# Corporate Spreads, Sovereign Spreads, and Crises

Julia Bevilaqua
Wharton School of Business

Galina B. Hale*
Federal Reserve Bank of San Francisco

Eric Tallman
Federal Reserve Bank of San Francisco

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**Abstract**

We document that positive correlation between corporate and sovereign cost of funds borrowed on global capital markets weakens during periods of unusually high sovereign spreads, when corporate borrowers are able to issue debt that is priced at lower rates than sovereign debt. This state-dependent correlation between sovereign and corporate cost of funds has not been previously documented in the literature. We demonstrate that this stylized fact is not explained by a different composition of borrowers issuing debt during periods of high sovereign spreads or by the relationship between corporate and sovereign credit ratings. The decline in the correlation between corporate yields and sovereign yields is observed across countries and industries as well as for a given borrower over time. We propose a simple information model that reationalizes our empirical observations: when sovereign spreads are high and more volatile, spreads on corporate debt are less correlated with spreads on sovereign debt. The calibrated model matches well the empirical correlation between sovereign and corporate cost of funds during normal and crisis times and is able to explain the heterogeneity in the estimates across market segments.

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# 1 Introduction

Pricing of sovereign bonds has received a lot of attention in the international finance literature.[1] Much less attention is devoted to the pricing of corporate bonds and loans obtained by companies on global financial markets, and even less attention to the relationship between the pricing of sovereign debt and that of corporates in the same country. 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.[2]

One would therefore expect that corporate bond yields are subject to sovereign "floors" — that is, corporate spreads would generally be higher than sovereign spreads. Another way to put it — sovereign credit risk is a component of a corporate credit risk, and therefore risk premium 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 spreads 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 also document a strong positive correlation between corporate and sovereign cost of funds, but show that it weakens during periods of unusually high sovereign spreads, to which we refer as sovereign debt crises, or simply crises. In fact, we observe that during crises, corporate borrowers are able to issue debt that is priced at lower rates than sovereign debt. This state-dependent correlation between sovereign and corporate cost of funds has not been previously documented in the literature, to the best of our knowledge.[3] We demonstrate that this stylized

[1] See, for example Eichengreen and Mody (2000),

[2] This was, in fact, an explicit policy of rating agencies until 1997 (Standard, 1997). 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.

[3] The closest we could find is the observation in Williams et al. (2013) that the sensitivity of bank ratings changes

fact is not explained by a different composition of borrowers issuing debt during crises relative to the composition of borrowers in normal times. We show that this stylized fact is observed across countries and industries as well as for a given borrower over time. We propose a simple information model that reationalizes our empirical observations: when sovereign spreads are high and more volatile, spreads on corporate debt are less correlated with spreads on sovereign debt. When we calibrate the model to match the moments of the data, we find a correlation between sovereign and corporate spreads during normal and crisis times similar to that observed in the data.

In our empirical analysis we focus on debt obtained by corporate borrowers on global debt markets, both by issuing bonds and by borrowing from global banks. We combine these data with information on primary and secondary sovereign bond spreads. We construct indicators of crisis times for each country using two-state Markov regression with unequal variance applied to de-trended sovereign spreads for each country. The results show very clear crisis states for most countries, in which not only the level of spreads is high, but also their variance. Turning to corporate spreads, we find that during normal times, overall correlation between private and sovereign spreads in the pooled data is about 0.4, but it is only half that during crisis times.[4] When we control for borrower fixed effects, we find that within correlation is about 0.2 in normal times and also falls by half during crisis times.

Contrary to our expectations, we find that the characteristics of the borrowers that issue bonds or obtain loans during crisis periods are not different from those of the borrowers that borrow during normal times. While our data does not include financial information about the borrowers, we can compare other dimensions of borrowers as well as of bond and loan contracts. We find no difference between crisis and normal time periods in the share of financial borrowers, share of manufacturing-sector borrowers, and share of borrowers that have borrowed previously. We also find no difference in maturity and size of bonds and loans, and in the incidence of debt rollover as opposed to new issues. There is only one exception. 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) and find that share of exporters is higher during crisis periods among

to sovereign rating changes is influenced by macroeconomic factors and the countries' financial freedom.

[4]This correlation is not affected by including time fixed effects.

advanced economies borrowers, but not among emerging market borrowers.[5]

Next we investigate whether sensitivity of corporate ratings to sovereign ratings follows a similar pattern and therefore spreads simply react to ratings in a way that we would expect. We find that corporate ratings are indeed 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 rating during crisis times, whether we define crises as periods of high sovereign spreads or as periods in which sovereign ratings fall below investment grade levels. Moreover, when we estimate regressions of corporate yields on both sovereign yields and sovereign ratings, we find that the effect of sovereign ratings does not vary between normal and crisis periods and the effect of sovereign yields remains the same as in our basic regressions.

Given that composition effects or ratings do not explain our stylized fact, we propose a simple model in which we take sovereign spreads and sovereign debt crisis events as exogenous and analyze global investors response in terms of corporate debt pricing. In the very few models we found 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 private borrowing costs. In our model we endogenize this link by assuming that sovereign spreads contain noisy information about creditworthiness of corporate borrowers. The model shows that when spreads are higher or more volatile, the information value contained in them declines and therefore resulting demand for corporate debt is less sensitive to sovereign spread 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 correlation between private and sovereign spreads from normal to crisis times.

We conduct additional empirical analysis by splitting our data into four market segments: bonds and loans, firms from advance and emerging economies. We find that our stylized facts hold for advanced economies' bonds and for emerging economies' loans, while the pattern breaks down for advanced economies loans and emerging economies bonds. Our model can explain these differences using two observations: first, sovereign spreads are more volatile for emerging markets and therefore the signal they provide is less informative than that for advanced economies; second, public infor-

[5]This 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.

mation about bond issuers is much more readily available than public information about borrowers taking out loans. It turns out that for the model to produce a difference between normal and crisis time sensitivity of private cost of funds to sovereign spreads, precision of public information and of the signal from sovereign spread need to be of similar magnitude. This is the case for advanced economies' bonds (high precision of both) and emerging economies' loans (low precision of both). For emerging market bonds, public signal is more precise than information from sovereign spreads, while for advanced economies loans public signal is less precise than information from sovereign spreads.

To summarize, this paper contributes to the literature by uncovering a new stylized fact about the relationship between private cost of funds obtained on global markets and sovereign spreads: there is a substantial positive correlation between the two in normal times, but when sovereign spreads are high this correlation weakens to about half the normal time value. We explore potential explanations and find that neither composition effects nor dynamics of credit ratings can explain this observation (Part 3). We present a simple information model that not only illustrates the findings qualitatively, but with calibration can produce similar correlations between private and sovereign spreads (Part 4). Moreover, we document differences in the relationship between private cost of funds and sovereign spreads across market segments and demonstrate that the model can explain these differences in an intuitive way (Part 5).

# 2 Data Sources

## 2.1 Private bond, loan, and ratings data

We collect data on private bonds, loans, and ratings from Dealogics DCM Analytics and Loan Analytics, which cover new bond issues and loans placed on international markets. Our analysis is limited to bonds and loans placed by private companies in foreign markets. The deal-level data provided by Dealogic include the name and nationality of the bond issuer or loan borrower, the deal amount, currency denomination, bond or loan yield, maturity date, bond ratings, and the industry classification of the issuer. We encode the ratings on a numeric scale ranging from 1

(AAA) for lowest credit risk to 21 (D) for default.[6] 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 110,535 individual bonds and 43,504 loans issued from 1993 to 2017. The countries included in our analysis represent those that have more than one private bond issue or loan per year–or more than 24 observations in our panel. This leads to a sample of 23 advanced economies in both bond and loan data samples, 14 emerging economies in our bond data sample, and 20 emerging economies in our loan data sample.

### 2.2 Cluster-level aggregation

In our analysis of heterogeneity of bond and loan yield responses to sovereign spreads we aggregate our data so that the unit of observation is an industry-country-quarter cluster. For each cluster we take the average of maturity years, bond and loan yields, issue amount, and ratings. When aggregating to the cluster level we separate countries, financial and non-financial firms, industries as defined by 2-digit SIC codes, and keep our data at a quarterly frequency.[7] We have 79 different industries in both our bond sample and our loan sample. In total there are 1,183 advanced economy and 423 emerging economy clusters in our bond data and 1,135 and 613 advanced and emerging economy clusters, respectively, in our loan sample. Overall, we have 18,138 bond and 21,792 loan cluster-level observations.

After we aggregate to the country-industry-quarter cluster-level we create a seasoned issuer and a rollover variable. We define a seasoned issuer as a cluster that has issued at least once before in our sample.[8] Rollover is a dummy variable that equals 1 if the size of the bond or loan does not exceed the value of the bonds or loans maturing for the given cluster in a given quarter.[9] We also created a dummy variable for manufacturing which takes the value of 1 if the industry of the bond or loan cluster has a SIC code of 20 through 39, which correspond to the manufacturing industries.

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

[7] Firms codified as financial by Dealogic are not always in SIC industry that corresponds to finance.

