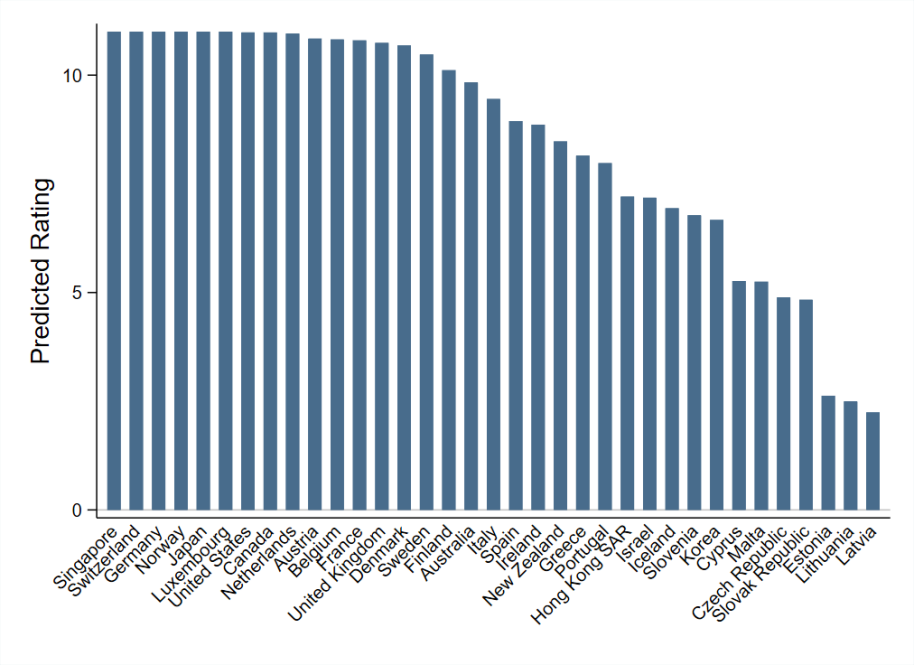

Figure 6: AEs: Illustrative Predicted S&P Rating by Economy

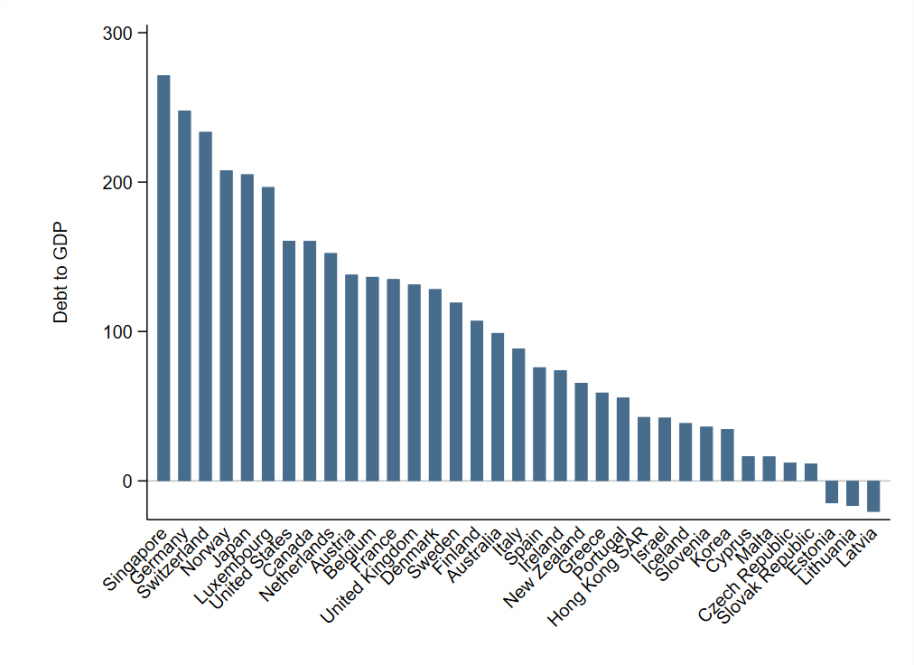

Figure 7: AEs: Illustrative Debt Tolerance Ratio for S&P Rating $R = 9$

The clear message of Figure 6 is that, given similar debt and forecast primary balances,

AEs have very different expected ratings.[8] Countries such as Germany, for example, have an expected rating of 11, while, at the same level of debt and primary balances, Ireland has a predicted rating of 9, and the Baltic countries have a predicted rating of 2. That there are differences across countries is not surprising. Even given debt, and the forecast evolution of primary balances over the next five years, investors may question what will happen over a longer horizon. The degree of uncertainty about interest rates and primary balances can vary. The composition of the investors' pool can vary, with some investors having a lower tolerance to increases in debt, and thus different values of x. Yet, the differences are striking.

