Corporate Yields and Sovereign Yields

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Abstract

We document that positive association between corporate and sovereign cost of funds borrowed on global capital markets weakens during periods of unusually high sovereign yields, when some corporate borrowers are able to issue debt that is priced at lower rates than sovereign debt. This state-dependent sensitivity of corporate yields to sovereign yields has not been previously documented in the literature. We demonstrate that this stylized fact is observed across countries and industries as well as for a given borrower over time. It is not explained by a different composition of borrowers issuing debt during periods of high sovereign yields, by the relationship between corporate and sovereign credit ratings, and only partially explained by financial crises and IMF programs. We propose a simple information model that rationalizes our empirical observations: when sovereign yields are high, corporate yields are less sensitive to sovereign yields.

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1 Introduction

Sovereign bond yields play an important role in pricing corporate bonds. Conventional wisdom holds that the sovereign has the ability to divert resources from the corporate sector to cover its fiscal needs, which implies that corporate borrowers can only be as safe as their sovereign. Consistent with that wisdom, Eichengreen and Mody (2000) and Bedendo and Colla (2015), among others, find that sovereign risk ratings or other measures of sovereign risk affect corporate spreads and the likelihood of bond issuance. Moreover, it is commonly believed that corporate bond ratings are subject to a "sovereign ceiling," that is, corporate bond ratings cannot be better than the ratings of their sovereigns.[1] One would therefore expect that corporate bond yields are subject to sovereign "floors" — that is, corporate yields would generally be higher than sovereign yields. Another way to put it — sovereign credit risk is a component of corporate credit risk, and therefore risk compensation would be at least as high for corporate borrowers as for their sovereigns. Existing empirical studies find that the cost of borrowing in global markets for corporate borrowers tends to be correlated with the yields that their sovereigns pay on their debt (Durbin and Ng, 2005; Corsetti et al., 2014; Mendoza and Yue, 2012; Bedendo and Colla, 2015).

In this paper, we show that this well-known close link between sovereign and corporate bond yields weakens when sovereign yields are unusually high (high-yield state) and propose an information model that predicts such dynamics. This state-dependent relationship between sovereign and corporate cost of funds has not been previously documented in the literature, to the best of our knowledge.[2] We demonstrate that this stylized fact is observed across countries and industries as well as for a given firm over time. It is not explained by bond ratings or a different composition of borrowers issuing debt in the high-yield state relative to the composition of borrowers in low-yield states. It is only partially explained by financial crises or presence of IMF programs. We propose a simple information model that rationalizes our empirical observations: when sovereign

[1] This was, in fact, an explicit policy of rating agencies until 1997 (Standard & Poor's, 1997). Nevertheless, Almeida et al. (2017), Adelino and Ferreira (2016), Borensztein et al. (2013), Ferri et al. (2001), Klein and Stellner (2014) , and Williams et al. (2013) empirically document that this relationship persisted after 1997 as well. More recently, Cavallo and Valenzuela (2010) use option-adjusted spreads to examine the influence of sovereign risk on corporate risk in emerging markets. In a recent paper, Mohapatra et al. (2018) study the characteristics of bonds that are rated better than their sovereigns.

[2] The closest we could find is the observation in Williams et al. (2013) that the sensitivity of bank ratings changes to sovereign rating changes is influenced by macroeconomic factors and the countries' financial freedom.

yields are high, yields on corporate debt are less sensitive to the yields on sovereign debt. When we calibrate the model to match the moments of the data, we find a relationship between sovereign and corporate yields during normal and high-yield times similar to that observed in the data.

Our study encompasses corporate bonds issued by borrowers from 44 countries between 1993 and 2017. To keep the sample as homogeneous as possible, we narrow our analysis down to bonds issued by corporate borrowers on global market in their home currency, for which we observe primary yields. We combine these data with information on primary and secondary sovereign bond yields. We show that the relationship between corporate and sovereign yields is concave: as sovereign yields increase, corporate yields become less sensitive to them. This is true even if we control for common shocks and cross-sectional firm differences by including time and firm fixed effects.

We use regression discontinuity to further investigate the non-linear relationship between corporate and sovereign bond yields. To this end we construct indicators of the high-yield state using a two-state dynamic Markov switching regression applied to the panel of sovereign bond yields (measured in real terms). The results show very clear high-yield states for many countries, in which not only the level of yields is high, but also their variance. We find that in the low-yield state corporate and sovereign bond yields co-move nearly 1-to-1, but the response of corporate yields to sovereign is substantially lower in the high-yield state.

We consider three empirical explanations for this discontinuity. First, we show that credit ratings alone can't explain the pattern we observe in the data. We show that corporate ratings are highly correlated with sovereign ratings, consistent with the literature. However, we find that there is no change in the sensitivity of corporate ratings to sovereign ratings during high-yield, or bad rating, times. Moreover, when we control for corporate bond ratings in the regression, we continue to find the decline in sensitivity of corporate yields to sovereign yields in the high-yield state.[3]

Second, we test whether our finding is driven by other events that tend to be accompanied by high sovereign yields, such as financial crises. We find that sensitivity of corporate yields to sovereign is lower when countries are subject to IMF programs or when they experience financial crises.

[3]For further analysis of the relationship between the impact of sovereign yields and corporate ratings on corporate bond yields, see Bevilaqua et al. (2020).

However, when we look at the episodes of high sovereign yields that are not classified as financial crises and do not correspond to IMF program years, we still find lower sensitivity of corporate yields to sovereign.

Third, we show that the difference between low- and high-yield states is not explained by different sets of firms issuing bonds in different states. We find that the distribution of bond issue size and maturity is the same in both states. New issuers are just as likely to enter markets in high-yield as in low-yield states. There is no difference in the share of financial or manufacturing firms issuing debt in the two states. We do find that, among emerging market firms, exporters are more likely to issue during high-yield states, which is consistent with the finding by Durbin and Ng (2005) that exporters are most likely to be able to place their bonds at spreads below those of their sovereigns. The opposite, however, is true for advanced economies firms.[4] While corporate bond ratings tend to worsen when sovereign yields are high, the distribution of the ratings obtained on bonds issued in low-yield states is the same for firms that issue in low-yield state and in high-yield state. We show that our benchmark results are robust to including controls for the changing borrower characteristics and to limiting the sample to firms that issue bonds in both states.

We propose a simple model that offers an explanation of the non-linear relationship between sovereign and corporate yields. In our stylized information model we take sovereign yields as exogenous and analyze global investors' response in terms of corporate debt pricing. In most models that link sovereign debt to the corporate cost of credit, there is an assumption of a constant and exogenous effect that sovereign spread has on corporate borrowing costs.[5] In our model we endogenize this link by assuming that sovereign yields contain noisy public information about creditworthiness of corporate borrowers. The model shows that when sovereign yields are high, the information value contained in them declines, and therefore demand for corporate debt is less sensitive to sovereign yield signals. We calibrate the few parameters of the model to the basic moments of the data and find that we can match quite well the change in the sensitivity of corporate yields to sovereign yields between low- and high-yield states.

[4] We construct a proxy for the probability that a borrower is an exporter using the share of exports in total output of each country-industry cell (at 2-digit SIC level).

[5] This link is endogenized in Du and Schreger (2017), but in their model there is no independent default risk by corporate borrowers.

To summarize, this paper contributes to the literature by uncovering a new stylized fact about the relationship between the corporate cost of funds obtained on global markets and sovereign yields: there is a very close positive relationship between the two in low-yield states, but when sovereign yields are high this relationship weakens significantly. We explore potential explanations and find that neither composition effects, nor dynamics of credit ratings, nor financial crises can fully explain this observation (Part 3). We present a simple information model that not only illustrates the findings qualitatively, but with calibration can produce similar sensitivity of corporate yields to sovereign across states (Part 4). We believe the model provides a useful and plausible explanation of the stylized fact we document, but acknowledge the possibility of alternative explanations.

Our findings show that the impact of sovereign debt crises (or more generally, periods of fiscal distress reflected in high sovereign yields) on firms might be more contained than previously thought. The fact that firms' costs of borrowing do not rise proportionally to the sovereign yields during fiscal distress means lower economic costs of such episodes. This, of course, is good news in general. On the flip side, however, it implies that cost of firms' access to global capital markets is less likely to play a role as a disciplining mechanism for sovereign borrowing: not only do firms continue to borrow during fiscal distress, including default episodes, but some of them are able to borrow at lower costs than their sovereigns. In this sense, our paper contributes to the debate on the costs of sovereign debt crises, going back to Eaton and Gersovitz (1981) and Bulow and Rogoff (1989) and surveyed by Borensztein and Panizza (2009) and Tomz and Wright (2013).[6]

2 Data Sources

Our goal is to analyze the broadest sample of bond issues available for a sufficiently long period of time to study within-firm dynamics. To this end, we collect corporate and sovereign bond yield and ratings data from Dealogic and Global Financial Data for a broad sample of 44 countries for the 1993-2017 time period.

[6] In a recent paper, Hebert and Schreger (2017) show quite the opposite for the case of Argentine firms' equity prices.

2.1 Corporate bond yields and ratings

The data on pricing and ratings of corporate bonds come from Dealogic's DCM Analytics, which cover new bond issues placed on international markets. Our analysis is limited to bonds placed by companies that are not owned by the government in foreign markets in home currency. The deal-level data provided by Dealogic include the name and nationality of the bond issuer, the deal amount, currency denomination, primary bond yield, maturity date, bond ratings, and the industry classification of the issuer.[7]

In our analysis we rely on bond yields, rather than spreads, because for local currency corporate bond spreads, the benchmark is usually sovereign bond yield of the same maturity. However, our goal is to study the correlation between corporate and sovereign yields. Relying on spreads would create spurious correlation in the variables. Moreover, it is not clear what we would use as a benchmark to compute sovereign bond spreads.

We encode the ratings on a numeric scale ranging from 1 (AAA) for lowest credit risk to 21 (D) for default.[8] We first use the ratings of Standard & Poor's, then Moody's, and then Fitch ratings to fill in missing data.

In total our sample spans 137,717 individual corporate bonds issued from 1993 to 2017. The countries included in our analysis represent those that have more than one corporate bond issue per year–or more than 24 observations in our panel. In our regression analysis we have to limit the sample further to country-year pairs in which at least one measure of home-currency sovereign yield is available. This leads to a sample of 79,332 bonds issued by firms from 22 advanced economies and 22 emerging economies, listed in Table A.2.

We conduct our analysis separately for advanced economies' (AEs) bonds and emerging market economies' (EMEs) bonds for a number of reasons. Most importantly, types of firms that are able to access international bond markets, especially in home currency, are quite different for advanced and emerging economies. In addition, for most of our sample, advanced economies sovereign credit

[7]Secondary yield data is only available for a much smaller set of corporate bonds from a limited set of countries. For our robustness tests, we supplement the primary yield data with secondary market corporate bond indexes for a handful of counties, as discussed in Section 3.7.