[8] We do this separately for bond and loans, because throughout this paper bonds and loans are treated separately.

[9] An alternative approach would be to compute those at firm level and then aggregate to cluster level. By creating seasoned issuer and rollover indicators at the cluster level we trade off firm-level precision in exchange for allowing for mergers and acquisitions and for intra-firm transfers of credit.

### 2.3 Sovereign spreads

As our analysis is based on the relationship between sovereign bond spreads and private bond spreads, we obtain sovereign bond data from Global Financial Data using two main series. The first is each country's 10-year government bond yield denominated in local currency. The second is JPMorgan's Emerging Market Bond Index Plus (EMBI+), which tracks total returns of external debt instruments in emerging markets around the world and is denominated in U.S. dollars. The bond and loan yield data we obtain from Dealogic has securities denominated in both local and foreign currency. Since the EMBI+ series — our main source of emerging market sovereign yield data — is denominated in U.S. dollars, we performed our emerging market analysis of private bonds and loans issued in USD. Since we had advanced economy sovereign data available in both home currency and U.S. dollars we decided to perform that analysis in home currency because we found private bonds and loans in advanced economies were more likely to be issued in home currency.

To create sovereign spreads for the emerging economies in our sample we either subtract the U.S. 10-year Treasury Bill from the yield of the local 10-year government bond or use the EMBI+ index. We then choose the series for each country with longer coverage. For advanced economies we must account for the fact that the government bond is issued in home currency while the 10-year U.S. Treasury bill is denominated in USD. To account for this currency mismatch, we use the data and analysis provided by Du and Schreger (2016) on the covered interest rate parity (CIP) deviation between government bond yields. Particularly, we use equation (2) in their paper, where $y$ is the bond yield in local currency and USD respectively and $\rho$ is the difference of the log of the forward exchange rate and the spot exchange rate for the currency of interest.

$$y_{10t}^{LC} = y_{10t}^{\$} + \rho_{10t}. \tag{1}$$

In order to avoid introducing spurious correlation in the data, we use private bond and loan yields, instead of spreads, in our analysis.

Missing from the DCM Analytics bond and loan 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 and loan data from DCM Analytics contains 4-digit SIC code descriptions for each observation. 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 clusters as either "exporters" or "non-exporters" by comparing cluster export shares to the median export share for all advanced and emerging economies clusters 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 capital control data from Fernandez et al. (2016).

# 3 Empirical regularities and stylized facts

## 3.1 Patterns in raw data

We first investigate whether there is any evidence of an actual sovereign "celing" (or "floor" in the context of spreads) in our data. As Figure 1 shows for Brazil, Russia, Ireland, and Spain, there appears to be a sovereign floor on bond spreads for these countries during the time periods when sovereign spreads are relatively low. However, when sovereign bond spreads rise, private bond spreads appear to breach the floor and fall below sovereign ones.

To see if this is a widespread phenomenon, we plot bin-scatter diagrams for advanced and emerg-

ing economies bond and loan spreads against their sovereign spreads. The results are shown in Figure 2, with linear regression fit discontinuity at the 75th percentile of sovereign spreads in a given subsample. We can see much larger impact of sovereign spreads on bond yields for both advanced and emerging economies, and for loan spreads for emerging economies.

### 3.2 Identifying crises

In order to analyze whether the sovereign ceiling was broken during periods of high sovereign spreads (to which we refer as crisis periods) we construct a crisis measure using a Markov switching model with state-dependent variance. Given a global trend of declining interest rates, we first remove linear trends from sovereign spread series for each country. We then define a crisis as a time in which the probability of being in the high-spread state is greater than 50 percent. Tables 1 and 2 show country-by-country results of the Markov regression for the countries in our sample. We can see that in the majority of cases high-spread regimes are associated with higher variance of the spreads. We can also observe that the probability of switching from one regime to another is quite low for most countries.[10]

### 3.3 Basic regression analysis

Our primary goal is to investigate the relationship between private sovereign yields in both bond and loan markets and how that relationship changes when sovereign spreads are high. We observed that at high levels of sovereign spread private yields on bond or loan issued by a firm $i$ in country $c$ in quarter $t$ ($r_{ict}^{priv}$) become less sensitive to changes in the sovereign spreads ($r_{ct}^{sov}$). To demonstrate this stylized fact more systematically, we estimate a linear regression model with private yields as our dependent variable at the bond and loan issue level.

$$r_{ict}^{priv} = \alpha + \beta_1 r_{ct}^{sov} + \beta_2 I(crisis_{ct}) + \beta_3 I(crisis_{ct}) * r_{ct}^{sov} + \varepsilon_{ict}, \tag{2}$$

where $I(crisis_{ct}$ is the crisis year indicator for country $c$ in quarter $t$.

[10] We refer to high sovereign spread regimes as crises for the sake of brevity, fully understanding that many countries in our data did not have any sovereign debt crises during the time period we study.

Table 3 reports the estimates for this regression for all our data pooled together with an increasingly comprehensive set of fixed effects. In column (4) we include time, firm fixed effects as well as eight fixed effects for all possible combinations of three indicators: bond/loan, advanced/emerging economy, financial/non-financial sector borrower. Standard errors are clustered on country-time, the level at which our independent variable, sovereign spreads, varies.

The first three columns do not include firm fixed effects, thus they capture both within and between effect. We can see that in all cases there is a strong positive correlation between private yields and sovereign spreads during non-crisis periods. However, during crisis periods this correlation is less by about a half — consistent with the bin-scatter evidence. Once we include firm fixed effects, we only measure the within-effects.[11] We find the same qualitative pattern with the non-crisis sensitivity of private yields to sovereign yields being substantially lower, as one would expect. Once again this sensitivity drops to about half its value during crisis periods.[12]

### 3.4 Composition effects

Having established a pattern of lower sensitivity of private bond and loan yields to sovereign spreads during crises, a natural question to ask is whether the composition of firms that issue bonds and borrow from banks during crises is different from the composition of firms that borrow in non-crisis times. To investigate this, we compare the characteristics of the issuers in crisis and non-crisis periods along many dimensions. What we find is that there does not appear to be any obvious compositional differences in those firms that issued during normal times and those that issued during crises. To demonstrate this point, Tables 4 through 7 provide summary statistics of our key variables for crisis times and non-crisis times separated by bonds and loans and country type.

By construction, sovereign spreads have significant variation over the two periods. Importantly, private yields do not vary to the same degree–again indicating that the sovereign ceiling may be pierced during times of crisis. None of the other variables show any substantial or statistically

[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] The results are the same if we estimate this set of regressions for bond yields only. If we estimate these regressions just for loans, we find qualitatively similar, but smaller in magnitude between correlation of loan yields with sovereign yields that is half as large during crises, but no within sensitivity of loan spreads to sovereign spreads during both normal and crisis times.

significant differences between crisis and non-crisis periods in any of the four subsamples. In fact, they are remarkably similar! The only variable that shows any difference is the share of exporters, which is higher in crisis periods for advanced economies. We also estimated a two-stage Heckman Regression at a cluster level with the first stage estimating the probability of a given cluster issuing a bond or a loan in crisis and non-crisis period, but did not find any significant coefficients on control variables in the first stage probit regressions.[13] Bottom line, we failed to find any selection or composition effects along any observable dimensions that could explain change in the sensitivity of private bond yields to sovereign spreads between crisis and non-crisis time periods.

### 3.5 Ratings

Our next conjecture is that the changing sensitivity of corporate spreads to sovereign spreads follows the sensitivity of corporate ratings to sovereign ratings. That is, we conjecture that sovereign ceiling in ratings is pierced during crises resulting in lower sensitivity of corporate ratings, and therefore spreads, to sovereign ratings during crises. We test this conjecture as follows.

First, we want to see whether corporate ratings are less sensitive to sovereign ratings during crises. We start by constructing a bin-scatter diagram similar to the one we constructed for spreads (Figure 3. We allow for regression discontinuity between BB+ and BB ratings (investment grade versus speculative grade), which in our numerical scale corresponds to a value between 10 and 11. Because only a small subsample of loans have information on borrower ratings, we only show these diagrams for bonds. We observe that for both advanced and emerging economies there is no decline in corporate rating sensitivity to sovereign ratings when sovereign ratings are poor. If anything, the sensitivity is higher for advanced economies.

Next, we estimate a set of regressions similar to the ones specified by equation (2) but with dependent variable being corporate rating and control variables being sovereign rating and its interaction with crisis times. For consistency of the analysis, we continue to define crisis times as before, based on the Markov switching regression analysis of sovereign spreads. The results are reported in Table 8. Consistent with the literature (Almeida et al., 2017; Adelino and Ferreira,

[13] Results are available upon request.

2016), we find a strong positive correlation between corporate and sovereign ratings, but this correlation does not decline by any meaningful amount during crisis times. In fact, in within regressions reported in column (4) the correlation during crisis times is even slightly higher. Thus, we don't observe changes in "sovereign ceiling" dynamics between normal and crisis times.