The message from Figure 7, which shows what can be called a "debt tolerance" level, that is, the level of debt above which a country is predicted to lose its rating of 9 with 50 percent probability (given zero forecast primary balances and the year 2020 time effect), is even clearer. At one end, the highest illustrative debt ratio tolerance levels are for Singapore's (272 percent) and Germany (248 percent. In the middle of the range are countries such as the United States (161 percent), France (135 percent), and Italy (89 percent). At the low end are the Baltic states, with negative ratios: Even with zero debt, and with zero primary balances, they the estimates imply that ratings agencies would grant them a rating of 9 or more with probability less than 0.5. While the levels of the debt ratios would be different, the differences between them would be the same if we chose a different rating, a different probability, and a different year. The same remarks apply as above: These differences across countries in required debt ratios are striking.

Figures 8 and 9 present the results of the same exercises for the EMs. The difference is in the choice of the lower rating threshold, namely 2, in computing the threshold level of debt. The conclusions are very similar.[9] For the same set of debt and forecast primary balances (the EMDE sample average levels), Qatar's expected rating is 8, China's is 6.7, India's is 4.1, and Brazil's is 2.6.[10] For Pakistan and Türkiye, the predicted rating is 1, that is, below

[8]The calculation is based on the AE sample average levels of debt and the forecast primary balances of 65 percent of GDP and 1.3 percent of GDP, respectively

[9]The results are robust to using higher threshold, namely R=4.

[10]For the EMDE sample, the calculation is based on the sample average levels of debt and the forecast primary balances of 47 percent of GDP and 0.50 percent of GDP, respectively

investment grade. The debt ratio such that a country reaches at least a rating of 2, with probability 0.5, varies from 161 percent in Qatar, 134 percent in China, down to 79 percent in Mexico, and negative values for Pakistan and others.