[8]This is consistent with the convention used in Borensztein et al. (2013).

risk is quite low and quite stable, compared to emerging economies, with the exception of European periphery bonds during the euro debt crisis. For these reasons, we don't have any reason to believe, *a priori*, that the relationship between corporate yields and sovereign yields will have the same dynamics for advanced and emerging economies.

2.2 Sovereign bond yields

We combine information on secondary market sovereign yields obtained from Global Financial Data (GFD) with primary yields obtained from Dealogic. From GFD we obtain secondary market yields for each country's 10-year government bonds denominated in local currency. This ensures that we have sovereign yields corresponding to dates on which corporate bonds were issued. We fill in the gaps in GFD series using these primary yields on sovereign bonds placed abroad in local currency from Dealogic. To do so, we compute a median yield among all sovereign bonds issued in each country and each month, regardless of maturity.[9] We use the last observed median yield for months without bond issue.

2.3 Other information

Additional data come from a variety of sources.

Missing from the DCM Analytics bond data is information on whether the firm is an exporter. In order to proxy for whether a firm is involved in international trade we use the share of exports in total production for a given country-industry sector. We construct this measure in three steps in the same way as Hale et al. (2019). First, we collect export data at the 2-digit SITC code level from the United Nations Conference on Trade and Development for each country in our sample. Next, we gather country-industry industrial production data from the United Nations Industrial Development Organization at the 2-digit ISIC code level. We then create a correspondence between 2-digit SITC codes and 2-digit ISIC codes in order to merge the export and industrial production data together. We create a measure of exports as a share of total production for each country-industry. The bond

[9] We do not match sovereign bond maturity to corporate bond maturity for our analysis because of data limitations. This, of course, adds noise to our regressions. In the robustness tests we demonstrate that controlling for corporate bond maturity does not alter the results.

data from DCM Analytics contains 4-digit SIC code descriptions for each observation, from which we extract the 2-digit SIC code. Thus, we finally create a correspondence between 2-digit SIC codes and 2-digit ISIC codes to merge the annual export share of each country-industry onto our bond data. For our analysis we classify all firms as either "exporters" or "non-exporters" by comparing their export shares to the median export share for all country-industry cells over the entire sample.

We also collect certain country-level variables that are used in our robustness tests. This includes quarterly exchange rate data between domestic currency and the U.S. dollar from the IMF's International Financial Statistics. We also use annual current account as a percent of GDP, real GDP growth, real GDP per capita, and CPI inflation data from the World Bank's World Development Indicators. Finally, we use country-level corporate bond indexes from Bloomberg.

3 Empirical regularities and possible explanations

Patterns in the raw data show close relationship between sovereign and corporate yields that weakens when sovereign yields are high. We identify in the data states with high sovereign yields and demonstrate non-linearity in the relationship between sovereign and corporate yields using regression discontinuity. We show that this discontinuity pattern is not explained by the behavior of corporate ratings, is not full explained by financial crises, and is not due to composition effects.

3.1 Patterns in raw data

We establish our main stilized fact, the declining sensitivity of corporate yields to sovereign yields when sovereign sovereign yields are high, by analyzing raw data. An example of the stylized fact we uncover is presented in Figure 1, which shows for Spain primary yields on corporate and sovereign bonds, secondary yields on sovereign 10-year bonds, and the estimated probability that sovereign yields are in the "high" state.[10] With a few exceptional issues, there appears to be a sovereign "floor" on bond yields during the time periods when sovereign yields are relatively low. However, when sovereign bond yields rise relative to trend, yields of many corporate bond issues appear to

[10]The estimation procedure to determine states is described in Section 3.2.1.

breach the floor and fall below sovereign ones.

To see if this is a widespread phenomenon, we plot bin-scatter diagrams for advanced (AEs) and emerging economies (EMEs) bond yields against their sovereign yields. Because these are yields on local currency bonds, we want to avoid correlation that arises from cross-countries inflation differences. For this reason, we subtract CPI inflation rate from yields and plot real yields. The results are shown in Figure 2, with quadratic regression fit. We can see that when sovereign yields are low, they tend to correspond nearly 1-to-1 with corporate yields. However, as sovereign yields increase, corporate yields do not increase quite as much, resulting in a concave relationship between the two.

We can formalize these results in a regression analysis by estimating a quadratic relationship between the yield y_{ict} on a bond i issued by a firm with operations in country c in quarter t and sovereign bond yield in country c in quarter t, sy_{ct}.

$$y_{ict} = \alpha + \beta_1 sy_{ct} + \beta_2 sy_{ct}^2 + \varepsilon_{ict}, \tag{1}$$

where α is a stand-in for various fixed effects (time, time and country, time and firm, depending on specification) and ε_{ict} are robust standard errors clustered on country-year, since it is the level at which our explanatory variable is observed.[11] We estimate our regressions separately for advanced and emerging economies.

Since in the regressions we can control for a set of increasingly comprehensive fixed effects, we are not too concerned about inflation, thus we keep our analysis simple by regressing nominal yields on nominal yields.[12] The results are shown in Table 1. We can see that even with time and firm fixed effects (columns (5) and (6)), we observe a tight relationship between corporate and sovereign yields that weakens as yields increase. The quadratic relationship implied by the coefficient estimates in columns (5) and (6), assuming 0 intercept, is plotted in Figure 4.

[11] Since we assign countries to firms by the nationality of operations, the classification of the firms is at the locational level, and therefore firm fixed effects completely span country fixed effects.

[12] Including CPI inflation as a control does not alter the results, as discussed in Section 3.7.

3.2 Regression discontinuity

The analysis of patterns in the raw data suggests that the relationship between sovereign and corporate yields is not stable. In particular, Table 1 shows that as sovereign yields increase, corporate yields become less sensitive to them. Our example in Figure 1 and the patterns in Figure 2 suggest that there might be discontinuity in the relationship between sovereign and corporate yields — that is, a threshold of sovereign yields above which the response of corporate yields to sovereign ones is weakened. To test this possibility, we endogenously identify in our data time periods in which sovereign yields are relatively high ("high-yield states") and estimate a regression discontinuity model using the indicator of high-yield states.

3.2.1 Identifying states

We follow Gadea Rivas and Perez-Quiros (2015) to generate synthetic time series from a panel. We do so by simply appending each country's real sovereign yield monthly time series to the previous country's time series. The new synthetic "time" variable is simply a counter of observations, corresponding to time periods for country 1, then continuing the counter for country 2, etc.[13] This methodology allows us to account for cross-sectional as well as time-series moments in sovereign yields. For these synthetic time series, we estimate a two-state dynamic Markov-switching model, in which we allow mean yields (expressed in real terms) and their variance to vary by state. In addition, we allow mean yields to be different in each state for advanced and emerging economies and allow for a linear trend for advanced economies only.[14] Formally,

$$rsy_{ct} = \mu_{S_{ct}}^{AE} + \mu_{S_{ct}}^{EME} + \beta\, \mathrm{I(AE)} * t + \varepsilon_{ct}, \tag{2}$$

[13] For the case where there is a total of T_1 time periods for country 1, the counter for country 2 will be $T_1 + 1$, $T_1 + 2$, ... $T_1 + T_2$. For country 3 it will be $T_1 + T_2 + 1$, $T_1 + T_2 + 1$, etc. There is no requirement for the panel to be balanced.

[14] In pre-testing, we found a strong downward trend in yields for all advanced economies. Not allowing for this trend leads to high-yield state estimates for all advanced economies in the beginning of the sample. For emerging economies there is no significant trend, but if included, estimated trend is positive (not statistically significant) and leads to an estimated high-yield state for all emerging economies in the beginning of the sample.

where rsy_{ct} is the real sovereign bond yield in country c in month t, $\mu^{AE}_{S_{ct}}$ and $\mu^{EME}_{S_{ct}}$ are state-dependent intercepts, and ε_{ct} is normally distributed error with mean zero and state-dependent variance. State S_{ct} is unobserved and evolves according to a 2-state Markov process with transition probabilities p_{12} and p_{21}. Compared to a country-by-country analysis, this panel approach takes into account cross-country differences in real sovereign yields and is, therefore, less likely to produce predictions of "high-yield" state for countries with low sovereign yields for the entire sample period.

The estimates of the model are reported in Table 2. We estimate two clearly defined states, with high-yield state (S^H) also having higher variance of yields. We define "high-yield" state as a state in which the estimated probability of a high-yield state is above 0.6.[15] We find that the estimated variance of yields is also higher in the high-yield state. We smooth this definition by ignoring any resulting states (high or low) that only last one month. Appendix Table A.2 reports all years for each of the countries in the data, in which sovereign yields are in high state and we observe both home currency corporate bond issuance and some measure of sovereign bond yields.[16]

3.3 Basic regression analysis

To test for discontinuity of the relationship between corporate and sovereign bond yields across high- and low-yield states, we estimate the following regression.

$$y_{ict} = \alpha + \beta_1 sy_{ct} + \beta_2 S^H_{ct} + \beta_3 S^H_{ct} * sy_{ct} + \varepsilon_{ict}, \tag{3}$$

where S^H_{ct} is the indicator of high-yield state for country c in quarter t. Fixed effects α and standard errors are defined in the same way as in the quadratic regressions reported in Table 1.

Table 3 reports the estimates for this regression. We can see that if we only control for common dynamics with time fixed effects (columns (1) and (2)), there is nearly a 1-to-1 relationship between corporate and sovereign bond yields in both emerging and advanced economies in the low-yield state.

[15] Given low probability of switching states, in most cases state definition will not change if a different threshold is chosen. See Figure 1 for the example.

[16] This means that some years are not listed for some countries even if they are identified as high-yield years, if in these years there were no home currency bond issued. For example, high-yield state for Brazil is defined for all years between 2005 and 2017. Table A.2 only lists 2006-07, 2012-15, because only in these years do we observe home currency bonds place by Brazilian firms in global markets, for which we have data on yields in our data source.

In the high-yield state, however, the sensitivity of corporate yields to sovereign yields is only half as large (the interaction term is approximately -0.5). As we add country and firm fixed effects, we keep finding a nearly 1-to-1 relationship for emerging market yields in the low-yield state, but less sensitivity for advanced economies. Once we add country or firm fixed effects, the decline in sensitivity during high-yield states is not as dramatic, but it remains statistically significant and substantial in magnitude. In our benchmark specification with time and firm fixed effects, which is only identified by within-firm changes in yields (columns (5) and (6)), the sensitivity of corporate yields to sovereign yields declines from nearly 1 to 0.8 for EMEs and from 0.6 to 0.4 for AEs during high-yield periods.

3.4 Ratings

Credit ratings alone can't explain the pattern we observe in the behavior of corporate yields. First, corporate ratings' sensitivity to sovereign ratings does not show any discontinuity. Second, the pattern in corporate yields is robust to controlling for corporate ratings.

Our conjecture is that the changing sensitivity of corporate yields to sovereign yields follows the sensitivity of corporate ratings to sovereign ratings. That is, we conjecture that the sovereign ceiling in ratings is pierced during high-yield, or bad rating, states, resulting in lower sensitivity of corporate ratings, and therefore yields, to sovereign ratings during these periods. We test this conjecture as follows.