Finally, using a similar set of regressions, we run a "horse race" between the effect of sovereign yields and sovereign ratings on corporate yields to determine whether sovereign yields or sovereign ratings are more important determinants of the corporate yields and whether this changes during crises. The results are reported in Table 9. We find that the effects of sovereign yields on corporate yields during both normal and crisis times are nearly unchanged compared to our basic regressions in Table 3. Correlation in normal times continues to be of a similar magnitude for each specification and it is only half as large during crisis times. The effect of sovereign rating is much smaller, has a counter-intuitive sign in all but the last specification, and does not change between normal and crisis times.[14]

Thus, we conclude that ratings alone do not explain the pattern we established — a decline of sensitivity of private corporate yields to sovereign yields during crisis times.

# 4 Stylized Model

To understand these empirical regularities, we present a very simple stylized model. The fact that we are trying to explain is not specifically the presence or absence of floor or ceiling, but rather a strong sensitivity of private spreads to sovereign spreads during normal times that goes down during sovereign debt crises defined as periods of high levels and volatility of sovereign spreads. In this context we think of the information model, in which investors face some public and private information about the firms that they can lend to or buy their debt. Sovereign spread, publicly observed, can be 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 two reasons why sovereign spreads might contain information about private firms' credit risk. First, as we learned from the Asian crisis

[14]The results are the same if we include a control for borrower's corporate rating, which has a positive and statistically significant correlation with corporate yields. These results are not reported but are available upon request.

experience in the late 1990s and the euro area debt crisis, foreign private debt might be implicitly guaranteed by the government (Corsetti et al., 1999; Acharya et al., 2014).[15] Second, low sovereign spreads 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 thread to firms' future profitability from outsides government debt.[16]

Assume that a representative firm needs to raise up to one unit of funds for one period. For simplicity, assume that borrowing takes form of a zero-coupon bond with a total face value of 1. 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, but we don't have a global game here because there are no strategic complementarities 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 $ps = (1/p - 1)$. Given that the risk-free rate of return on storage technology is 0, $ps$ is also a spread on the private bond.

Denote exogenous unobserved probability of default as $\pi$. A risk-neutral investor will choose to buy bond if

$$(1-\pi)\frac{1}{p} \geq p, \quad \text{or} \quad p \leq \sqrt{1-\pi}. \tag{3}$$

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 $\rho$ distribution

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

[16] 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.

are publicly known. Assume for simplicity that $\pi = \Phi(\rho)$, where $\Phi$ 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 spread into the model, assume that sovereign spread $ss$ reflects the sovereign's default probability, which is a publicly known function of the sovereign credit risk $y$, so that $ss = \Phi(y)$. Sovereign credit risk (or sovereign spread) is observed and is a noisy signal about a firm's credit risk, $y = \rho + \nu$, $\nu \sim N(0, 1/\alpha)$.[17]

Given this information structure, all investors have the same prior expectation of $\rho$:

$$E\rho|_y = \frac{\alpha y + \gamma\tau}{\alpha + \gamma}. \tag{4}$$

After receiving private signal $x_i$, each investor's posterior expectation of $\rho$ is

$$E_i\rho|_{x_i,y} = \frac{\alpha y + \beta x_i + \gamma\tau}{\alpha + \beta + \gamma}. \tag{5}$$

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 $x^*$:

$$p^* = \Phi\left(\sqrt{\beta}\left(x^* - \frac{\alpha y + \gamma\tau}{\alpha + \gamma}\right)\right). \tag{6}$$

From (3) and (5), the investor will be indifferent between buying and not buying the bond if

$$p^* = \sqrt{1 - \Phi\left(\frac{\alpha y + \beta x_i + \gamma\tau}{\alpha + \beta + \gamma}\right)} \tag{7}$$

Combining (6) and (7) gives us a solution for $x^*$, which implies $p^*$ and equilibrium $ps^* = 1/p^* - 1$.

[17] One can think of $\tau$ 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 $\nu$. Because $y$ is observed, this will not change the model predictions.

There is no closed form solution. However, the solution is well defined and unique given that (6) gives $p^*$ as increasing function of $x^*$, while (7) 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 (6).

Mean bond yield in the data is 4.9 percent with standard deviation 3.2 percentage points, average sovereign spread is 1 percent with standard deviation of 1.7 percentage points in non-crisis years and 2.6 percentage points during crisis years. Given these data we can calibrate the model parameters. As a starting point, we can take $y = -2.3$, which implies $ss = 0.01$. In non-crisis years, $\alpha = 0.5$ and in crisis years, $\alpha = 0.3$ to match standard deviations that are 1.4 and 1.8 times the mean of sovereign spread in normal and crisis times, respectively. We can proxy for the precision of 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, or 59 percent of the mean yield. Thus, we can set $\beta = 1.1$. Finally, we set $\tau = -1.55$ (which corresponds to default probability in the model of 6 percent) and $\gamma = 4.5$ to match the equilibrium mean private bond yield of 4.9 and the sensitivity of private yields to sovereign spreads in non-crisis periods from column (4) of Table 3: 0.18.

Figure 4 shows how for these parameter values private spread varies with sovereign spread. The only difference between the two lines is the precision of the sovereign spread as a signal. First, we note that regardless of the precision of the sovereign spread signal, higher sovereign spread is associated with lower impact of sovereign spread on private spread. Second, for the same values of sovereign spreads, private spreads are higher when sovereign spreads are less informative of a firm's creditworthiness. This is because without as much reliance on a secondary public signal, which has a more favorable mean value than private signals, fewer investors choose to invest. Finally, with lower precision of the sovereign spread signal, the sensitivity of private spreads to sovereign spreads is lower: if we regress model private spread on model sovereign spread, the regression coefficient drops from 0.18 for the model with high $\alpha$ (the coefficient we calibrated to) to 0.12 for the model with low $\alpha$, slightly above 0.1 coefficient on crisis-time sensitivity of private yields to sovereign spreads computed as $\beta_3 - \beta_1$ in column (4) of Table 3.

# 5 Further empirical analysis

We now turn to further empirical analysis of the relationship between private bond and loan yields and sovereign spreads. For this analysis, we break down our sample into four market segments: we separate bond issues and loans, and split firms into two groups — those from advanced and those from emerging economies. We add a number of control variables that may shed additional light on our findings and further test for any evidence of heterogeneity and composition effects. We conduct this analysis at the country-industry cluster level to reduce noise and granularity of our dependent variable. Cluster represents all bond issues and loans by all financial or non-financial firms in industry $m$ country $c$ in time $t$. In all regressions we cluster standard errors on country-year and include cluster (country-industry) and time fixed effects.

$$\begin{aligned} r^{priv}_{mct} &= \alpha_{mc} + \alpha_t + \beta_1 r^{sov}_{ct} + \beta_2 I(crisis_{ct}) + \beta_3 I(crisis_{ct}) * r^{sov}_{ct} \\ &+ X'_{mct}\gamma_1 + I(crisis_{ct}) * X'_{mct}\gamma_2 + Z'_{ct}\gamma_3 \varepsilon_{mct}, \end{aligned}$$

where $r^{priv}_{mct}$ is an average bond or loan yield for a given cluster $mct$, $\alpha_{mc}$ and $\alpha_t$ are country-industry and time fixed effects, and $X_{mct}$ is a set of cluster-averaged firm-level explanatory variables that includes cluster average issue size, average issue maturity, whether the cluster is seasoned, and whether it's debt is likely being rolled over, and whether the firms are financial or not. We interact all these variables with the crisis indicator to test whether sensitivity of spreads to other variables also changes between normal and crisis times. $Z_{ct}$ is a set of country-level explanatory variables that tend to be important in explaining corporate bond and loan spreads in international markets.[18] The results are reported in Tables 10 and 11.

We find that our benchmark results are driven by advanced economies' bond issues and emerging economies' loans, as shown in columns (1)-(3) of Table 10 and columns (4)-(6) of Table 11. For these cases we find that in normal times corporate yields are highly sensitive to sovereign spreads

[18] We are not including any variables reflecting current macroeconomic conditions because they tend to be well summarized by sovereign spreads and therefore would likely lead to high degree of collinearity, especially given country and time fixed effects. We are not including propensity to export, because it is computed at country-industry-year level and varies very little over time for a given country-industry cluster. Thus, its effect is absorbed by cluster fixed effects.

but this sensitivity drops substantially during crisis periods. In fact, for emerging markets' loans we cannot reject the hypothesis that there is no correlation between private bond yields and sovereign spreads during crises. Given that we include cluster (country-industry) and time fixed effects, the regression is identified by over-time variation in a given cluster's average yield that is not due to common trend and fluctuations. These results are robust to including different sets of controls and their interactions with crisis indicator.

For emerging markets' firms bond issues, we find small negative correlation between corporate bond yields and sovereign spreads, once we control for common trend and fluctuations by including time fixed effectst. We do not find a significant difference between crisis and normal periods, but point estimates show that we can't reject the hypothesis of zero correlation in crisis times. For advanced economies' loans, we find a pattern that is opposite to our stylized facts — during normal times there is a small negative correlation between loan yields and sovereign spreads, but during crisis times there is a small positive correlation. These differences suggest that global bond and loan markets for both advanced and emerging economies are quite segmented.