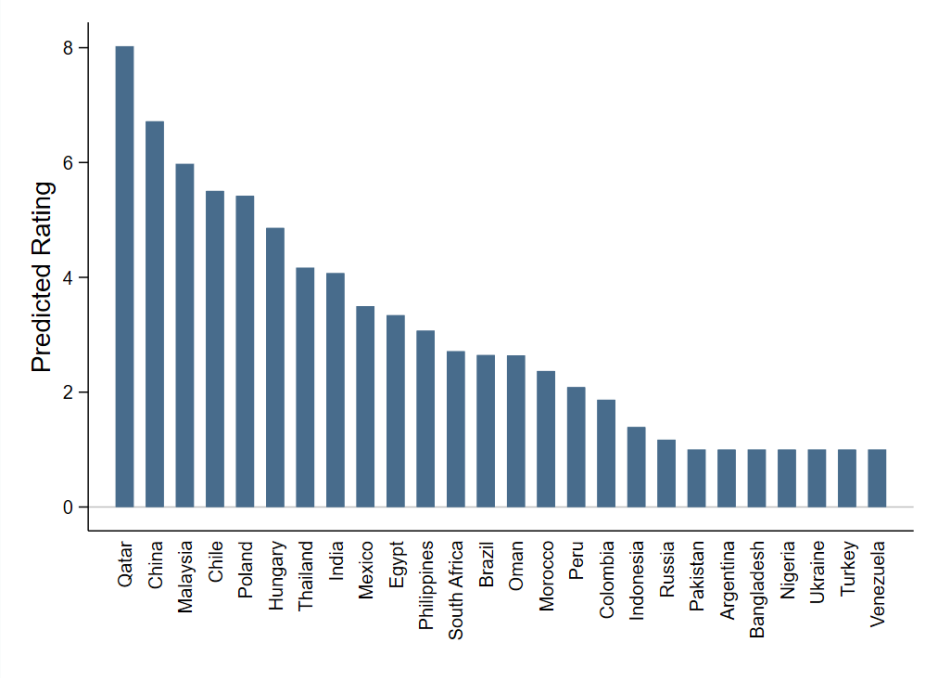

Figure 8: EMDEs: Illustrative Predicted S&P Rating by Economy

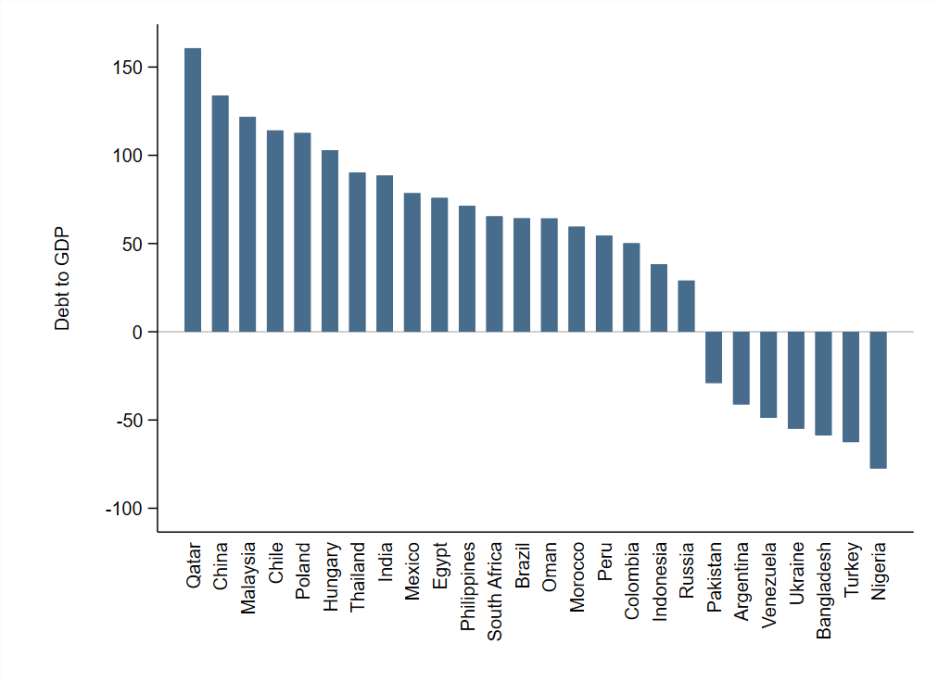

Figure 9: EMDEs: Illustrative Debt Tolerance Ratio for S&P Rating $R = 2$

7 Conclusions

We have shown three major differences between our model and actual ratings. More weight, by rating agencies, on debt relative to forecast primary balances. A smaller effect of $r - g$ on ratings. And very large country effects. We believe that, while our model is simple, its broad implications are straightforward and more general. Still, as a matter of logic, one can draw two conclusions from the paper. It may be that our model is missing some essential aspects of the effect of fiscal policy on the probability of default. Or it may be that our model reaches roughly the right conclusions, and rating agencies should revisit their methods. This is why we have chosen "An exploration" as part of the title. There are different ways to explore the results further.

The first is to look at the same relation, but in terms of spreads, which reflect investors' rather than rating agencies' perceptions. In preliminary work, we find that spreads put relatively more weight on forecast primary balances relative to debt than ratings do, thus closer to the implications of our model, although a gap remains. Second, by exploring how

much of the country effects can be explained by differences in political variables, the role of the central bank, and so on, through their effects of x and the σs. Third, by looking at actual defaults, and their relation to debt and primary balances. This is easier to do for emerging markets, with low average ratings and a higher proportion of actual defaults than for advanced countries with much higher ratings, and very few actual defaults. We have not explored the last two.

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Data Appendix

1. Ratings

Ratings are taken from S&P, Moody's, Fitch. These represent ratings on EU or US denominated bonds. Letter ratings are mapped into cardinal ratings. For S&P and Fitch, the cardinal ratings range from 11 (AAA) to 1 (below investment grade). For Moody's, they range from 11 (Aaa) to 1 (below investment grade).

Notably, the ratings are not conditional on actual issuance. They are conditional on current and prospective conditions.

More specifically, for S&P and Fitch, the 11 cardinal ratings (11 = best) are classified in Table A1 as follows:

Table A1: Rating classification (cardinal and letter): S&P and Fitch

Cardinal	**Letter**
11	AAA
10	AA+
9	AA
8	AA-
7	A+
6	A
5	A-
4	BBB+
3	BBB
2	BBB-
1	Below investment grade

For Moody's, cardinal and letter ratings are reported below in Table A2.

Table A2: Rating classification (cardinal and letter): Moody's

Cardinal	**Letter**
11	Aaa
10	Aa1
9	Aa2
8	Aa3
7	A1
6	A2
5	A3
4	Baa1
3	Baa2
2	Baa3
1	Below investment grade

The distribution of S&P ratings is reported in Table A3.