First, we test whether corporate ratings are less sensitive to sovereign ratings during bad-ratings times. We construct a bin-scatter diagram similar to the one we constructed for yields, but for ratings: Figure 3. We observe that for emerging economies there is no decline in corporate rating sensitivity to sovereign ratings when sovereign ratings are poor (high values). If anything, their sensitivity becomes higher. For advanced economies we observe a very minor decline in the corporate rating sensitivity to sovereign ratings.

Next, we estimate a set of regressions similar to the ones specified by equation (3), but now control for corporate bond rating. We allow for the sensitivity of corporate yields to corporate ratings to vary in low- and high-yield states. If corporate ratings are less responsive to sovereign

ones when sovereign bond yields are high, and corporate yields are responsive to corporate ratings, we would no longer observe a decline in the responsiveness of corporate yields to sovereign ones in the high-yield state. The results of these regressions are reported in Table 4. We find that controlling for ratings does not change the sensitivity of corporate yields to sovereign yields in the low-yield state. The decline in this sensitivity in the high-yield state, however, is now even larger in magnitude than in our benchmark regressions. We find that corporate bond ratings do affect corporate yields, but there is no evidence of this relationship changing when sovereign yields are high.

3.5 Crises

Sovereign yields tend to be high during financial crises. Our next conjecture, therefore, is that the observed pattern is due to an omitted variable that correlates with high-yield states. An obvious example would be some measure of financial crises. We test whether the weakened sensitivity of corporate yields to sovereign yields is only observed in periods of financial crises. We considered a number of measures of financial crises from the literature, including Laeven and Valencia (2013) data set on financial crises, updated in Laeven and Valencia (2018), Scheubel and Stracca (2016) Global Financial Safety Net (GFSN) database which also contains information on IMF prorgrams, Reinhart and Rogoff (2014) financial crises data, and Eichengreen and Gupta (2016) data on sudden stops. We find that, while financial crises and IMF programs do weaken the sensitivity of corporate yields to sovereign, we also observe the weakening of this relationship when high-yield episodes are not accompanied by crises or IMF programs.

From GFSN database, we obtained information on the number of IMF programs in each country and each year and converted it to a binary indicator of whether a country has at least one IMF program in a given year. This is a promising variable, because an IMF program might alter sovereign yields without having as much impact on corporate yields. Therefore, given that IMF programs tend to correspond to high-yield states, this would explain the lower sensitivity of corporate yields to sovereign ones.[17]

[17] Central bank swap lines may have a similar impact. However, we did not find any robust patterns by looking at the presence of such swap lines.

The rest of the variables we experiment with are various measure of financial crises. We did not obtain any robust results with either Eichengreen-Gupta or GFSN measures of sudden stops or reserve adequacy. We obtained the most robust results by combining all indicators of Laeven-Valencia (LV) crises, creating an indicator which is equal to one if any of the following occur: sovereign default, sovereign debt restructuring, currency crisis, or systemic banking crisis. From Reinhart-Rogoff (RR) data, we created an indicator that is equal to one if either default or domestic default occurs. Table A.2 lists years for the countries in our regression sample in which there are either IMF programs, or LV crises, or RR defaults. We do not show years in which there are no corporate home currency bond issues or any measures of sovereign yield, because these are not part of our regression sample.

Using our benchmark specification in columns (5) and (6) of Table 3, we replace an indicator of high-yield state with one of these indicators at a time. The results are reported in Table 5. We find a similar pattern to our benchmark result — during non-crisis states there is a strong relationship between corporate and sovereign yields, but this relationship weakens, especially in the presence of an IMF program or in case of sovereign default in an advanced economy. An exception is the LV crisis indicator for EMEs, which does not seem to have a significant impact on corporate bond yields in either state. Whenever significant, the main effect of crisis indicators is as expected, increasing corporate yields.

Thus, financial crises might be the reason for less sensitivity of corporate yields to sovereign when sovereign yields are high. To test for this, we run "horse race" regressions, in which we include crisis indicators along with the indicator of the high-yield state, which we orthogonalize with respect to crisis measures. That is, for the regressions with IMF program indicator, we include the high-yield state indicator that only takes on a value of one if the high-yield state year is not also a year with an IMF program. We do similar orthogonalization of the high-yield state indicator for LV and RR measures.

The results are reported in Table 6. We continue to find that in states with no crises and low yields there is a very close association between corporate and sovereign yields. We observe that, as before, crisis indicators are associated with higher corporate yields and that during crises corporate

yields are less sensitive to sovereign yields. We find, however, that crises do not entirely explain the reduction in responsiveness of corporate yields to sovereign ones. With one exception,[18] we continue to find that in high-yield states that are not accounted for by crisis measures, there is a significant reduction in the magnitude of the response of corporate yields to sovereign. The magnitude of this reduction is smaller relative to benchmark when we control for IMF programs.

3.6 Composition effects

Our findings are not explained by different sets of firms issuing bonds in high-yield states. We show that distributions of most characteristics of bonds and of borrowers are quite similar in both states. We also show that our results are robust to controlling for differences in composition and to limiting the sample of borrowers to those that issued bonds both in normal and in high-yield states.

First, we test whether the composition of firms that issue bonds in high-yield periods is different from the composition of firms that borrow during low-yield periods. To investigate this, we compare the characteristics of the issuers in the two states along a number of dimensions.[19] Tables 7 and 8 provide summary statistics of our key variables for the two states for EMEs and AEs, respectively. Quite surprisingly, the distribution of most bond and issuer characteristics is nearly identical in the two states. Average amount and the range of issue sizes are the same; mean and dispersion of maturities is the same, but we do observe some very short maturity issues in low-yield, but not in the high-yield state. The share of issuers that are seasoned (have placed a home currency bond on international markets previously) is the same in both states. The share of financial firms is the same.

There are a couple of differences. We construct an indicator of whether the issue is likely to be a debt rollover, as opposed to a new issue. This indicator is different from a "seasoned" indicator,

[18]For advanced economies, we actually find an increase in sensitivity during non-crisis high-yield state periods when we control for the LV crisis indicator. For many advanced economies, LV crisis years are 2008-2009. However, our results are not driven by the global financial crisis. If we repeat our benchmark results excluding 2008 and 2009, our results remain unchanged — this and other robustness tests are described below.

[19]Dealogic data does not provide information on issuers balance sheet characteristics. Given the breadth of our sample, it is not feasible to match most of the issuers to any source of balance sheet data, for this reason, our analysis is limited to bond issuance history, bond characteristics, and limited information on issuers available in Dealogic.

because we take into account maturity and amount of past issues. We code a bond as a "rollover" issue if it is issued around the time when one of the previously issued bonds is maturing and in the amount not exceeding the amount of this matching bond issue. We find that for advanced economies the share of rollover issues is the same in the two states, but for EMEs there is actually a lower share of rollover issues in the high-yield state. This is contrary to our expectations — our prior was that issuing a new debt is harder and less attractive than rolling over old debt when sovereign yields are high.

We find that the share of manufacturing firms from EMEs is the same in both states, but for AEs this share falls from 12 to 6 percent in the high-yield state. This decline, however, can be spurious given high standard deviation of this share relative to its mean. For EMEs we observe a higher share of firms that are likely to be exporters during high-yield states. This is consistent with our priors — exporting firms are less likely to be viewed by investors as being subject to sovereign risk such as the risk of expropriation. The change, however, goes in the other direction for firms from AEs: the share of firms that are likely to be exporting drops dramatically in the high-yield state. These changes are not likely to affect our results because firm characteristics are absorbed by firm fixed effects in our benchmark regressions.[20]

Finally, we find that corporate bond ratings are on average worse for both firms form AEs and from EMEs during the high-yield state. This, however, does not necessarily mean that firms that issue bonds in the high-yield state are more risky. In fact, it is much more likely that the same firms are being downgraded, or bonds that they issue during the high-yield state get worse ratings, when sovereign yields are high. This is because high sovereign yields tend to be associated with adverse macroeconomic developments and rating agencies, as we discussed previously, tend to take sovereign risk into account when assigning ratings to corporates and their bonds.

In order to properly control for risk composition of bond issuers, we compute for each firm an average rating across all bonds issued in all low-yield states in our entire time sample. We then compare these low-yield firm ratings for the sample of bonds issued in each state. We find that the distribution of this low-yield average rating is remarkably similar across states for firms from both

[20]Even though probability to be an exporter is time-varying, it does not change much over time for a given firm.

EMEs and AEs.

To test whether our results are driven by the differences in issuer composition that we uncovered, we repeat our benchmark regressions controlling for likelihood of being an exporter, our indicator of debt rollover, and firm's low-yield state rating.[21] The results are reported in Table 9. While additional controls do have significant effect on bond yields, at least in some specifications, our main results are unaffected when we include them. Thus, these specific changes in issuer composition are not driving our main result.

There might be other differences between issuers that we do not observe because of data limitations. For a final test of composition effects, we limit the sample to firms that issue in both states. The results are reported in Table 10. Even for this substantially smaller sample we find the pattern to be very similar to our benchmark results. Thus, we are quite confident that the composition of bond issuers does not explain the decline in corporate yield sensitivity to sovereign yields in high-yield states.

3.7 Robustness tests

We show that our results are not unique to the specification we chose. The results of our robustness tests are reported in Table 11 with specifications corresponding to columns (5) and (6) of Table 3.

First, because our explanatory variable only varies at country and time level, we cannot include country*time fixed effects in the regression. Thus, we might be concerned about macroeconomic dynamics impacting our results. To test for this, we include the same country-level control variables as Borensztein et al. (2013). We find that our results are robust to their inclusion. As expected, high inflation is associated with higher nominal yields on home currency bonds. Other variables do not have a robust impact on yields. Our main results of the association between corporate and sovereign yields remain unchanged.

Next, we add bond-level control variables. We find that bonds with longer maturities tend to have higher yields, as one would expect. We find that larger issue amounts are associated with

[21] Even though we did not find the differences in the distribution of the low-yield state rating, we still believe it to be an important control for bond yield. It drops out in the regressions with firm fixed effects, because it does not vary for a given firm over time, by construction.

lower yields, but not significantly so for AE borrowers. We also find that seasoned borrowers tend to face lower cost of debt than new issuers. Bonds issued under U.S. law tend to have higher yields relative to U.K. and other governing laws. Including these controls does not alter our benchmark results.

We also split the samples into borrowers that are classified as financial and non-financial in the data. Separately, we exclude from the sample all multinational firms, which we define as firms for which nationality of operations is different from parent nationality. We find that our main results are very similar for these subsets of borrowers, as reported in Table 12.

We exclude 2008 and 2009 from the sample to see if our results are driven by the bonds that are issued during the Global Financial Crisis. The results are reported in Table 13. They show that excluding these two years does not materially change our results.