### 5.1 Heterogeneity and country-level effects

Consistent with our previous results, we find very little evidence of heterogeneity across clusters within these four market segments. We find that bonds with longer maturities tend to have higher yields, as one would expect, but this correlation does not change during crisis times. We also find that financial firms from advanced economies tend to pay lower yields on their bonds, by the same amount in normal and crisis times. The only statistically significant difference in terms of sensitivity to our control variables between normal and crisis times is that clusters that roll over their debt during crises pay a lower yield than clusters that issue new debt. While we found that the share of clusters that roll over their debt is the same in crisis and normal times, this finding is consistent with our intuition that debt roll over is easier in crisis times than sales of new debt issues.

We find that larger loan amounts are associated with lower yields, and that this effect is larger for advanced economies' borrowers in crisis times. We also find that advanced economies' borrowers

pay more if their loans have longer maturity, also especially during crises. For both advanced and emerging economies, financial firms pay less on their loans, and this effect is unchanged during crises.

In terms of country-level control variables, we find that currency depreciation in advanced economies is associated with higher bond yields, above and beyond the effect already incorporated in the sovereign spreads, but the same is not the case for loan yields. Currency depreciation does not have an effect on emerging market bond and loan yields. Capital controls only matter for emerging market loan yields — capital controls on inflows tend to lower the cost of borrowing, while capital controls on outflows increase it. Both of these effects are dampened when sovereign spreads are high. Including country-level controls does not alter the effect of sovereign spreads on private cost of funding during either normal or crisis times.

### 5.2 Calibrating model to market segments

Can our model rationalize the differences in the effects of sovereign spreads on private yields across market segments revealed by our data analysis? More or less, with different model calibrations, reported in Table 12.

For emerging market bonds we found negative correlation between private yields and sovereign spreads in normal times and no correlation in crisis times. The main difference between advanced and emerging economies from our model point of view is higher levels of private yields and higher levels and volatility of sovereign spreads. We can calibrate the model to sovereign and private yields observed for emerging markets, as reported in Table 5. The calibration is in column (2) of Table 12. We calibrate $\tau$ and $y$ to match ranges of private and sovereign cost of funds. We keep $\beta$ and $\gamma$ the same as in the benchmark to minimize differences with benchmark calibration. We choose $\tau$ and non-crisis $\alpha$ to be the same as in column (4) of Table 12. We choose crisis $\alpha$ to be 9 times lower, to match a three-fold increase in the standard deviation of sovereign spreads for emerging markets from normal to crisis times, as reported in Table 5.

While our model is monotone and always produces positive relationship between private and sovereign spreads, it is easy to see that with higher values of $ss$ and lower values of $\alpha$, it is easy

to produce the results where $ps$ changes very little with $ss$ and further reducing $\alpha$ does not make much difference. In this particular calibration, for both values of $\alpha$ the effect $\partial ps/\partial ss \leq 0.01$. Thus, while the model cannot explain the negative effect of sovereign spreads on private yields that we find that for emerging market bonds, the model can easily produce low sensitivity that would not lead to finding a statistically significant result in the data in both normal and crisis times.[19] Intuitively, because in emerging markets sovereign spreads are higher and more volatile than in advanced economies at all times, they are not adding much information to the public signal already available through corporate bond ratings.

What is the difference between bond and loans in terms of information? Companies that obtain loans from individual banks or syndicates of lenders do not need to have public credit ratings. Moreover, firms borrowing from banks rather than on portfolio debt market are less likely to be publicly traded. Thus, public information about such borrowers tends to be much more limited (Hale and Santos, 2008, 2006). We cannot calibrate the information precision to the dispersion of spreads within a rating, because ratings are not available for most borrowers. We simply lower the precision of the public signal $\gamma$ to be the same as that of private signal $\beta$ and both to be lower than normal times precision of information from sovereign spread, $\alpha$, which for advanced economies we keep unchanged from the benchmark. To calibrate the model to advanced countries' borrowers, we match the private yields to be 1.5 percent (see Table 6), and sovereign spreads ranging from 0 to 8 percent, as in the benchmark calibration. This calibration is reported in column (3) of Table 12. The model cannot produce a negative effect of $ss$ on $ps$, but for this set of parameters, we do observe only a small difference between $\partial ps/\partial ss$ in normal and crisis times.[20]

For emerging market loans, we set $\tau$ and non-crisis $\alpha$ to match average yield on loans issued to emerging market borrowers from Table 7 and the effect of sovereign spreads on loan yields estimated for emerging market borrowers, in column (4) of Table 11. We set crisis $\alpha$ to be 9 times lower than normal times $\alpha$, to match a three-fold increase in the standard deviation of sovereign spreads for

[19] If we do not include time fixed effects in the regressions, we obtain a near zero coefficient on sovereign spread in both normal and crisis times in regressions that correspond to columns (4)-(6) in Table 10. That is, time fixed effect absorbs some of the positive correlation between sovereign and private cost of funds. These result are available upon request.

[20] In this case we also find near zero effect of sovereign spread on loan yields in the regression, once we drop time fixed effect.

emerging markets from normal to crisis times, as reported in Table 5. With these parameters, reported in column (4) of Table 12, we find a substantial decline in sensitivity of private spreads to sovereign spreads: $\partial ps/\partial ss$ falls from 0.15 to 0.02. Note that we left the precision of private and public signal unchanged from our calibration for advanced economies loans (column (3)), which produced very little difference between crisis and normal times.

Overall, we can show that for the same drop in $\alpha$, which is the only change in the calibration from non-crisis to crisis period, the model can produce results consistent with observed differences across market segments in terms of the change in sensitivity of private yields to sovereign spreads from normal to crisis times. For advanced economies ($\alpha$ is relatively high, reflecting low volatility of sovereign spreads — compare columns (1) and (3) in Table 12): the model predicts a substantial decline in private yield sensitivity to sovereign spreads when the precision of another public signal $\gamma$ is high (bonds), but very little difference when the precision of the public signal is low (loans). For emerging economies (volatility of sovereign spreads is high ($\alpha$ is low) — compare columns (2) and (4) in Table 12), the model predicts a negligible decline in private yield sensitivity to sovereign spreads when precision of another public signal $\gamma$ is high (bonds), but a substantial decline in private yield sensitivity to sovereign spreads when the precision of the public signal is low (loans). In other words, high sensitivity of private yields to sovereign spreads occurs in the model when magnitudes of the precision of public signal and of the signal from sovereign spread are similar in magnitude.

### 5.3 Robustness tests

We conduct a series of robustness checks to verify our results were not merely unique to our specification. These results are available upon request.

First, we include control variables reported in Tables 10 and 11 specifications one at a time to test how robust the coefficients on sovereign spread and the interaction of sovereign spread and crisis are to the controls added. What we find is that the relationship between private yield and sovereign spreads both in normal times and during a crisis are highly robust to the addition of different controls.

Following the work of Borensztein et al. (2013) we repeat our analysis at the firm-level. Including similar controls as in our cluster-level regressions we find more strong evidence that the impact of sovereign spreads on private yields is positive but fall in crisis times for advanced economy bond yields and emerging economy loan yields. We also find that the issue-level controls we include are more significant at the firm-level, including a strong negative effect on yields of being a seasoned issuer. As a further robustness test we also include the same country-level controls as Borensztein et al. (2013). We find that our results are again robust to their inclusion. As expected, we find that higher GDP volatility leads to higher private yields and that high GDP growth tends to lower yields.

We also, in firm-level regressions for bond yields, control for governing laws at the firm-level and find that having a bond governed by U.S. or English law tends to raise bond yields, but the sensitivity of bond yields to sovereign spreads remains unchanged.

Finally, we split the samples into borrowers that are classified as financial and non-financial in the data. We find that our main results are very similar for these subsets of borrowers, whether we estimate our regressions at the cluster or at the firm level.

# 6 Conclusion

In this paper we uncover a new stylized fact: when sovereign spreads are high, private firms are able to borrow from global capital markets at a lower cost than their sovereigns and, more generally, private cost of funds becomes less correlated with sovereign spreads. Our initial hunch that this observation is due to a specific set of firms that are able to borrow during such crisis times is not supported by the data. Moreover, we do not observe a weakening of the link between private credit ratings and sovereign credit ratings during crisis times.

To understand this stylized fact we turn to the information model, in which we view sovereign spreads as an additional public source of information about creditworthiness of the firms. It turns out that such model not only produces dynamics consistent with the stylized fact, but is also able to rationalize differences in sensitivity of private cost of funds to sovereign spreads across different

market segments.

These findings shed light on the corporate debt pricing dynamics in global markets. In particular, the 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 spreads still have important impact on the private cost of funds, which means sovereign spreads contain information that is not reflected in sovereign ratings. Our findings are also a word of caution against assuming that rating dynamics and spread dynamics are equivalent.