Table A3: Distribution of Ratings

Panel A. Advanced Economies		
Rating	Frequency	Percent
1	30	2.9
2	29	2.8
3	32	3.1
4	21	2.1
5	57	5.6
6	88	8.6
7	79	7.8
8	73	7.2
9	105	10.3
10	129	12.7
11	376	36.9
Total	1,019	100

Panel B. Emerging Markets and Developing Economies		
Rating	Frequency	Percent
1	1,664	72.5
2	181	7.9
3	129	5.6
4	99	4.3
5	95	4.1
6	48	2.1
7	32	1.4
8	28	1.2
9	18	0.8
Total	2,294	100

Notes. Panel A reports the distribution for the AE sample corresponding to Table 2. Panel B reports the distribution for the EMDE sample corresponding to Table 3.

The three agencies' categorical ratings are closely correlated, as reported in Table A4.

Table A4: S&P, Moody's, and Fitch. Correlation between Ratings

Panel A. Advanced Economies			
Variable	S&P	Moody's	Fitch
S&P	1.000	0.943***	0.964***
Moody's	0.943***	1.000	0.964***
Fitch	0.964***	0.964***	1.000
Panel B. Emerging Market and Developing Economies			
Variable	S&P	Moody's	Fitch
S&P	1.000	0.933***	0.932***
Moody's	0.933***	1.000	0.910***
Fitch	0.932***	0.910***	1.000

Notes. *** denotes statistical significance at the 1 percent level.

Why are these ratings important? One reason is that ratings determine premium governments can offer on their debt. Figure A1 reports the relationship between ratings and spreads. Reported spreads are on USD or Euro-denominated bonds, and are calculated as the difference between long term yields for the country and the risk free rate measured by U.S. Treasury yields (for USD-denominated bonds) and German government yields (for Euro-denominated bonds).

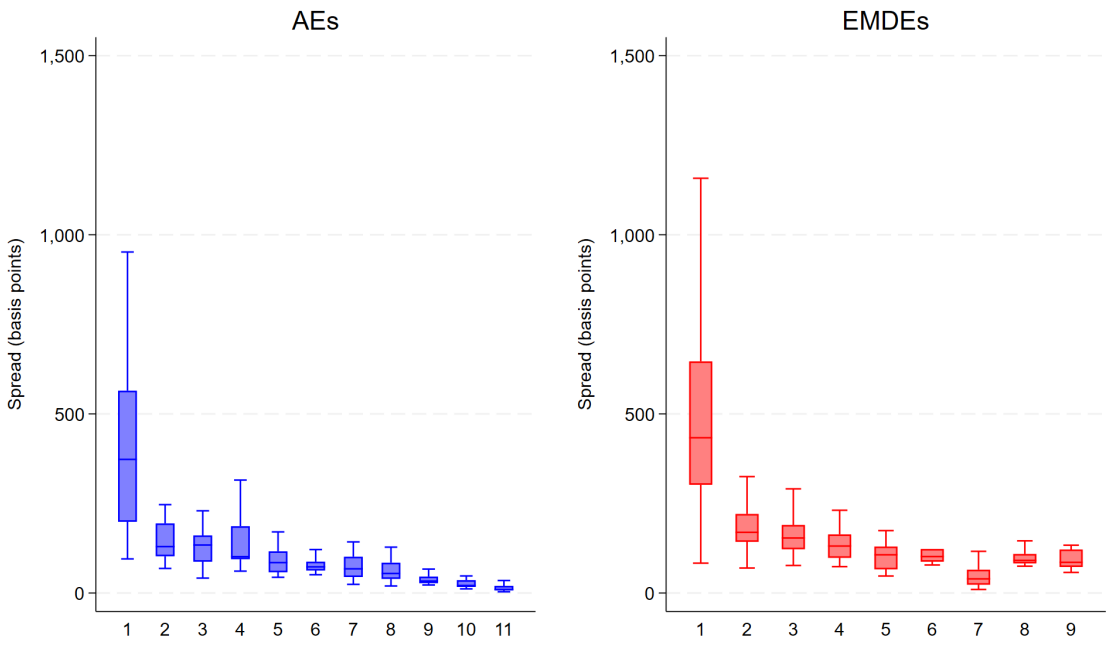

Figure A1: Sovereign Spreads vs. (S&P) Ratings

Notes. Spreads are on USD-denominated bonds for majority of countries, and calculated over U.S. Treasury yields. For spreads on euro-denominated bonds, these are calculated over German government yields. Weighted Average Spread is used which is the Par-value weighted spread across all of a country's bonds with more than one year remaining maturity. Annual data spanning 98 countries (25 advanced economies and 73 emerging market and developing economies) from 2012 to 2024.