Finally, because corporate bond issuance is infrequent in many emerging markets in our sample, we test whether the relationship that we uncovered holds if we look at the aggregate secondary bond price indexes for emerging markets. To do so, we collected from Bloomberg corporate bond indexes (yields) for countries for which they are available, 17 emerging markets. In most cases, we could only get U.S. dollar-based indexes. Thus, we also downloaded U.S. dollar sovereign bond yields, from Global Financial Data. We estimated regressions in equations (1) and (3) for these yields, for this panel of countries. The results are reported in Table 14. We find that the pattern holds for these data as well, both in quadratic and in discontinuity specifications. Thus, we find that the pattern applies not only to local currency bond yields, but also to U.S. dollar bond yields, and that it is prevalent on the secondary market as well as at a time of bond origination, at least for the set of emerging market bonds.

4 Stylized Model

Why is there a discontinuity in the relationship between sovereign and corporate bond spreads? Our empirical analysis provided only a partial explanation. To further study this, we present a stylized information model, because we believe that an information model has the best chance to

generate such discontinuity. In this model, publicly observed sovereign yields provide information about unobserved creditworthiness of corporate borrowers. Some of our empirical observations also point to information content in sovereign yields that affects pricing of corporate bonds. First, our results in Table 4 show that even when we control for bond ratings, there is a relationship between corporate and sovereign yields that varies by state. This suggests that there might be information content in sovereign yields that investors use to price corporate bonds. Second, the presence of the IMF program likely distorts the signal from sovereign debt prices, which is consistent with our findings that the presence of the IMF program partially explains the reduction in corporate bond yield sensitivity to sovereign yields.

In our model investors face some public and private information about the firms that they can lend by buying their debt. Sovereign yield, publicly observed, is an additional noisy signal that is in some way informative about the credit risk of the firm located in that sovereign's country.

There are three reasons why sovereign yields might contain information about firms' credit risk. First, as we learned from the Asian crisis experience in the late 1990s and the euro area debt crisis, foreign corporate debt might be implicitly guaranteed by the government (Corsetti et al., 1999; Acharya et al., 2014).[22] Second, low sovereign yields might indicate a good economic outlook, as perceived by the market, which would also suggest a good outlook for performance of individual firms. Finally, there might be direct threat to firms' future profitability from outsized government debt.[23]

Assume that a representative firm needs to raise up to one unit of funds for one period. For simplicity, assume that borrowing takes the form of a zero-coupon bond with a total face value of 1. Risk-neutral investors bid on the bond placement and the more investors are interested in buying the bond, the higher will be the price and the lower will be the yield. If there is a continuum of investors, the price will be simply equal to the share of investors that want to buy the bond, p. This means that the gross return on investment of p in the absence of default will be $1/p$. Note that the information structure in our model is akin to that of the global game (Carlsson and van

[22]This is one reason literature cites for sovereign ceiling in ratings.

[23]Agca and Celasun (2012) show, for example, that higher sovereign debt is associated with higher cost of borrowing for corporates, while Kaminsky and Schmukler (2002) study the effect of sovereign ratings on stock returns.

Damme, 1993; Morris and Shin, 2002), but our model does not feature strategic complementarity central to global game models and, consequently, has unique equilibrium. In our model, the more investors want to buy the bond, the lower the return and incentive to buy the bond.

Assume that there is zero recovery in case of default, so that gross return in case of default is 0. Assume also that the risk-free rate or storage technology gives a 0 net return, thus an opportunity cost of investing is simply p. In the absence of default, the yield on this bond will be $r = (1/p - 1)$.

Denote exogenous unobserved probability of default as π. A risk-neutral investor will choose to buy the bond if

$$(1-\pi)\frac{1}{p} \geq p, \quad \text{or} \quad p \leq \sqrt{1-\pi}. \tag{4}$$

Probability of default for an individual firm is unknown, but it is public information that it is a function of an unobserved credit risk measure $\rho \sim N(\tau, 1/\gamma)$, where both moments of ρ distribution are publicly known. Assume for simplicity that $\pi = \Phi(\rho)$, where Φ denotes standard normal CDF. In addition, assume that each investor i gets a private signal x_i about creditworthiness of the firm: $x_i = \rho + \varepsilon$, $\varepsilon \sim N(0, 1/\beta)$. The distribution of private signals is publicly known.

To introduce sovereign yield into the model, assume that sovereign yield s reflects the sovereign's default probability, which is a publicly known function of the sovereign credit risk y, so that $s = \Phi(y)$. Sovereign credit risk (or sovereign yield) is observed and is a noisy signal about a firm's credit risk, $y = \rho + \nu$, $\nu \sim N(0, 1/\alpha)$.[24]

Given this information structure, all investors have the same prior expectation of ρ:

$$E\rho|_y = \frac{\alpha y + \gamma\tau}{\alpha + \gamma}. \tag{5}$$

After receiving private signal x_i, each investor's posterior expectation of ρ is

$$E_i\rho|_{x_i,y} = \frac{\alpha y + \beta x_i + \gamma\tau}{\alpha + \beta + \gamma}. \tag{6}$$

[24]One can think of τ as representing a corporate rating. For the study of information value of corporate bond ratings, see Kliger and Sarig (2000). The model can be extended to include, in addition, sovereign credit rating that would modify the mean of the distribution of ν. Because y is observed, this will not change the model predictions.

The equilibrium is determined by the investor that is indifferent between buying and not buying the bond, given her posterior belief about the credit risk of the firm, and the share of investors interested in buying the bond given their posterior beliefs. Denote the pivotal investor's signal x^*, then the share of investors that would want to buy a bond is given by the density of private signals that are lower than x^*:[25]

$$p^* = \Phi\left(\sqrt{\beta}\left(x^* - \frac{\alpha y + \gamma\tau}{\alpha + \gamma}\right)\right). \tag{7}$$

From (4) and (6), the investor will be indifferent between buying and not buying the bond if

$$p^* = \sqrt{1 - \Phi\left(\frac{\alpha y + \beta x^* + \gamma\tau}{\alpha + \beta + \gamma}\right)} \tag{8}$$

Combining (7) and (8) gives us a solution for x^*, which implies p^* and equilibrium $ps^* = 1/p^* - 1$.

There is no closed form solution. However, the solution is well defined and unique given that (7) gives p^* as increasing function of x^*, while (8) gives p^* as decreasing function of x^*, both limited to [0, 1] interval for the full support of x. It is easy to see that this is an equilibrium, because any investor j with signal $x_j < x^*$ will invest, but investor k with signal $x_k > x^*$ will not, consistent with (7).

We can calibrate the model to AEs and EMEs separately, using low-yield moments. For EMEs, mean corporate bond yield in the data in the low-yield state is 5.6 percent with standard deviation 2 percentage points, average sovereign yield is 4.3 percent with standard deviation of 1.9 percentage points in low-yield state (see Table 7). For AEs, mean corporate bond yield in the data in the low-yield state is 3.6 percent with standard deviation 2.3 percentage points, average sovereign yield is 3.2 percent with standard deviation of 1.8 percentage points in low-yield state (see Table 8).

As a starting point, we can take $y = -1.59$, which implies $s = 0.056$ for EMEs, $y = -1.85$, which implies $s = 0.032$ for AEs. For both sets of countries we calibrate $\alpha = 0.4$ to match standard deviation that is about half of the mean of sovereign yields. We can proxy for the precision of

[25]This equilibrium, similarly to global game, assumes high-order beliefs. If the belief structure is simpler and each investor's prior about the signal distribution is that she gets the mean signal, the equilibrium will be qualitatively the same.

private signals using parameters of the distribution of bond yields within given credit rating. On average across ratings, the standard deviation of bond yields for a given rating is 2.85. Thus, we can set $\beta = 1.12$. Finally, for EMEs we set $\tau = -2$ (which corresponds to default probability in the model of 2 percent) and $\gamma = 0.13$ to match the equilibrium mean corporate bond yield of 5.6 and the sensitivity of corporate yields to sovereign yields, measured by a coefficient in an OLS regression, in non-crisis periods from column (5) of Table 3: 0.98. For AEs, we set $\tau = -2.25$ (which corresponds to default probability in the model of 1.2 percent) and $\gamma = 0.3$ to match the equilibrium mean corporate bond yield of 3.6 and the sensitivity of corporate yields to sovereign yields in non-crisis periods from column (6) of Table 3: 0.62.

Figure 5 shows how for these parameter values corporate yield varies with sovereign yield. For both AEs and EMEs we note that higher sovereign yield is associated with lower response of corporate yield to sovereign. To simulate high-yield state, we shift the range of sovereign yields in our simulation by 2 percentage points, to correspond to the average difference between sovereign yields in normal and high-yield states, and leave the rest of the parameters unchanged. We obtain in the model the regression coefficient of 0.83 for EMEs and 0.51 for the AEs, that is a reduction of 15 basis points for EMEs and of 11 basis points for AEs, which is in a ballpark of the interaction coefficient observed in columns (5) and (6) of Table 3. When we regress model corporate yield on model sovereign yield in this new range of sovereign yields, the regression coefficient drops from 0.98 (the coefficient we calibrated to) to 0.83 for EMEs and from 0.62 (the coefficient we calibrated to) to 0.51 for AEs. This is a good match for the 0.82 coefficient on high-yield state sensitivity of corporate yields to sovereign for EMEs, computed as $\beta_3 - \beta_1$ in column (5) of Table 3. For AEs, the model underpredicts the decline by half: β_3 in column (6) of Table 3 is -0.24, while the model only predicts a decline of 0.11.

5 Conclusion

In this paper we uncover a new stylized fact: when sovereign yields are high, firms are able to borrow from global capital markets at a lower cost than their sovereigns and, more generally, corporate cost of funds becomes less sensitive to sovereign yields. Our initial hunch that this observation is

due to a specific set of firms that are able to borrow during such high-yield times is not supported by the data. Moreover, we do not observe a weakening of the link between corporate credit ratings and sovereign credit ratings during high-yield times. We do find that the sensitivity of corporate yields to sovereign becomes lower during financial crises and when countries are subject to IMF programs. However, even controlling for these, we find the decline in sensitivity of corporate yields to sovereign, when sovereign yields are high for reasons unexplained by financial crises.

To understand this stylized fact we turn to the information model, in which we view sovereign yields as an additional public source of information about creditworthiness of the firms. The model can qualitatively and quantitatively match the pattern we observe in the data, indicating that the mechanism described may, indeed, be a potential explanation for the dynamics of sensitivity of corporate to sovereign yields. While we believe the model provides a plausible and useful explanation, we do not claim to rule out other possibilities that we have not considered. Moreover, further analysis is needed to empirically corroborate the information mechanism we propose in our model. Unfortunately, we are not aware of the data that could shed light on this, and therefore leave it to future research.

These findings shed light on the corporate debt pricing dynamics in global markets. In particular, they demonstrate both the importance and the limitations of the public information provided by sovereign and corporate credit ratings. The importance of ratings goes beyond their direct impact on pricing — they alter the information set available to investors and therefore may impact pricing dynamics in a more complex way. The limitation is shown by the fact that even when we control for sovereign ratings, sovereign yields still have an important impact on the corporate cost of funds, which means sovereign yields contain information that is not reflected in sovereign ratings. Our findings are also a word of caution against assuming that rating dynamics and yield dynamics are necessarily equivalent.