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Figure 1: Two examples

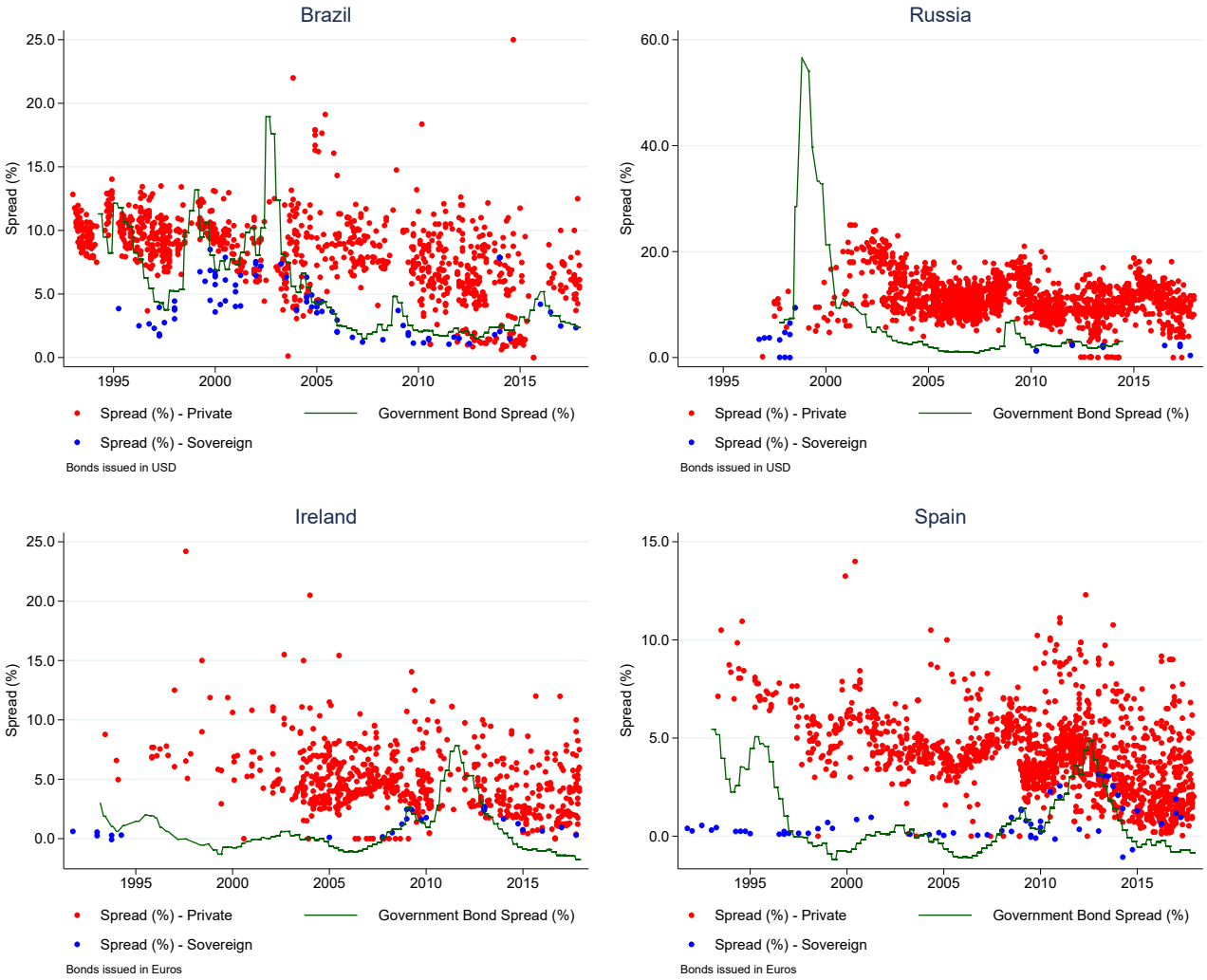


Figure 2: All data

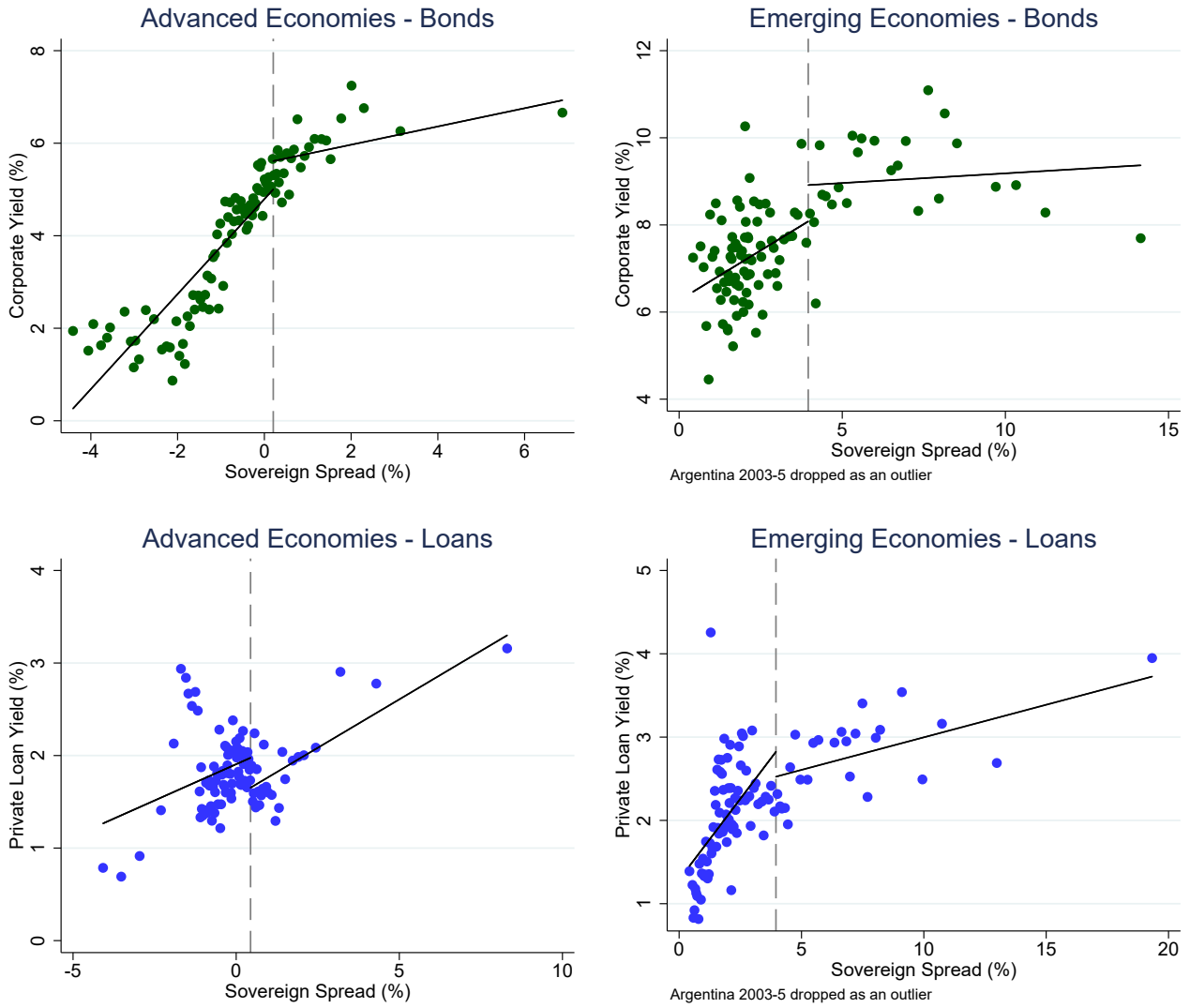


Figure 3: All data

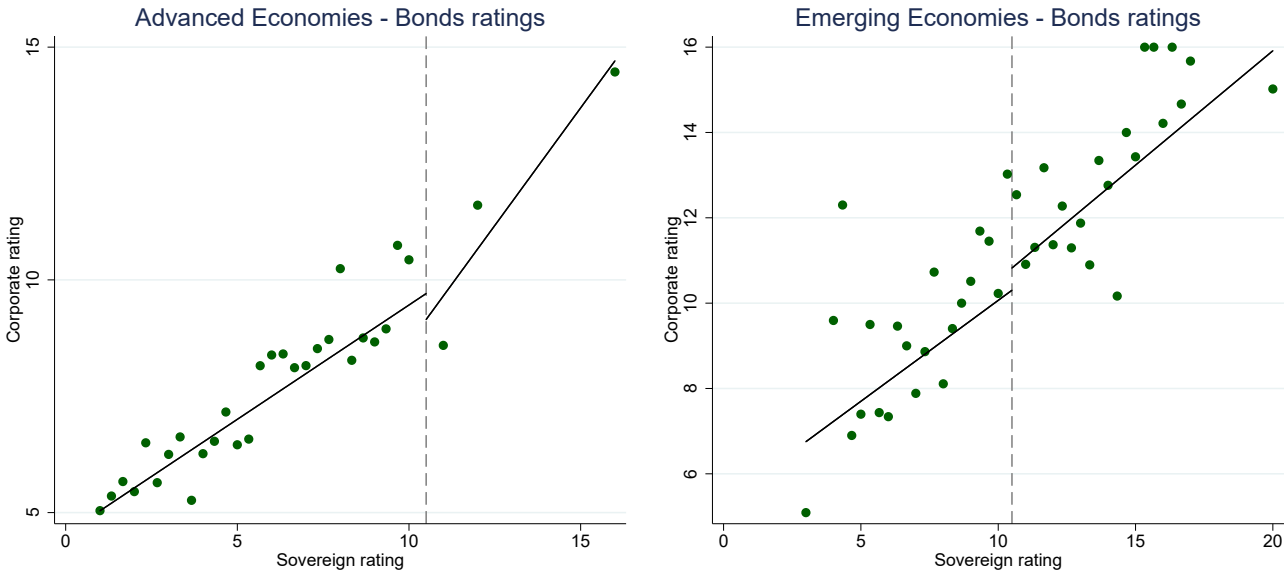
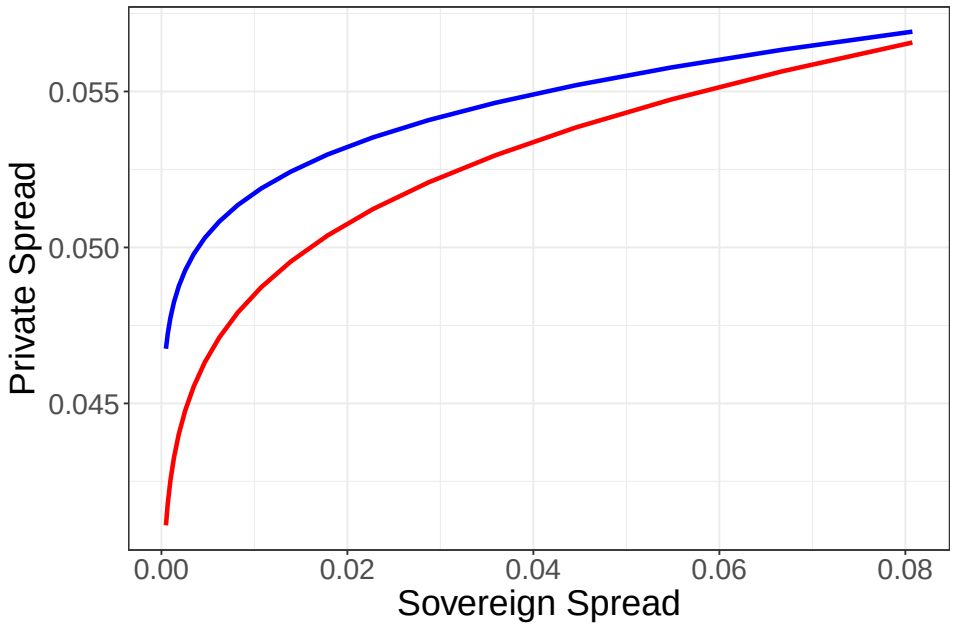



Figure 4: Model predictions




Note: parameter values are as follows: $\tau = -1.55$, $y \in [-3.3; -1.4]$ with step 0.1. $\beta = 1.1$, $\gamma = 4.5$, red line corresponds to $\alpha = 0.5$, blue line corresponds to $\alpha = 0.3$.

Table 1: Markov Results: Emerging Economies

| Country | Spread State 1 | Spread State 2 | $\sigma_1$ | $\sigma_2$ | Prob. 1 to 2 | Prob. 2 to 1 | Observations |
|---|---|---|---|---|---|---|---|
| Argentina | -11.05 | 13.35 | 10.43 | 6.12 | 0.01 | 0.01 | 223 |
| Brazil | -5.46 | 1.10 | 1.39 | 2.72 | 0.03 | 0.00 | 227 |
| Chile | -0.78 | 1.37 | 0.54 | 0.66 | 0.01 | 0.02 | 171 |
| China | -0.52 | 0.35 | 0.16 | 0.41 | 0.03 | 0.02 | 243 |
| Colombia | -1.65 | 4.22 | 1.60 | 0.13 | 0.01 | 0.03 | 160 |
| Egypt | -0.89 | 1.70 | 0.73 | 1.04 | 0.03 | 0.05 | 145 |
| Indonesia | -1.50 | 0.62 | 0.57 | 0.98 | 0.04 | 0.01 | 113 |
| Malaysia | -1.55 | 0.33 | 0.55 | 0.68 | 0.02 | 0.01 | 142 |
| Mexico | -0.76 | 0.52 | 0.40 | 0.56 | 0.06 | 0.03 | 188 |
| Panama | -0.66 | 0.65 | 0.52 | 0.66 | 0.04 | 0.03 | 215 |
| Peru | -1.12 | 0.79 | 0.54 | 0.88 | 0.05 | 0.04 | 250 |
| Philippines | -1.91 | 1.47 | 1.37 | 1.46 | 0.04 | 0.03 | 214 |
| Russia | -1.97 | 1.15 | 0.97 | 2.40 | 0.03 | 0.03 | 136 |
| South Africa | -0.49 | 0.86 | 0.34 | 1.07 | 0.04 | 0.06 | 146 |
| South Korea | -0.94 | 0.99 | 0.50 | 0.93 | 0.01 | 0.01 | 216 |
| Thailand | -1.15 | 0.25 | 0.38 | 0.69 | 0.03 | 0.02 | 142 |
| Turkey | -0.60 | 1.74 | 0.95 | 0.59 | 0.02 | 0.05 | 100 |
| Ukraine | -2.24 | 2.56 | 0.94 | 3.57 | 0.04 | 0.04 | 154 |
| Venezuela | -6.44 | 5.99 | 2.73 | 7.69 | 0.02 | 0.02 | 298 |
| Vietnam | -0.96 | 0.83 | 0.43 | 0.43 | 0.02 | 0.03 | 103 |

Table 2: Markov Results: Advanced Economies

| Country | Spread State 1 | Spread State 2 | $\sigma_1$ | $\sigma_2$ | Prob. 1 to 2 | Prob. 2 to 1 | Observations |
|---|---|---|---|---|---|---|---|
| Australia | -0.57 | 0.88 | 0.53 | 0.61 | 0.01 | 0.02 | 345 |