2. Interest rates, and interest-growth differential

Due to thinly available data on 10-year government bond yields especially for emerging markets, we use the "effective rate of government debt" (or total interest payments as a ratio of debt) from the WEO database. For consistency, we use the same measure for both AEs and EMs.

We construct the interest-growth differential (r-g) as the difference between the forecasted effective interest rate and forecasted nominal growth (average of 0-year ahead to 5-year ahead forecasts). Following Mauro and Zhou (2021), the interest-growth differential is adjusted to account for valuation effects. The estimated (r-g) is specified in equation (A1) below.

$$r - g = \frac{\bar{i} + (\alpha_{n-1} \cdot \Delta\pi) - \bar{ng}}{1 + \bar{ng}} \tag{A1}$$

where $\bar{i}$ is the average forecasted effective interest rate, $\Delta\pi$ is the mean forecasted inflation differential, $\bar{ng}$ is average forecasted nominal growth, α_{n-1} is one-year lagged share of foreign-currency debt in overall debt.

3. Robustness Checks

Sub-samples with different time periods

Tables A5 and A6 present robustness of the main results presented in Column (6) of the text in Table 2. The results in Table 2 for AEs are remarkably stable across different sample periods.

For EMDEs, however, this is not the case. While the magnitude and significance of the coefficient on lagged debt remain broadly consistent across specifications, the same cannot be said for forecasted primary balances. As reported in Column (7) (which is identical to Column (6) of Table 3), the estimated coefficients on forecasted primary balances is statistically insignificant.

Table A6 further shows that the estimated effects increase nearly monotonically as the sample is progressively restricted to earlier years, with the largest and most precisely estimated effects obtained when the sample ends in 2019.

Table A5: Robustness to Different Sample Periods. Advanced Economies

	Pooled model						
	(1) Year≤2019	(2) Year≤2020	(3) Year≤2021	(4) Year≤2022	(5) Year≤2023	(6) Year≤2024	(7) Year≤2025
Debt-to-GDP	−0.0532***	−0.0522***	−0.0506***	−0.0496***	−0.0484***	−0.0477***	−0.0470***
	(0.0052)	(0.0050)	(0.0048)	(0.0047)	(0.0045)	(0.0044)	(0.0042)
Forecast primary balance-to-GDP	0.0724**	0.0750**	0.0736**	0.0744**	0.0706**	0.0722**	0.0709**
	(0.0303)	(0.0299)	(0.0294)	(0.0294)	(0.0293)	(0.0293)	(0.0291)
Observations	2,445	2,547	2,649	2,751	2,853	2,955	3,057
Year FE	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES
Agency FE	YES	YES	YES	YES	YES	YES	YES
Pseudo R^2	0.438	0.435	0.433	0.432	0.430	0.428	0.426
Ratio of coefficients: primary balance-to-debt	−1.362	−1.437	−1.456	−1.499	−1.459	−1.515	−1.510
Number of countries	35	35	35	35	35	35	35
Sample: start year	1995	1995	1995	1995	1995	1995	1995
Sample: end year	2019	2020	2021	2022	2023	2024	2025

Table A6: Robustness to Different Sample Periods. Emerging Market and Developing Economies

	Pooled model						
	(1) Year≤2019	(2) Year≤2020	(3) Year≤2021	(4) Year≤2022	(5) Year≤2023	(6) Year≤2024	(7) Year≤2025
Debt-to-GDP	−0.0477***	−0.0481***	−0.0475***	−0.0464***	−0.0457***	−0.0452***	−0.0449***
	(0.0097)	(0.0098)	(0.0094)	(0.0092)	(0.0089)	(0.0087)	(0.0085)
Forecast primary balance-to-GDP	0.0329**	0.0368***	0.0366***	0.0280**	0.0266**	0.0212**	0.0161
	(0.0135)	(0.0130)	(0.0119)	(0.0112)	(0.0107)	(0.0105)	(0.0106)
Observations	5,216	5,497	5,775	6,050	6,323	6,595	6,867
Year FE	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES
Agency FE	YES	YES	YES	YES	YES	YES	YES
Pseudo R^2	0.567	0.567	0.567	0.566	0.565	0.563	0.562
Ratio of coefficients: primary balance-to-debt	−0.689	−0.764	−0.772	−0.603	−0.581	−0.468	−0.359
Number of countries	112	112	112	112	112	112	112
Sample: start year	1997	1997	1997	1997	1997	1997	1997
Sample: end year	2019	2020	2021	2022	2023	2024	2025

Interaction of debt with $r - g$

Tables A7 and A8 (for AEs and EMs, respectively) report results from estimating ordered probit regressions that include an interaction of debt-to-GDP with $r - g$. All specifications include rating agency and country fixed effects. Column (1) additionally includes year fixed effects and an interaction of debt-to-GDP with year; Column (2) retains year fixed effects but drops the debt-to-GDP $\times$ year interaction; and Column (3) drops year fixed effects entirely, attributing all time variation in ratings to $r - g$. Column (3) is therefore the most demanding specification, while Column (1) is the most flexible. Across all three, the estimated coefficient on Debt-to-GDP $\times$ $(r - g)$ is negative and statistically significant, indicating that rating agencies penalize a given level of debt more heavily when $r - g$ is higher.