Our findings show that the impact of sovereign debt crises (or more generally, periods of fiscal distress reflected in high sovereign yields) on firms might be more contained than previously thought. The fact that firms' cost of borrowing does not rise proportionally to the sovereign during fiscal distress means lower economic costs of such episodes. This, of course, is good news in general. On

the flip side, however, it implies that cost of access to global capital markets by firms is not likely to play a role as a disciplining mechanism for sovereign borrowing: not only do firms continue to borrow during fiscal distress, including default episodes, but they are able to borrow at a lower cost than their sovereigns. In this sense, our paper contributes to the debate on the size of the penalty from sovereign debt crises by showing that, at least in terms of corporate borrowing costs, the penalty by global capital markets might not be as severe as previously thought.

References

Acharya, V. V., Drechsler, I., and Schnabl, P. (2014). A pyrrhic victory? bank bailouts and sovereign credit risk. *Journal of Finance*, 69(6):2689–2739.

Adelino, M. and Ferreira, M. A. (2016). Bank ratings and lending supply: Evidence from sovereign downgrades. *The Review of Financial Studies*, 29(7):1709–1746.

Agca, S. and Celasun, O. (2012). Sovereign debt and corporate borrowing costs in emerging markets. *Journal of International Economics*, 88(1):198–208.

Almeida, H., Cunha, I., Ferreira, M. A., and Restrepo, F. (2017). The real effects of credit ratings: The sovereign ceiling channel. *The Journal of Finance*, 72(1):249–290.

Bedendo, M. and Colla, P. (2015). Sovereign and corporate credit risk: Evidence from the eurozone. *Journal of Corporate Finance*, 33:34–52.

Bevilaqua, J., Hale, G., and Tallman, E. (2020). Corporate yields: Effect of credit ratings and sovereign yields. mimeo.

Borensztein, E., Cowan, K., and Valenzuela, P. (2013). Sovereign ceilings "Lite"? The impact of sovereign ratings on corporate ratings. *Journal of Banking & Finance*, 37(11):4014–4024.

Borensztein, E. and Panizza, U. (2009). The costs of sovereign default. *IMF Staff Papers*, 56:683–741.

Bulow, J. and Rogoff, K. (1989). Sovereign debt: Is to forgive to forget? *American Economic Review*, 79(1):43–50.

Carlsson, H. and van Damme, E. (1993). Global games and equilibrium selection. *Econometrica*, 61(5):989–1018.

Cavallo, E. A. and Valenzuela, P. (2010). The determinants of corporate risk in emerging markets: an option-adjusted spread analysis. *International Journal of Finance and Economics*, 15(1):59–74.

Corsetti, G., Kuester, K., Meier, A., and Müller, G. J. (2014). Sovereign risk and belief-driven fluctuations in the euro area. *Journal of Monetary Economics*, 61:53–73.

Corsetti, G., Pesenti, P., and Roubini, N. (1999). Paper tigers? a model of the asian crisis. *European Economic Review*, 43(7):1211–36.

Du, W. and Schreger, J. (2017). Sovereign Risk, Currency Risk, and Corporate Balance Sheets. Columbia Business School.

Durbin, E. and Ng, D. (2005). The sovereign ceiling and emerging market corporate bond spreads. *Journal of International Money and Finance*, 24(4):631–649.

Eaton, J. and Gersovitz, M. (1981). Debt with potential repudiation: Theoretical and empirical analysis. *The Review of Economic Studies*, page 289309.

Eichengreen, B. and Gupta, P. (2016). Managing sudden stops. The World Bank Policy Research Working Paper No.7639.

Eichengreen, B. and Mody, A. (2000). What explains changing spreads on emerging market debt? In *Capital Flows and the Emerging Economies: Theory, Evidence, and Controversies*. University of Chicago Press.

Ferri, G., Liu, L.-G., and Majnoni, G. (2001). The role of rating agency assessments in less developed countries. *Journal of Banking and Finance*, 25:115–148.

Gadea Rivas, M. D. and Perez-Quiros, G. (2015). The failure to predict the great recessiona view through the role of credit. *Journal of the European Economic Association*, 13(3):534–559.

Hale, G., Jones, P., and Spiegel, M. (2019). Home currency issuance in international bond markets. Federal Reserve Bank of San Francisco WP 2014-19.

Hebert, B. and Schreger, J. (2017). The costs of sovereign default: Evidence from argentina. *American Economic Review*, 107(10):3119–314.

Kaminsky, G. and Schmukler, S. (2002). Emerging markets instability: Do sovereign ratings affect country risk and stock returns? *World Bank Economic Review*, 16(2):171–95.

Klein, C. and Stellner, C. (2014). Does sovereign risk matter? New evidence from eurozone corporate bond ratings and zero-volatility spreads. *Review of Financial Economics*, 23(2):64–74.

Kliger, D. and Sarig, O. (2000). The information value of bond ratings. *Journal of Finance*, 55(6):2879–2902.

Laeven, L. and Valencia, F. (2013). Systemic banking crises databse. *IMF Economic Review*, 61(2):225–270.

Laeven, L. and Valencia, F. (2018). Systemic banking crises revisited. International Monetary Fund Working Paper No. 18/206.

Mendoza, E. G. and Yue, V. Z. (2012). A general equilibrium model of sovereign default and business cycles. *The Quarterly Journal of Economics*, 127(2):889–946.

Mohapatra, S., Nose, M., and Ratha, D. (2018). Determinants of the distance between sovereign credit ratings and sub-sovereign bond ratings: Evidence from emerging markets and developing economies. *Applied Economics*, 50(9):934–956.

Morris, S. and Shin, H. S. (2002). Social value of public information. *American Economic Review*, 92(5):1521–1534.

Reinhart, C. and Rogoff, K. (2014). This time is different: A panoramic view of eight centuries of financial crises. *Annals of Economics and Finance*, 15(2):1065–1188.

Scheubel, B. and Stracca, L. (2016). What do we know about the global financial safety net? rationale, data and possible evolution. ECB Occasional paper No. 177.

Standard & Poor's (1997). Less credit risk for borrowers in 'dollarized' economies. *Credit Week*, April 30.

Tomz, M. and Wright, M. L. (2013). Empirical research on sovereign debt and default. *Annual Review of Economics*, 5(1):247272.

Williams, G., Alsakka, R., and Gwilym, O. A. (2013). The impact of sovereign rating actions on bank ratings in emerging markets. *Journal of Banking and Finance*, 37(2):563–577.