| Austria | -0.67 | 0.59 | 0.31 | 0.61 | 0.02 | 0.02 | 345 |
| Belgium | -0.84 | 0.54 | 0.29 | 0.65 | 0.02 | 0.01 | 345 |
| Canada | -0.70 | 0.21 | 0.22 | 0.31 | 0.03 | 0.01 | 345 |
| Denmark | -0.69 | 0.40 | 0.33 | 0.45 | 0.04 | 0.02 | 345 |
| Finland | -1.11 | 0.80 | 0.66 | 0.83 | 0.02 | 0.01 | 345 |
| France | -0.68 | 0.57 | 0.34 | 0.48 | 0.02 | 0.02 | 345 |
| Germany | -0.51 | 0.46 | 0.27 | 0.33 | 0.02 | 0.03 | 345 |
| Greece | -4.90 | 4.95 | 1.12 | 6.19 | 0.01 | 0.01 | 313 |
| Ireland | -1.21 | 1.49 | 0.53 | 1.88 | 0.01 | 0.01 | 345 |
| Italy | -1.99 | 1.24 | 0.64 | 1.34 | 0.01 | 0.00 | 345 |
| Japan | -0.68 | 0.79 | 0.51 | 0.56 | 0.01 | 0.01 | 345 |
| Luxembourg | -0.65 | 0.55 | 0.30 | 0.52 | 0.02 | 0.02 | 345 |
| Netherlands | -0.61 | 0.52 | 0.29 | 0.42 | 0.02 | 0.02 | 345 |
| New Zealand | -0.60 | 0.60 | 0.41 | 0.59 | 0.02 | 0.02 | 345 |
| Norway | -0.60 | 0.67 | 0.47 | 0.48 | 0.01 | 0.02 | 345 |
| Portugal | -2.45 | 1.83 | 0.58 | 2.64 | 0.01 | 0.01 | 345 |
| Singapore | -0.29 | 0.38 | 0.31 | 0.41 | 0.03 | 0.04 | 244 |
| Spain | -1.67 | 1.17 | 0.59 | 1.33 | 0.01 | 0.01 | 345 |
| Sweden[a] | -1.18 | 0.54 | 0.62 | 0.62 | 0.03 | 0.01 | 345 |
| Switzerland | -0.47 | 0.54 | 0.36 | 0.42 | 0.02 | 0.02 | 345 |
| Taiwan | -0.68 | 0.71 | 0.55 | 0.34 | 0.02 | 0.02 | 285 |
| United Kingdom | -0.63 | 0.46 | 0.51 | 0.36 | 0.02 | 0.02 | 345 |

[a]Sweden does not converge with variance switching

Table 3: Basic yield regressions

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Sovereign spread | 0.38*** | 0.42*** | 0.60*** | 0.18*** |
| | (0.0058) | (0.028) | (0.038) | (0.030) |
| Crisis $*$ sovereign spread | -0.19*** | -0.26*** | -0.39*** | -0.082*** |
| | (0.0070) | (0.048) | (0.053) | (0.024) |
| Crisis | 0.015 | 0.11 | 0.13 | 0.28*** |
| | (0.016) | (0.11) | (0.095) | (0.049) |
| Fixed effects | none | time | time, triple[a] | firm, time, triple |
| Observations | 83042 | 82744 | 82744 | 76419 |
| Adjusted $R^2$ | 0.083 | 0.20 | 0.45 | 0.74 |

Unit of observation is individual bond or loan.
Dependent variable is the yield of the bond or loan.
Robust SEs clustered on country-time in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).
[a] Triple fixed effect is I(bond) $*$ I(financial firm) $*$ AE.