Table A7: Advanced Economies – Debt, Year, $r - g$ Interaction

	(1)	(2)	(3)
Debt-to-GDP	−0.0018	−0.0486***	−0.0494***
	(0.0063)	(0.0050)	(0.0046)
Forecast primary balance-to-GDP	0.0716*	0.1155***	0.0612***
	(0.0395)	(0.0389)	(0.0227)
Debt-to-GDP $\times$ $(r - g)$	−0.0048***	−0.0026***	−0.0024***
	(0.0008)	(0.0007)	(0.0005)
Observations	2,484	2,484	2,484
Pseudo R^2	0.478	0.449	0.438
Agency FE	Y	Y	Y
Country FE	Y	Y	Y
Year FE	Y	Y	N
Debt-to-GDP $\times$ Year	Y	N	N

*Notes. All columns report results from a pooled model at the rating agency–country–year level. All columns include rating agency and country fixed effects. Column (1) additionally includes year fixed effects and a debt-to-GDP $\times$ year interaction; Column (2) retains year fixed effects but drops the debt-to-GDP $\times$ year interaction; and Column (3) drops year fixed effects and the debt-to-GDP $\times$ year interaction. Standard errors in parentheses, clustered at the rating agency–country level. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.*

Table A8: Emerging Markets – Debt, Year, $r - g$ Interaction

	(1)	(2)	(3)
Debt-to-GDP	-0.0360^{***}	-0.0463^{***}	-0.0303^{***}
	(0.0098)	(0.0096)	(0.0076)
Forecast primary balance-to-GDP	0.0784^{***}	0.0619^{***}	-0.0209
	(0.0240)	(0.0227)	(0.0228)
Debt-to-GDP $\times$ $(r - g)$	-0.0022^{***}	-0.0021^{***}	-0.0019^{***}
	(0.0007)	(0.0007)	(0.0006)
Observations	1,938	1,938	1,938
Pseudo R^2	0.489	0.471	0.412
Agency FE	Y	Y	Y
Country FE	Y	Y	Y
Year FE	Y	Y	N
Debt-to-GDP $\times$ Year	Y	N	N

*Notes. Sample of 25 EMs, over the period 1997-2025. All columns report results from a pooled model at the rating agency–country–year level. All columns include rating agency and country fixed effects. Column (1) additionally includes year fixed effects and a debt-to-GDP $\times$ year interaction; Column (2) retains year fixed effects but drops the debt-to-GDP $\times$ year interaction; and Column (3) drops year fixed effects and the debt-to-GDP $\times$ year interaction. Standard errors in parentheses, clustered at the rating agency–country level. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.*

Non-linearity in debt

One potential concern is that the effects we estimate in Tables 2 and 3 may be different depending on inital debt levels. Table A9 repeats those tables including the square of debt ratio to allow for non-linearity. We do not find any robust evidence for non-linearity in the effects of debt on ratings.

Table A9: Non-Linearity in Debt

Panel A: Advanced Economies

	(1) S&P	(2) S&P	(3) S&P	(4) Moody's	(5) Fitch	(6) Stacked
Debt-to-GDP	−0.0051**	−0.0052**	−0.0544***	−0.0592***	−0.0545***	−0.0513***
	(0.0022)	(0.0022)	(0.0052)	(0.0054)	(0.0050)	(0.0079)
Debt-to-GDP (squared)	−0.0000	−0.0000	0.0000	0.0000**	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Forecast primary balance-to-GDP	0.0622***	0.0702***	0.0924***	0.0777***	0.0692***	0.0719**
	(0.0098)	(0.0127)	(0.0303)	(0.0274)	(0.0265)	(0.0290)
Observations	1,019	1,019	1,019	1,019	1,019	3,057
Year FE	NO	YES	YES	YES	YES	YES
Country FE	NO	NO	YES	YES	YES	YES
Agency FE						YES
Pseudo R^2	0.0273	0.0323	0.458	0.449	0.449	0.427
PB / Debt-to-GDP	−12.21	−13.56	−1.700	−1.311	−1.269	−1.402
No. of countries	35	35	35	35	35	35
Sample years	1995–2025					