Figure 1: An example

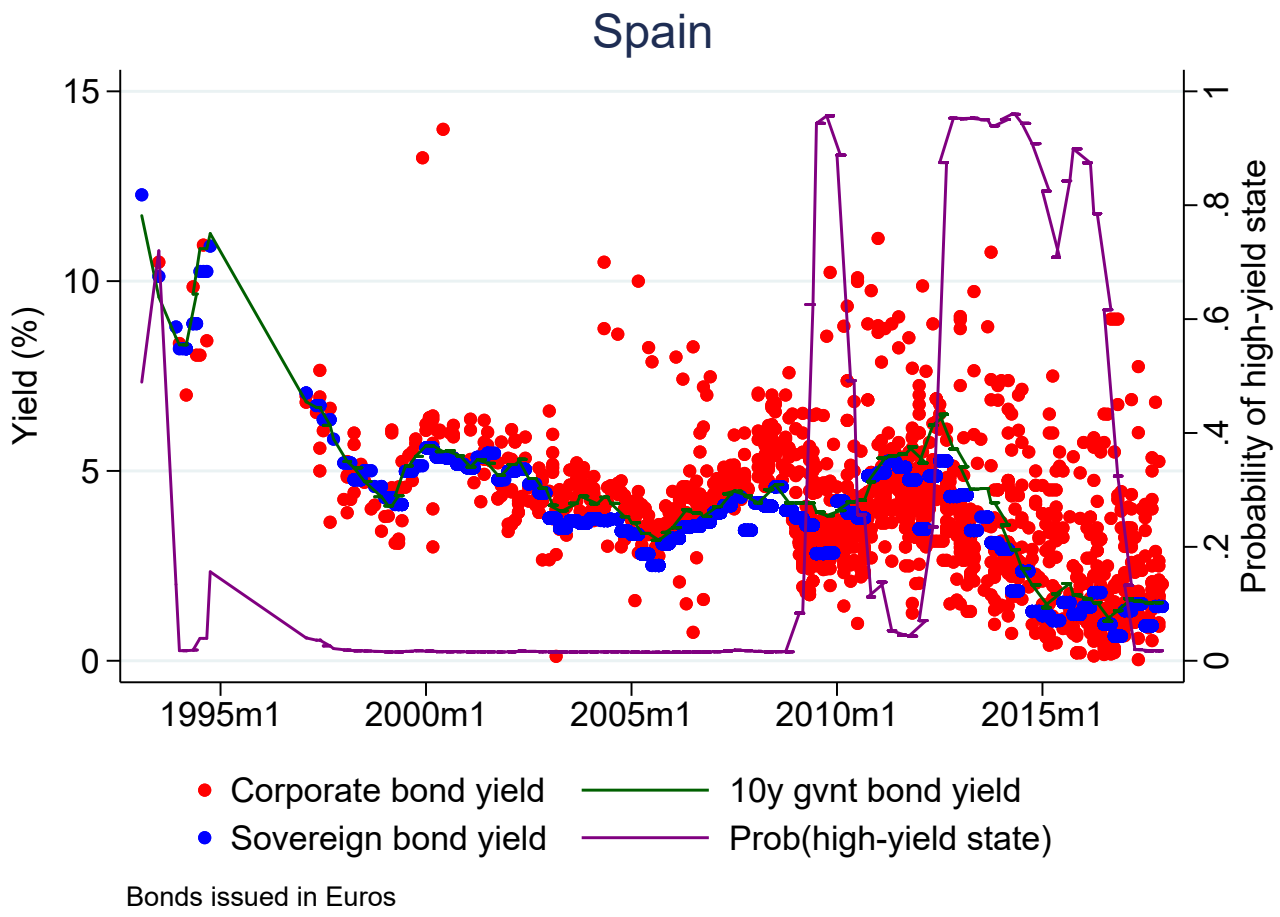


Figure 2: All home-currency bonds

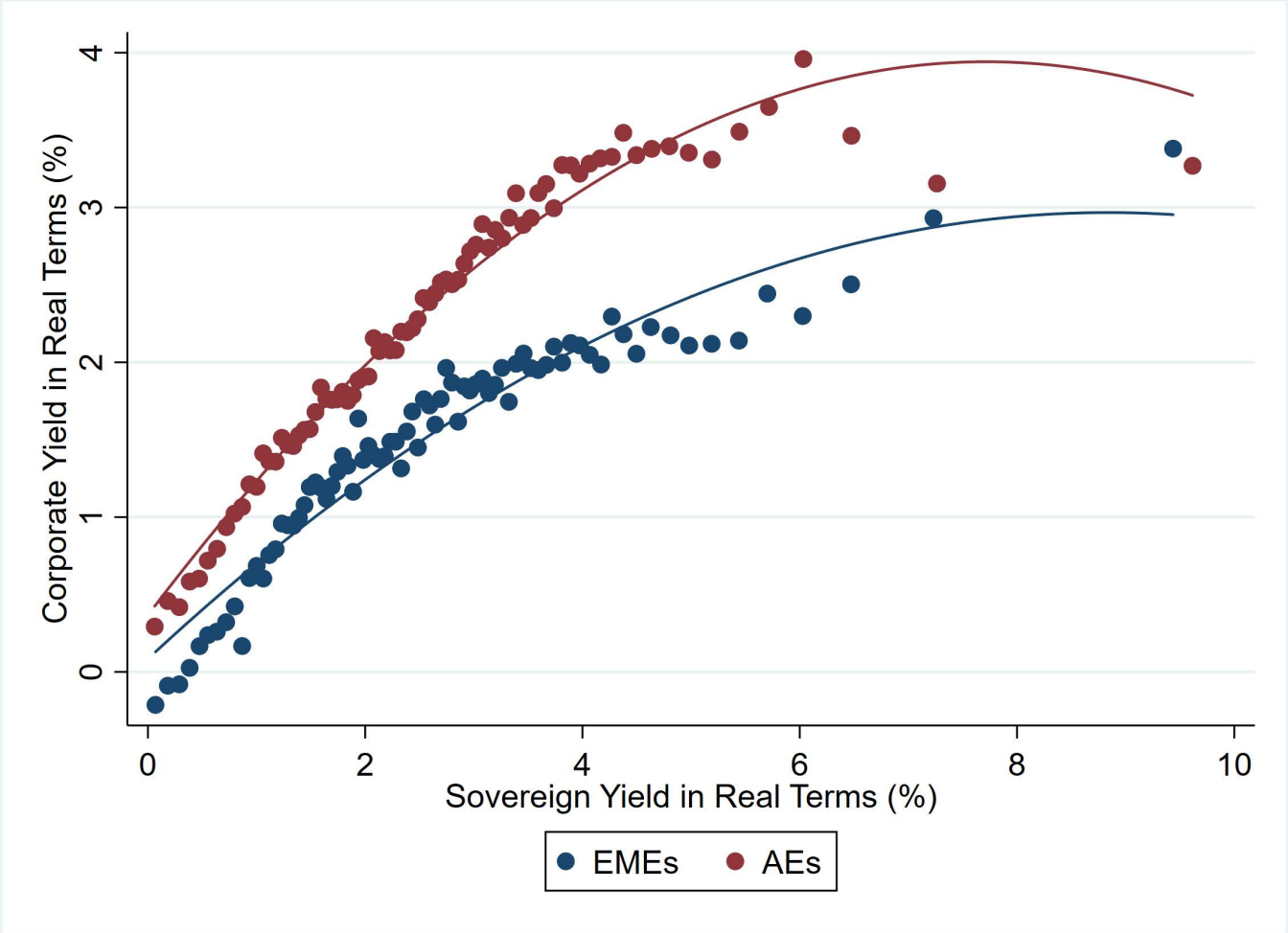


Figure 3: All home-currency bonds

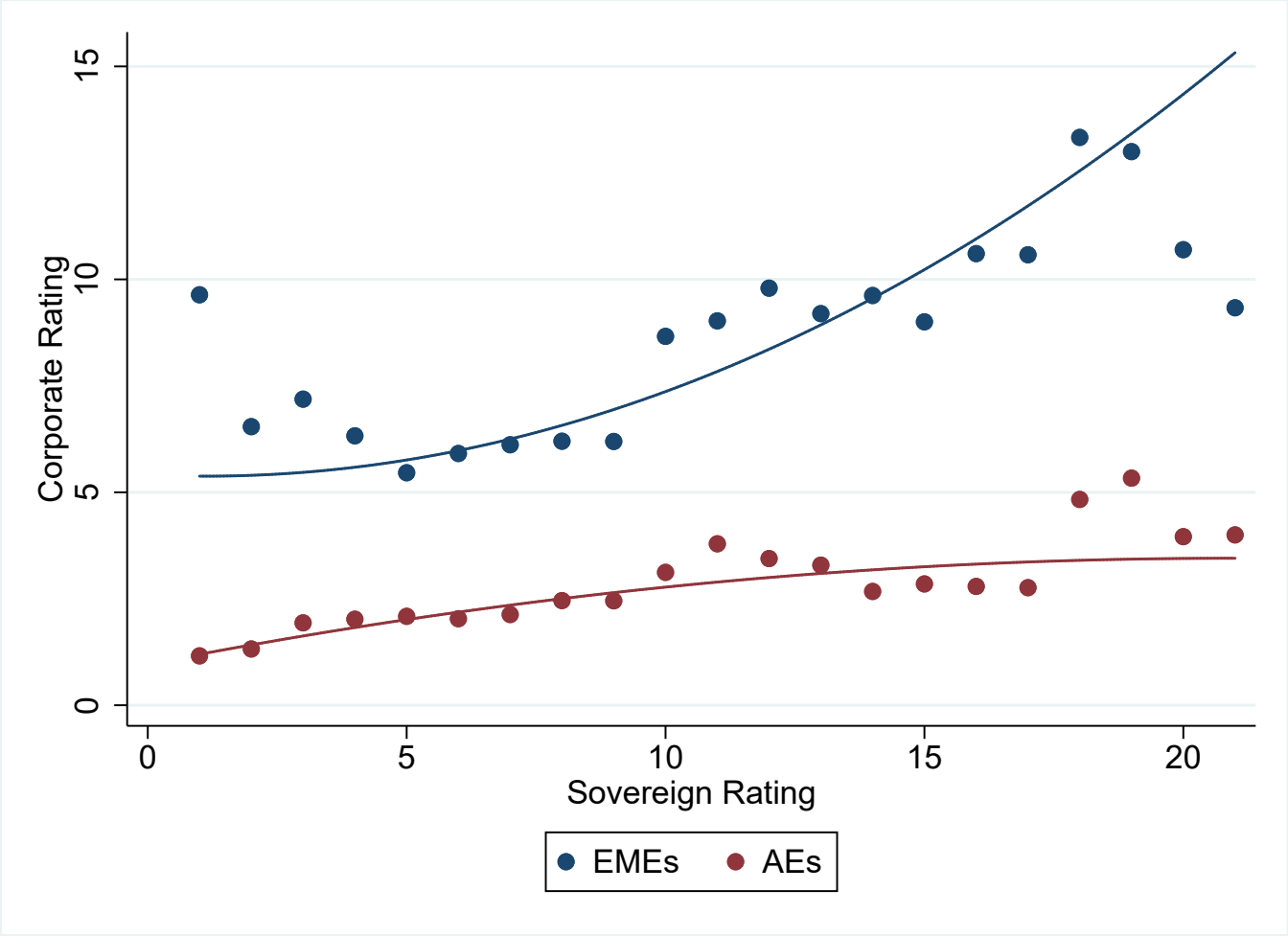
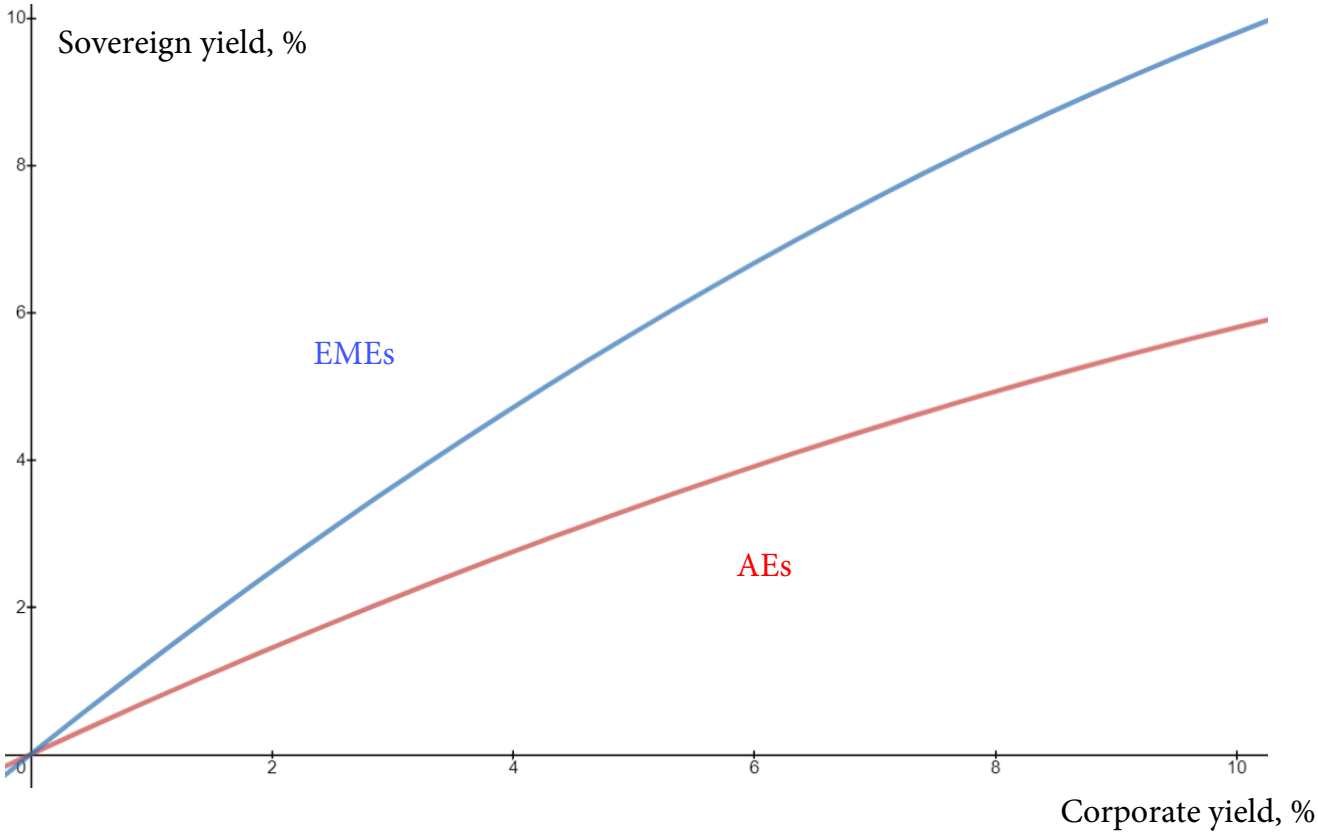
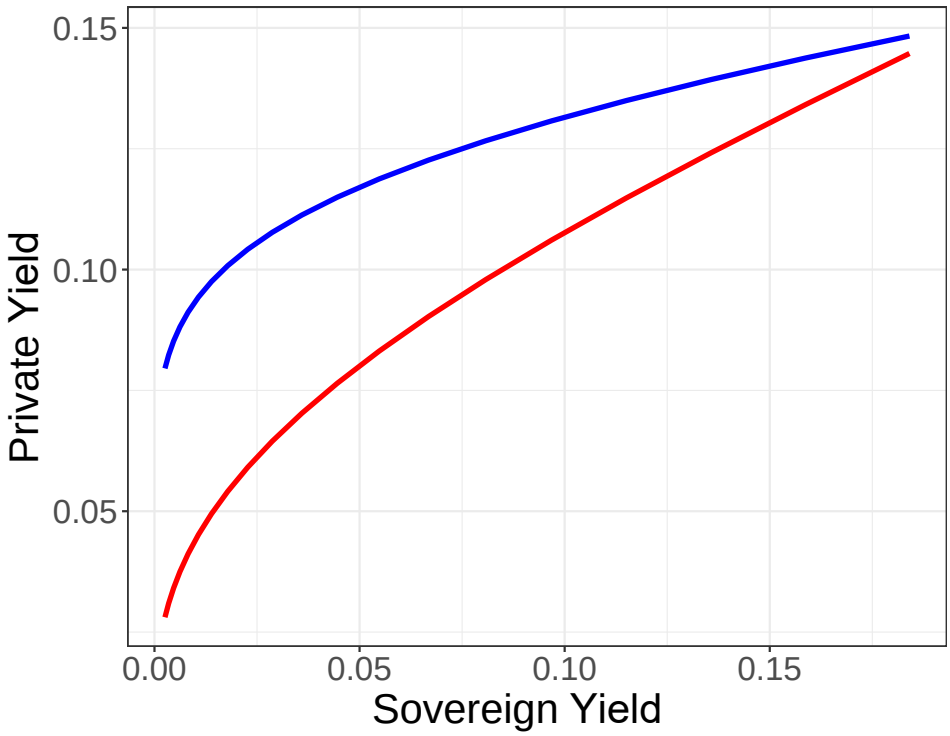


Figure 4: Regression results



Note: the lines represent regression coefficient estimates from columns (5) and (6) of Table 1.