Table 4: Bonds: Advanced Economies

| | No Crisis | | | | Crisis | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | St. Dev. | Min | Max | Mean | St. Dev. | Min | Max |
| Priv. Yield | 3.82 | 2.4 | -.86 | 28.2 | 4.29 | 2.48 | -15.2 | 22.7 |
| Sovereign Spread | -1.4 | 1.49 | -4.69 | 2.97 | -.00876 | 1.56 | -3.13 | 29.8 |
| ln(Amount) | 18.7 | 1.28 | 9.4 | 23.4 | 19.1 | 1.19 | 10.3 | 23.3 |
| Yrs. to Maturity | 8.85 | 6.96 | .678 | 40 | 8.95 | 7.45 | 1 | 40 |
| Rollover | .375 | .484 | 0 | 1 | .373 | .484 | 0 | 1 |
| Seasoned Issuer | .948 | .222 | 0 | 1 | .942 | .234 | 0 | 1 |
| Financial | .445 | .497 | 0 | 1 | .451 | .498 | 0 | 1 |
| Manufacturing | .227 | .419 | 0 | 1 | .204 | .403 | 0 | 1 |
| Export Share (> Median)[a] | .33 | .47 | 0 | 1 | .61 | .488 | 0 | 1 |

[a] 1 if the export share is greater than the median export share value across the whole sample. Summary statistics at the country-quarter-industry level.

Table 5: Bonds: Emerging Economies

| | No Crisis | | | | Crisis | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | St. Dev. | Min | Max | Mean | St. Dev. | Min | Max |
| Priv. Yield | 7.49 | 2.63 | -.252 | 17.8 | 7.95 | 2.87 | .026 | 15.5 |
| Sovereign Spread | 2.56 | 1.92 | .249 | 12 | 5.46 | 7.34 | .764 | 58.2 |
| ln(Amount) | 19 | 1.28 | 13 | 22.5 | 19 | 1.09 | 13.8 | 22.1 |
| Yrs. to Maturity | 8.02 | 6.44 | .508 | 40 | 7.3 | 5.72 | .456 | 40 |
| Rollover | .182 | .386 | 0 | 1 | .2 | .4 | 0 | 1 |
| Seasoned Issuer | .904 | .294 | 0 | 1 | .885 | .319 | 0 | 1 |
| Financial | .419 | .494 | 0 | 1 | .367 | .482 | 0 | 1 |
| Manufacturing | .211 | .408 | 0 | 1 | .275 | .447 | 0 | 1 |
| Export Share (> Median)[a] | .0876 | .284 | 0 | 1 | .13 | .337 | 0 | 1 |

[a] 1 if the export share is greater than the median export share value across the whole sample. Summary statistics at the country-quarter-industry level.

Table 6: Loans: Advanced Economies

| | No Crisis | | | | Crisis | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | St. Dev. | Min | Max | Mean | St. Dev. | Min | Max |
| Priv. Yield | 1.52 | 1.11 | -1.6 | 11.5 | 2.22 | 1.4 | -1.59 | 18.4 |
| Sovereign Spread | -.563 | 1.04 | -4.69 | 3.25 | .615 | 1.74 | -3.13 | 29.8 |
| ln(Amount) | 5.33 | 1.35 | -3.27 | 10.8 | 5.45 | 1.31 | -.944 | 11.1 |
| Yrs. to Maturity | 6.03 | 3.82 | .25 | 40 | 5.63 | 3.71 | .17 | 40 |
| Rollover | .207 | .405 | 0 | 1 | .219 | .413 | 0 | 1 |
| Seasoned Issuer | .916 | .278 | 0 | 1 | .943 | .231 | 0 | 1 |
| Financial | .133 | .34 | 0 | 1 | .112 | .316 | 0 | 1 |
| Manufacturing | .277 | .447 | 0 | 1 | .279 | .449 | 0 | 1 |
| Export Share (> Median)[a] | .641 | .48 | 0 | 1 | .756 | .43 | 0 | 1 |

[a] 1 if the export share is greater than the median export share value across the whole sample
Summary statistics at the country-quarter-industry level.

Table 7: Loans: Emerging Economies

| | No Crisis | | | | Crisis | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | St. Dev. | Min | Max | Mean | St. Dev. | Min | Max |
| Priv. Yield | 2.13 | 1.57 | -.1 | 12.8 | 2.38 | 2.68 | .03 | 87.1 |
| Sovereign Spread | 2.43 | 2.15 | -.455 | 17 | 5.07 | 7.33 | .519 | 66.3 |
| ln(Amount) | 5.07 | 1.2 | .0953 | 8.87 | 4.86 | 1.14 | -1.61 | 8.7 |
| Yrs. to Maturity | 4.42 | 3.1 | .08 | 20 | 4.15 | 3.17 | .08 | 20.5 |
| Rollover | .26 | .439 | 0 | 1 | .231 | .422 | 0 | 1 |
| , Seasoned Issuer | .896 | .305 | 0 | 1 | .91 | .286 | 0 | 1 |
| Financial | .208 | .406 | 0 | 1 | .196 | .397 | 0 | 1 |
| Manufacturing | .294 | .456 | 0 | 1 | .337 | .473 | 0 | 1 |
| Export Share (> Median)[a] | .119 | .324 | 0 | 1 | .189 | .392 | 0 | 1 |

[a] 1 if the export share is greater than the median export share value across the whole sample
Summary statistics at the country-quarter-industry level.

Table 8: Rating regressions

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Sovereign rating | 0.56*** | 0.56*** | 0.39*** | 0.21*** |
| | (0.0051) | (0.019) | (0.033) | (0.029) |
| Crisis $*$ sovereign rating | -0.034*** | -0.025 | 0.018 | 0.054*** |
| | (0.0078) | (0.029) | (0.027) | (0.014) |
| Crisis | -0.11*** | -0.19 | -0.30** | -0.30*** |
| | (0.029) | (0.19) | (0.15) | (0.059) |
| Fixed effects | none | time | time, triple[a] | firm, time, triple |
| Observations | 107476 | 107009 | 107009 | 103805 |
| Adjusted $R^2$ | 0.16 | 0.23 | 0.31 | 0.73 |

Unit of observation is individual bond or loan.
Dependent variable is a public rating of the borrower.
Robust SEs clustered on country-time in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).
[a] Triple fixed effect is I(bond) $*$ I(financial firm) $*$ AE.

Table 9: Yield regressions with ratings

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Sovereign spread | 0.52*** | 0.44*** | 0.61*** | 0.19*** |
| | (0.0087) | (0.037) | (0.041) | (0.031) |
| Crisis $*$ sovereign spread | -0.26*** | -0.22*** | -0.40*** | -0.090*** |
| | (0.0099) | (0.065) | (0.068) | (0.027) |
| Crisis | -0.038 | 0.18 | -0.062 | 0.24*** |
| | (0.025) | (0.13) | (0.10) | (0.070) |
| Sovereign rating | -0.092*** | -0.047** | -0.16*** | 0.060*** |
| | (0.0041) | (0.019) | (0.020) | (0.023) |
| Crisis $*$ sovereign rating | -0.027*** | -0.052 | 0.043 | 0.0051 |
| | (0.0060) | (0.038) | (0.034) | (0.016) |
| Fixed effects | none | time | time, triple[a] | firm, time, triple |
| Observations | 78031 | 77630 | 77630 | 71480 |
| Adjusted $R^2$ | 0.087 | 0.20 | 0.45 | 0.74 |

Unit of observation is individual bond or loan.
Dependent variable is the yield of the bond or loan.
Robust SEs clustered on country-time in all regressions.
*(P<0.10), **(P<0.05), ***(P<0.01).
[a] Triple fixed effect is I(bond) $*$ I(financial firm) $*$ AE.