Notes. This table reports results from an ordered probit regression of sovereign ratings on the 1-year lagged debt-to-GDP ratio, its square, and forecasted primary balances (average across t+0 through t+5 year-ahead forecasts). Panel A includes 35 advanced economies over 1995–2025. "PB / Debt-to-GDP" reports the ratio of the primary balance coefficient to the debt-to-GDP coefficient. Ratings are on foreign-currency bonds (S&P in Columns 1–3, Moody's in Column 4, Fitch in Column 5). Columns 1–5 use individual agency ratings at the country-year level; Column 6 uses a pooled model at the rating agency–country–year level. Standard errors (in parentheses) are clustered at the country level in Columns 1–5 and at the rating agency–country level in Column 6. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table A9: Non-Linearity in Debt *(continued)*

Panel B: Emerging Markets

	(1) S&P	(2) S&P	(3) S&P	(4) Moody's	(5) Fitch	(6) Stacked
Debt-to-GDP	−0.0132***	−0.0155***	−0.0379***	−0.0649***	−0.0407***	−0.0434***
	(0.0033)	(0.0034)	(0.0088)	(0.0086)	(0.0093)	(0.0143)
Debt-to-GDP (squared)	−0.0000	−0.0000	−0.0000	−0.0000	−0.0000	−0.0000
	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Forecast primary balance-to-GDP	0.0574***	0.0649***	0.0302*	0.0037	0.0203	0.0161
	(0.0101)	(0.0105)	(0.0156)	(0.0155)	(0.0155)	(0.0107)
Observations	2,294	2,294	2,294	2,393	2,180	6,867
Year FE	NO	YES	YES	YES	YES	YES
Country FE	NO	NO	YES	YES	YES	YES
Agency FE						YES
Pseudo R^2	0.0439	0.0476	0.568	0.603	0.653	0.562
PB / Debt-to-GDP	−4.364	−4.177	−0.798	−0.0563	−0.499	−0.370
No. of countries	97	97	97	97	97	112
Sample years	1997–2025					

Notes. This table reports results from an ordered probit regression of sovereign ratings on the 1-year lagged debt-to-GDP ratio, its square, and forecasted primary balances (average across t+0 through t+5 year-ahead forecasts). Panel B (next page) includes 97 emerging market economies over 1997–2025. "PB / Debt-to-GDP" reports the ratio of the primary balance coefficient to the debt-to-GDP coefficient. Ratings are on foreign-currency bonds (S&P in Columns 1–3, Moody's in Column 4, Fitch in Column 5). Columns 1–5 use individual agency ratings at the country-year level; Column 6 uses a pooled model at the rating agency–country–year level. Standard errors (in parentheses) are clustered at the country level in Columns 1–5 and at the rating agency–country level in Column 6. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table A10: Summary statistics for all the variables used in the regression analysis

Panel A. Advanced Economies					
Variable	N	Mean	Std. Dev.	Min	Max
(S&P) Categorical order of Foreign Currency Sovereign Ratings	1,019	8.43	2.87	1.00	11.00
(Moody's) Categorical order of Foreign Currency Sovereign Ratings	1,019	8.39	3.00	1.00	11.00
(Fitch) Categorical order of Foreign Currency Sovereign Ratings (Long-term)	1,019	8.33	2.86	1.00	11.00
Debt-to-GDP	1,019	64.91	41.50	0.05	258.37
Primary balance (0-yr, 1-yr: 5-yr ahead, average)	1,019	1.31	3.09	−10.49	21.73
RminusG	828	−0.17	2.93	−5.66	9.68
Panel B. Emerging Market and Developing Economies					
Variable	N	Mean	Std. Dev.	Min	Max
(S&P) Categorical order of Foreign Currency Sovereign Ratings	2,294	1.82	1.67	1.00	9.00
(Moody's) Categorical order of Foreign Currency Sovereign Ratings	2,393	1.83	1.69	1.00	9.00
(Fitch) Categorical order of Foreign Currency Sovereign Ratings (Long-term)	2,180	1.74	1.62	1.00	9.00
Debt-to-GDP	2,294	50.77	30.06	0.00	260.96
Primary balance (0-yr, 1-yr: 5-yr ahead, average)	2,294	0.30	3.31	−19.13	19.29
RminusG	646	−1.50	4.26	−11.35	25.50

Notes. This table reports summary statistics for key variables used in the econometric analysis. Panel A reports summary statistics based on the AE sample used in Table 2. Summary statistics for the Interest-growth differential correspond to the AE sample in Section 5. Panel B reports summary statistics based on the EMDE sample used in Table 3. Summary statistics for the Interest-growth differential correspond to the EM sample in Section 5.