Figure 5: Model predictions



Note: parameter values are as follows: For EMEs (blue line): $\tau = -2$, $y \in [-3; -1.1]$ with step 0.1. $\beta = 1.12$, $\gamma = 0.13$, $\alpha = 0.4$; For AEs (red line): $\tau = -2.25$, $y \in [-3; -1.1]$ with step 0.1. $\beta = 1.12$, $\gamma = 0.3$, $\alpha = 0.4$.

Table 1: Yield regressions — quadratic

	EME	AE	EME	AE	EME	AE
	(1)	(2)	(3)	(4)	(5)	(6)
Sovereign yield	1.95***	1.25***	1.41***	0.59***	1.31***	0.76***
	(0.18)	(0.043)	(0.15)	(0.050)	(0.14)	(0.045)
Sovereign yield squared	-0.063***	-0.041***	-0.046***	-0.015***	-0.033**	-0.018***
	(0.014)	(0.0026)	(0.013)	(0.0029)	(0.013)	(0.0021)
Fixed effects	time	time	time, country	time, country	time, firm	time, firm
Observations	34009	45323	34008	45323	31758	42865
Adjusted R^2	0.69	0.56	0.79	0.62	0.91	0.80

Unit of observation is individual bond.
Dependent variable is the yield of the bond.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 2: Dynamic Markov regression estimates

State	Low-yield	High-yield
Pr(transition)	0.013	0.026
Real yield variance	1.79	2.41
Mean real yield (%)		
EME	0.05	5.18
AE	2.26	5.71

Dependent variable is the yield of the government bond minus CPI inflation.
Equation allows for trend for AE.

Table 3: Yield regressions — discontinuity

	EME	AE	EME	AE	EME	AE
	(1)	(2)	(3)	(4)	(5)	(6)
Sovereign yield (a), β_1	1.29***	1.01***	0.93***	0.48***	0.98***	0.62***
	(0.050)	(0.033)	(0.050)	(0.044)	(0.028)	(0.040)
High-yield state (b), β_2	2.11***	1.35***	0.67*	0.53*	0.64*	0.79***
	(0.75)	(0.52)	(0.34)	(0.31)	(0.32)	(0.25)
(a)*(b), β_3	-0.51***	-0.55***	-0.20***	-0.18***	-0.16***	-0.24***
	(0.11)	(0.12)	(0.063)	(0.068)	(0.055)	(0.056)
Fixed effects	time	time	time, country	time, country	time, firm	time, firm
Observations	33704	45323	33704	45323	31544	42865
Adjusted R^2	0.72	0.56	0.79	0.62	0.91	0.79

Unit of observation is individual bond.
Dependent variable is the yield of the bond.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 4: Yield regressions — discontinuity. Controlling for ratings

	EME	AE	EME	AE	EME	AE
	(1)	(2)	(3)	(4)	(5)	(6)
Sovereign yield (a)	1.12***	1.13***	0.98***	0.55***	0.98***	0.59***
	(0.031)	(0.031)	(0.041)	(0.047)	(0.037)	(0.043)
High-yield state (b)	3.36***	2.64***	1.92***	0.90*	0.88*	0.85**
	(0.71)	(0.64)	(0.57)	(0.48)	(0.51)	(0.34)
(a)*(b)	-0.47***	-0.74***	-0.28***	-0.31***	-0.25***	-0.26***
	(0.11)	(0.11)	(0.070)	(0.079)	(0.081)	(0.060)
Bond rating (c)	0.25***	0.16***	0.19***	0.16***	0.067	0.077***
	(0.026)	(0.012)	(0.024)	(0.012)	(0.041)	(0.0090)
(c)*(b)	-0.11	-0.15***	-0.073	-0.0090	0.037	-0.011
	(0.068)	(0.038)	(0.057)	(0.031)	(0.051)	(0.022)
Fixed effects	time	time	time, country	time, country	time, firm	time, firm
Observations	6903	35606	6903	35606	6603	34252
Adjusted R^2	0.86	0.60	0.88	0.66	0.92	0.77

Unit of observation is individual bond.
Dependent variable is the yield of the bond.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 5: Yield regressions — "crisis" interactions

"Crisis" defined as:	IMF program		Laeven-Valencia		Reinhart-Rogoff	
	EME	AE	EME	AE	EME	AE
	(1)	(2)	(3)	(4)	(5)	(6)
Sovereign yield (a)	0.92***	0.66***	0.88***	0.65***	0.97***	0.49***
	(0.050)	(0.035)	(0.055)	(0.036)	(0.031)	(0.062)
"Crisis" (b)	4.56***	2.26***	1.33	0.87***	38.7***	2.38*
	(0.85)	(0.41)	(0.88)	(0.19)	(2.64)	(1.41)
(a)*(b)	-0.77***	-0.47***	-0.064	-0.30***	-2.65***	-0.30**
	(0.13)	(0.071)	(0.085)	(0.053)	(0.13)	(0.12)
Observations	31758	42865	31758	42865	24106	37640
Adjusted R^2	0.91	0.80	0.90	0.80	0.90	0.79

Unit of observation is individual bond.
Dependent variable is the yield of the bond.
Time and firm fixed effects included in all regressions.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 6: Yield regressions — "crisis" interactions and discontinuity

"Crisis" defined as:	IMF program		Laeven-Valencia		Reinhart-Rogoff	
	EME	AE	EME	AE	EME	AE
	(1)	(2)	(3)	(4)	(5)	(6)
Sovereign yield (a)	1.01***	0.70***	0.99***	0.68***	1.02***	0.60***
	(0.027)	(0.037)	(0.030)	(0.037)	(0.032)	(0.042)
"Crisis" (b)	5.21***	2.23***	2.18***	0.97***	38.2***	2.52*
	(0.78)	(0.42)	(0.75)	(0.18)	(2.68)	(1.39)
(a)*(b)	-0.86***	-0.50***	-0.16	-0.28***	-2.68***	-0.43***
	(0.12)	(0.072)	(0.17)	(0.064)	(0.13)	(0.094)
High-yield and no crisis (c)	0.26	0.039	0.68**	-0.21	0.90**	0.55
	(0.27)	(0.17)	(0.33)	(0.17)	(0.37)	(0.33)
(c)*(b)	-0.10**	-0.075**	-0.17***	-0.023	-0.23***	-0.19***
	(0.045)	(0.035)	(0.056)	(0.032)	(0.067)	(0.070)
Observations	31643	42865	31594	42865	24012	37640
Adjusted R^2	0.91	0.80	0.91	0.80	0.90	0.79

Unit of observation is individual bond.
Dependent variable is the yield of the bond.
Time and firm fixed effects included in all regressions.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 7: Bond characteristic: Emerging Economies

	Low-yield state				High-yield state			
	Mean	St. Dev.	Min	Max	Mean	St. Dev.	Min	Max
Priv. Yield	5.62	3.03	0	64.3	7.15	2.78	-.823	100
Sov. Yield	4.39	1.94	0	26.6	6.42	1.57	3.15	15.8
ln(Amount)	17.9	1.25	8.09	22.5	17.5	1.36	8.62	22
Yrs. to Maturity	4.23	3.93	.00556	40	4.03	3.41	.25	40
Rollover bond	.751	.433	0	1	.553	.497	0	1
Seasoned Issuer	.817	.387	0	1	.799	.401	0	1
Manufacturing	.172	.378	0	1	.179	.383	0	1
Financial	.537	.499	0	1	.534	.499	0	1
Export Share (> Median)[a]	.368	.483	0	1	.638	.481	0	1
Bond Rating	8.4	2.78	1	20	9.36	2.54	1	21
Bond rating in low-yield state	9.69	1.08	3.33	21	9.82	.966	3.33	16

[a] =1 if the export share is greater than the median export share value across the whole sample.
Summary statstics at the bond issue level. 29,727 bonds in low-yield state, 4,982 bonds in high-yield state.

Table 8: Bond characteristics: Advanced Economies

	Low-yield state				High-yield state			
	Mean	St. Dev.	Min	Max	Mean	St. Dev.	Min	Max
Priv. Yield	3.62	2.25	-38	100	4.47	2.42	-1.73	15.6
Sov. Yield	3.24	1.79	.0148	11.6	5.04	3.18	1.04	31.8
ln(Amount)	18.5	1.55	10.2	23.5	18.7	1.76	12.9	22.4
Yrs. to Maturity	7.46	6.05	.0194	40	6.42	6.22	.483	40
Rollover bond	.691	.462	0	1	.617	.486	0	1
Seasoned Issuer	.891	.312	0	1	.832	.374	0	1
Manufacturing	.119	.323	0	1	.0556	.229	0	1
Financial	.695	.46	0	1	.785	.411	0	1
Export Share (> Median)[a]	.763	.426	0	1	.25	.452	0	1
Bond Rating	5.44	3.67	1	21	7.87	3.86	1	21
Bond rating in low-yield state	8.98	2.47	1	20.8	8.94	2.15	1	18

[a] =1 if the export share is greater than the median export share value across the whole sample.
Summary statstics at the bond issue level. 43,924 bonds in low-yield state, 2,034 bonds in high-yield state.