Table 10: Bond Yield Regressions

| | Advanced Economies | | | Emerging Economies | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Sovereign Spread | 0.40*** | 0.41*** | 0.33*** | -0.17* | -0.17* | -0.16 |
| | (0.069) | (0.069) | (0.072) | (0.090) | (0.091) | (0.13) |
| Crisis ∗ Sov. Spread | -0.088** | -0.091** | -0.074* | 0.11 | 0.11 | 0.14 |
| | (0.040) | (0.040) | (0.044) | (0.085) | (0.086) | (0.11) |
| Crisis | 0.11 | 0.44 | 0.60 | 0.44 | 1.19 | 0.72 |
| | (0.65) | (0.71) | (0.81) | (2.55) | (2.56) | (2.61) |
| ln(Amount) | -0.021 | -0.049* | -0.029 | -0.027 | -0.084 | -0.093 |
| | (0.024) | (0.028) | (0.031) | (0.10) | (0.096) | (0.11) |
| Crisis ∗ ln(Amount) | 0.011 | -0.010 | -0.016 | -0.0039 | -0.026 | -0.0034 |
| | (0.035) | (0.038) | (0.043) | (0.13) | (0.13) | (0.13) |
| Yrs. to Maturity | | 0.011* | 0.0073 | | 0.025** | 0.020* |
| | | (0.0061) | (0.0063) | | (0.011) | (0.011) |
| Crisis ∗ Yrs. to Mat. | | 0.0094 | 0.0079 | | -0.011 | -0.0059 |
| | | (0.0079) | (0.0089) | | (0.017) | (0.018) |
| Rollover | | -0.029 | -0.0089 | | -0.20 | -0.20 |
| | | (0.042) | (0.046) | | (0.20) | (0.22) |
| Crisis ∗ Rollover | | -0.19*** | -0.19*** | | -0.031 | -0.020 |
| | | (0.064) | (0.070) | | (0.34) | (0.36) |
| Seasoned Issuer | | -0.063 | 0.031 | | -0.025 | 0.010 |
| | | (0.099) | (0.11) | | (0.25) | (0.28) |
| Crisis ∗ Seasoned | | 0.068 | 0.040 | | -0.063 | -0.12 |
| | | (0.14) | (0.18) | | (0.42) | (0.46) |
| Financial | | -0.12** | -0.10 | | 0.34 | 0.44** |
| | | (0.057) | (0.062) | | (0.21) | (0.22) |
| Crisis ∗ Financial | | -0.028 | -0.054 | | -0.32 | -0.41 |
| | | (0.071) | (0.080) | | (0.31) | (0.33) |
| Currency Depreciation (YoY) | | | 0.068*** | | | -0.012 |
| | | | (0.022) | | | (0.047) |
| Capital Inflow Controls | | | -0.0092 | | | 0.65 |
| | | | (0.90) | | | (0.75) |
| Capital Outflow Controls | | | -0.32 | | | -0.74 |
| | | | (0.27) | | | (0.72) |
| Sov. Spd ∗ In. Controls | | | 0.16 | | | 0.049 |
| | | | (0.39) | | | (0.10) |
| Sov. Spd ∗ Out. Controls | | | -0.027 | | | -0.069 |
| | | | (0.19) | | | (0.16) |
| Observations | 13292 | 13292 | 11178 | 1576 | 1576 | 1455 |
| Adjusted $R^2$ | 0.70 | 0.70 | 0.68 | 0.62 | 0.63 | 0.61 |

Unit of observation is country-industry-quarter cluster.
Dependent variable is average bond yield of country-industry-quarter cluster.
Regressions include country*industry and time FEs
Robust SEs clustered on country-time.
*(P<0.10), **(P<0.05), ***(P<0.01)

Table 11: Loan yield regressions

| | Advanced Economies | | | Emerging Economies | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Sovereign Spread | -0.11** | -0.12*** | -0.17*** | 0.15*** | 0.16*** | 0.18*** |
| | (0.046) | (0.045) | (0.047) | (0.054) | (0.056) | (0.061) |
| Crisis * Sov. Spread | 0.25*** | 0.27*** | 0.27*** | -0.11** | -0.12** | -0.12** |
| | (0.046) | (0.045) | (0.045) | (0.049) | (0.051) | (0.054) |
| Crisis | 0.42*** | 0.45** | 0.45** | 0.92 | 0.89 | 0.86 |
| | (0.15) | (0.18) | (0.18) | (0.75) | (0.77) | (0.79) |
| ln(Amount) | -0.056*** | -0.050*** | -0.048*** | -0.11*** | -0.12*** | -0.11*** |
| | (0.013) | (0.013) | (0.013) | (0.033) | (0.035) | (0.036) |
| Crisis * ln(Amount) | -0.083*** | -0.079*** | -0.095*** | -0.089 | -0.069 | -0.067 |
| | (0.025) | (0.025) | (0.027) | (0.14) | (0.15) | (0.15) |
| Yrs. to Maturity | | 0.015*** | 0.017*** | | 0.022 | 0.022 |
| | | (0.0045) | (0.0049) | | (0.014) | (0.014) |
| Crisis * Yrs. to Mat. | | 0.033*** | 0.033*** | | -0.055** | -0.054** |
| | | (0.0083) | (0.0097) | | (0.024) | (0.024) |
| Rollover | | -0.054 | -0.034 | | -0.036 | -0.032 |
| | | (0.035) | (0.041) | | (0.10) | (0.098) |
| Crisis * Rollover | | -0.055 | -0.022 | | -0.13 | -0.17 |
| | | (0.067) | (0.078) | | (0.23) | (0.24) |
| Seasoned Issuer | | -0.076 | -0.064 | | -0.093 | -0.11 |
| | | (0.053) | (0.055) | | (0.12) | (0.13) |
| Crisis * Seasoned | | -0.18 | -0.077 | | 0.28 | 0.27 |
| | | (0.11) | (0.095) | | (0.27) | (0.29) |
| Financial | | -0.23*** | -0.19*** | | -0.36** | -0.35** |
| | | (0.058) | (0.063) | | (0.17) | (0.17) |
| Crisis * Financial | | -0.12 | -0.30*** | | -0.26 | -0.28 |
| | | (0.090) | (0.100) | | (0.18) | (0.18) |
| Currency Depreciation (YoY) | | | -0.00020 | | | -0.0056 |
| | | | (0.0093) | | | (0.0095) |
| Capital Inflow Controls | | | 0.13 | | | -1.09*** |
| | | | (0.49) | | | (0.32) |
| Capital Outflow Controls | | | 0.050 | | | 0.65* |
| | | | (0.16) | | | (0.36) |
| Sov. Spd * In. Controls | | | 0.21 | | | 0.100** |
| | | | (0.23) | | | (0.047) |
| Sov. Spd * Out. Controls | | | -0.043 | | | -0.084** |
| | | | (0.12) | | | (0.039) |
| Observations | 13355 | 13202 | 10738 | 3410 | 3357 | 3295 |
| Adjusted $R^2$ | 0.46 | 0.47 | 0.49 | 0.18 | 0.18 | 0.18 |

Unit of observation is country-industry-quarter cluster.
Dependent variable is average bond yield of country-industry-quarter cluster.
Regressions include country*industry and time FEs
Robust SEs clustered on country-time.
*(P<0.10), **(P<0.05), ***(P<0.01)

Table 12: Model calibrations

| | Benchmark = AE bond (1) | EME bond (2) | AE loan (3) | EME loan (4) |
|---|---|---|---|---|
| $\tau$ | -1.55 | -1.3 | -2.25 | -1.3 |
| $\beta$ | 1.1 | 1.1 | 0.2 | 0.2 |
| $\gamma$ | 4.5 | 4.5 | 0.2 | 0.2 |
| y | [-3.3;-1.4] | [-2;-0.1] | [-3.3;-1.4] | [-2;-0.1] |
| $\alpha$ | 0.5 | 0.09 | 0.5 | 0.09 |
| crisis $\alpha$ | 0.3 | 0.01 | 0.3 | 0.01 |
| *ps* range | [0.04;0.06] | [0.083;0.087] | [0.014; 0.11] | [0.10; 0.17] |
| *ss* range | [0; 0.08] | [0.02; 0.46] | [0; 0.081] | [0.02; 0.46] |
| $\partial ps/\partial ss$ | 0.18 | 0.01 | 1 | 0.15 |
| crisis $\partial ps/\partial ss$ | 0.12 | 0.001 | 0.97 | 0.02 |
| $\partial ps/\partial ss$ – crisis $\partial ps/\partial ss$ | **0.06** | **0.009** | **0.03** | **0.13** |
| Estimation: | T 3 col (4) | T 10 col (4) | T 11 col (1) | T 11 col (4) |
| Data: $\partial ps/\partial ss$ (target) | 0.18 | -0.17 | -0.11 | 0.15 |
| Data: $\partial ps/\partial ss$ – crisis $\partial ps/\partial ss$ | **0.08** | **0.11** | **0.25** | **0.11** |

# A Appendix

Table A.1: Variables we investigate

| Variable Name | Description | Units | Source |
|---|---|---|---|
| Private Yield | All-in pricing for loans, 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 |
| Crisis | 1 if Markov probability of stage 2 exceeds 50% | | GFD |
| Amount | Total bond or loan 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 the 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 |
| Capital Import Controls | Overall inflow restrictions index | 0=least, 1=most restrictions | Fernandez, et al. (2016) |
| Capital Export Controls | Overall outflow restrictions index | 0=least, 1=most restrictions | Fernandez, et al. (2016) |
| 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 |