Table A11: List of Advanced Economies used in the main regression analysis (Table 2)

IFS Code	Economy
111	United States
112	United Kingdom
122	Austria
124	Belgium
128	Denmark
132	France
134	Germany
136	Italy
137	Luxembourg
138	Netherlands
142	Norway
144	Sweden
146	Switzerland
156	Canada
158	Japan
172	Finland
174	Greece
176	Iceland
178	Ireland
181	Malta
182	Portugal
184	Spain
193	Australia
196	New Zealand
423	Cyprus
436	Israel
532	Hong Kong SAR
542	Korea
576	Singapore
935	Czech Republic
936	Slovak Republic
939	Estonia
941	Latvia
946	Lithuania
961	Slovenia

Notes: This table reports the list of economies in the sample for the regressions in Column 3 of Table 2.

Table A12: List of Emerging Market and Developing Economies used in the main regression analysis (Table 3)

IFS Code	Economy
186	Türkiye
199	South Africa
213	Argentina
218	Bolivia
223	Brazil
228	Chile
233	Colombia
238	Costa Rica
243	Dominican Republic
248	Ecuador
253	El Salvador
258	Guatemala
268	Honduras
273	Mexico
278	Nicaragua
283	Panama
288	Paraguay
293	Peru
298	Uruguay
299	Venezuela
313	Bahamas, The
314	Aruba
316	Barbados
328	Grenada
339	Belize
343	Jamaica
366	Suriname
369	Trinidad and Tobago
419	Bahrain
433	Iraq
439	Jordan
443	Kuwait
446	Lebanon
449	Oman
453	Qatar
456	Saudi Arabia
469	Egypt
513	Bangladesh
522	Cambodia
524	Sri Lanka
534	India
536	Indonesia
548	Malaysia
564	Pakistan
566	Philippines
578	Thailand
582	Vietnam
614	Angola
616	Botswana

IFS Code	Country
622	Cameroon
624	Cape Verde
628	Chad
634	Congo, Republic of
636	Congo, Dem. Rep. of the
644	Ethiopia
646	Gabon
652	Ghana
662	Côte d'Ivoire
664	Kenya
674	Madagascar
678	Mali
684	Mauritius
686	Morocco
688	Mozambique
694	Nigeria
714	Rwanda
718	Seychelles
722	Senegal
742	Togo
744	Tunisia
746	Uganda
748	Burkina Faso
754	Zambia
819	Fiji
853	Papua New Guinea
911	Armenia
912	Azerbaijan
913	Belarus
914	Albania
915	Georgia
916	Kazakhstan
917	Kyrgyz Republic
918	Bulgaria
922	Russia
923	Tajikistan
924	China
926	Ukraine
927	Uzbekistan
942	Serbia
943	Montenegro, Rep. of
944	Hungary
948	Mongolia
960	Croatia
962	North Macedonia
963	Bosnia and Herzegovina
964	Poland
968	Romania

Notes: This table reports the list of economies in the sample for the regressions in Column 3 of Table 3.

Table A13: List of Advanced Economies used in regression of interactions with $r - g$

IFS Code	**Economy**
111	United States
112	United Kingdom
122	Austria
124	Belgium
128	Denmark
132	France
134	Germany
136	Italy
138	Netherlands
142	Norway
144	Sweden
146	Switzerland
156	Canada
158	Japan
172	Finland
174	Greece
176	Iceland
178	Ireland
182	Portugal
184	Spain
193	Australia
196	New Zealand
436	Israel
542	Korea
935	Czech Republic
941	Latvia
946	Lithuania

Notes: This table reports the list of economies in the sample for the regressions in Column 1 of Table A7.

Table A14: List of Emerging Market Economies used in the regression of interactions with $r - g$

IFS Code	**Economy**
186	Türkiye
199	South Africa
213	Argentina
223	Brazil
228	Chile
233	Colombia
273	Mexico
293	Peru
299	Venezuela
436	Israel
449	Oman
453	Qatar
469	Egypt
534	India
536	Indonesia
564	Pakistan
566	Philippines
578	Thailand
686	Morocco
922	Russia
924	China
926	Ukraine
935	Czech Republic
944	Hungary
964	Poland

Notes: This table reports the list of economies in the sample for the regressions in Column 1 of Table A8.

PUBLICATIONS

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