Table 9: Yield regressions — discontinuity with controls

	EME	AE	EME	AE	EME	AE
	(1)	(2)	(3)	(4)	(5)	(6)
Sovereign yield (a)	1.25***	1.06***	0.93***	0.52***	0.97***	0.63***
	(0.046)	(0.025)	(0.051)	(0.044)	(0.028)	(0.040)
High-yield state (b)	1.95***	1.33***	0.64*	0.58*	0.63*	0.80***
	(0.67)	(0.51)	(0.34)	(0.31)	(0.32)	(0.25)
(a)*(b)	-0.49***	-0.58***	-0.19***	-0.20***	-0.16***	-0.24***
	(0.11)	(0.12)	(0.063)	(0.068)	(0.055)	(0.056)
Exporter	0.49	-0.40**	0.33	-0.88***	0.049	-1.01***
	(0.33)	(0.16)	(0.30)	(0.14)	(0.22)	(0.33)
Rollover bond	-0.52***	-0.96***	-0.070	-0.71***	0.039	-0.029
	(0.10)	(0.056)	(0.063)	(0.055)	(0.035)	(0.022)
Low-yield rating	0.24***	0.045***	0.11***	0.063***		
	(0.030)	(0.0077)	(0.020)	(0.0100)		
Fixed effects	time	time	time, country	time, country	time, firm	time, firm
Observations	33704	45323	33704	45323	31544	42865
Adjusted R^2	0.73	0.60	0.80	0.64	0.91	0.79

Unit of observation is individual bond.
Dependent variable is the yield of the bond.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 10: Yield regressions — discontinuity. Only firms that issue in both states

	EME	AE	EME	AE	EME	AE
	(1)	(2)	(3)	(4)	(5)	(6)
Sovereign yield (a)	1.28***	0.60***	1.10***	0.52***	1.00***	0.57***
	(0.017)	(0.080)	(0.052)	(0.080)	(0.028)	(0.057)
High-yield state (b)	3.10***	0.77**	1.38***	0.92***	0.54*	0.79***
	(0.55)	(0.36)	(0.28)	(0.30)	(0.32)	(0.26)
(a)*(b)	-0.55***	-0.33***	-0.27***	-0.26***	-0.15***	-0.26***
	(0.090)	(0.089)	(0.049)	(0.072)	(0.051)	(0.058)
Fixed effects	time	time	time, country	time, country	time, firm	time, firm
Observations	19301	5876	19301	5876	18908	5497
Adjusted R^2	0.79	0.45	0.82	0.49	0.91	0.69

Unit of observation is individual bond.
Dependent variable is the yield of the bond.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 11: Yield regressions — discontinuity. Robustness tests

	EME	AE	EME	AE
	(1)	(2)	(3)	(4)
Sovereign yield (a)	0.88***	0.62***	0.99***	0.67***
	(0.052)	(0.039)	(0.030)	(0.040)
High-yield state (b)	0.46	1.06***	0.62*	0.85***
	(0.35)	(0.24)	(0.32)	(0.25)
(a)*(b)	-0.11*	-0.28***	-0.16***	-0.26***
	(0.056)	(0.050)	(0.055)	(0.056)
Log GDP per capita	-0.048	1.30**		
	(0.62)	(0.57)		
Inflation rate	0.082***	0.11***		
	(0.021)	(0.024)		
Current account/GDP	-0.012	0.0023		
	(0.017)	(0.0093)		
GDP growth rate	-0.064**	0.0063		
	(0.027)	(0.012)		
GDP volatility	0.084	-0.026		
	(0.091)	(0.062)		
Exchange rate depreciation	-0.0048	0.033*		
	(0.0052)	(0.018)		
Years to maturity			0.066***	0.087***
			(0.012)	(0.0050)
Rollover bond			0.035	-0.026
			(0.032)	(0.022)
Seasoned issuer			-0.083*	-0.061*
			(0.050)	(0.031)
Log issue amount			-0.062***	-0.0046
			(0.014)	(0.0089)
U.S. governing law			1.19***	0.33**
			(0.37)	(0.14)
U.K. governing law			-0.077	0.17***
			(0.16)	(0.048)
Observations	31531	40946	31543	42820
Adjusted R^2	0.91	0.80	0.92	0.83

Unit of observation is individual bond. Firm and time FEs in all regressions.
Dependent variable is the yield of the bond.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 12: Yield regressions — discontinuity. Financial and non-financial firms.

	EME fin.	EME non-fin.	AE fin.	AE non-fin.	EME dom.	AE dom.
	(1)	(2)	(3)	(4)	(5)	(6)
	(1)	(2)	(3)	est4	est5	est6
Sovereign yield (a)	1.02***	0.97***	0.53***	0.76***	0.98***	0.64***
	(0.033)	(0.042)	(0.044)	(0.054)	(0.030)	(0.040)
High-yield state (b)	0.77	0.38	0.63**	0.92***	0.98***	0.88***
	(0.55)	(0.25)	(0.26)	(0.23)	(0.33)	(0.29)
(a)*(b)	-0.19**	-0.11**	-0.19***	-0.25***	-0.21***	-0.26***
	(0.085)	(0.045)	(0.055)	(0.060)	(0.060)	(0.067)
Observations	17230	13035	30244	10779	29579	36504
Adjusted R^2	0.94	0.89	0.74	0.90	0.91	0.80

Unit of observation is individual bond. Firm and time FEs in all regressions.
Dependent variable is the yield of the bond.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 13: Yield regressions — discontinuity. Excluding Global Financial Crisis.

	EME	AE	EME	AE	EME	AE
	(1)	(2)	(3)	(4)	(5)	(6)
Sovereign yield (a)	1.29***	1.00***	0.92***	0.46***	0.96***	0.61***
	(0.053)	(0.034)	(0.058)	(0.044)	(0.033)	(0.041)
High-yield state (b)	1.76**	1.37***	0.97**	0.57*	0.80*	0.82***
	(0.86)	(0.53)	(0.42)	(0.30)	(0.45)	(0.25)
(a)*(b)	-0.47***	-0.55***	-0.25***	-0.18***	-0.19**	-0.23***
	(0.13)	(0.12)	(0.074)	(0.066)	(0.074)	(0.057)
Fixed effects	time	time	time, country	time, country	time, firm	time, firm
Observations	30642	40277	30642	40277	28512	37837
Adjusted R^2	0.72	0.57	0.79	0.63	0.91	0.81

Unit of observation is individual bond.
Dependent variable is the yield of the bond.
Robust SEs clustered on country-year in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).

Table 14: Yield regressions — quadratic and discontinuity. Secondary market USD yields.

	(1)	(2)	(3)	(4)
Sovereign yield (a)	0.13***	0.14***	0.20***	0.39***
	(0.024)	(0.034)	(0.027)	(0.036)
Sovereign yield squared (a^2)	-0.0015***		-0.0029***	
	(0.00047)		(0.00051)	
High-yield state (b)		0.24		1.21***
		(0.22)		(0.21)
(a)*(b)		-0.082**		-0.31***
		(0.034)		(0.034)
Fixed effects	time	time	country	country
Observations	912	912	912	912
Adjusted R^2	0.42	0.42	0.43	0.47

Unit of observation country-quarter. EMEs only.
Dependent variable is the USD yield of the sovereign bond.
*(P<0.10), **(P<0.05), ***(P<0.01).

A Appendix

Table A.1: Variables we investigate

Variable Name	Description	Units	Source
Corporate Yield	Yield to maturity for bonds	Percent	Dealogic
Rating	Rating assigned at issuance from S&P, Moody's, or Fitch	AAA=1,...,D=21	Dealogic
Sovereign Yield	10-year government bond yield or JP Morgan's EMBI+	Percent	GFD
Sovereign Rating	Sovereign bond rating at launch from S&P, Moody's, or Fitch	AAA=1,...,D=21	Dealogic
Amount	Total bond face value	USD	Dealogic
Years to Maturity	Number of years from issuance to maturity	Years	Dealogic
Rollover	1 if issuing amount does not exceed maturing amount		Dealogic
Seasoned Issuer	1 if firm cluster has issued before in the sample		Dealogic
Below-grade	1 if bond rated BB+ or below		Dealogic
Financial	financial firm = 1, nonfinancial firm = 0		Dealogic
Export Share	Industry exports as a share of industrial production	Share (0-1)	UNCTAD/UNIDO
Manufacturing	1 if SIC code between 20 and 39		Dealogic
Tradeable	1 if industry export share > 0		UNCTAD/UNIDO
Exchange rate	Quarterly exchange rate	Local currency/USD	IFS
GDP per capita	real GDP per total population	2010 USD	WDI
Inflation	Annual change in CPI	Percent	WDI
Currennt account/GDP	current account as a share of GDP	Percent	WDI
Growth GDP	Annual real GDP growth	Percent	WDI
Volatility GDP	Variance 10 year GDP growth	Variance 5 years	WDI
U.S. Laws	1 if the bond is governed by U.S. laws		Dealogic
England Laws	1 if the bond is governed by English laws		Dealogic

Table A.2: High-yield states and crises in the regression sample[a]

Country name	High-yield	IMF program	LV crises	RR default[b]
Argentina	none	2006	2013	2006-13, 2015
Australia	1993-95, 1997-98	none	none	none
Austria	none	none	2008-12	none
Belgium	1995, 2009-10	none	2008-12	none
Brazil	2006-07, 2012-15	2005	none	none
Canada	1994-96	none	none	none
Chile	2011	none	none	none
China	2004, 2009-10	none	none	none
Colombia	2008-09, 2011-14	2009, 2011-14	none	none
Croatia	2014, 2016	2003, 2006	none	N.A.
Cyprus	2009, 2017	none	2012	N.A.
Czech Republic	2000, 2002-04, 2009	none	1999-2000	N.A.
Denmark	1993, 1995	none	2008	none
Finland	2009-10	none	none	none
France	none	none	2008-09	none
Germany	none	none	2008-09	none
Greece	2009-17	2010-14	2008-12	2012-13, 2015
India	2001-03, 2005-06, 2015-17	none	none	none
Indonesia	2009-11, 2016-17	none	none	none
Ireland	1993, 1996, 2009-14	2010-13	2008-12	none
Italy	1993-96, 2012-15	none	2008-09	none
Japan	none	none	1997-01	none
Luxembourg	2009-10	none	2008-12	none
Malaysia	2000-05, 2009-10	none	none	none
Mexico	2003-12, 2015-17	2009-14	none	none
Netherlands	none	none	2008-09	none
New Zealand	1993, 97, 99-2000, 2007, 10-11, 13-17	none	none	none
Norway	2002-03	none	none	none
Peru	none	2007-09	none	none
Philippines	2002-07, 2009-10, 2015-17	none	none	none
Portugal	2009-2017	2011-14	2008-12	2014
Romania	2009	2003-04, 2006, 2009-11	none	none
Russia	2012, 2017	1999-2000	2000, 2008-09	1999-2000
Singapore	2015-17	none	none	none
Slovakia	2009	none	2000	none
Slovenia	2009-10, 2014	none	2009-10	none
South Korea	2000-03, 2006-08	2000	none	none
Spain	2009-10, 2012-16	none	2008-12	none
Sweden	1998, 2009-10	none	1994, 2008-09	none
Switzerland	none	none	2008-09	none
Turkey	none	none	none	none
Ukraine	none	2008-09	2008-09	N.A.
United Kingdom	1994-95	none	2007-11	none

[a] years with no issues of home currency bonds are not shown.