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ABSTRACT

SOVEREIGN VS. CORPORATE DEBT AND DEFAULT: MORE SIMILAR THAN YOU THINK

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Theory suggests that corporate and sovereign bonds are fundamentally different, also because sovereign debt has no bankruptcy mechanism and is hard to enforce. We show empirically that the two assets are more similar than you think, at least when it comes to high-yield bonds over the past 20 years. We use rich new data to compare high-yield US corporate ("junk") bonds to high-yield emerging market sovereign bonds 2002-2021. Investor experiences in these two asset classes were surprisingly aligned, with (i) similar average excess returns, (ii) similar average risk-return patterns (Sharpe ratios), (iii) similar default frequency, and (iv) comparable haircuts. A notable difference is that the average default duration is higher for sovereigns. Moreover, the two markets co-move differently with domestic and global factors. US "junk" bond yields are more closely linked to US market conditions such as US stock returns, US stock price volatility (VIX), or US monetary policy.

Keywords: Sovereign debt and default, default risk, corporate bonds, corporate default, junk

JEL classification: F3, G1, F4

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1. Introduction

A main tenet in international finance is that sovereign debt is unique, and fundamentally different from other debt classes such as corporate bonds (see e.g., Eaton and Gersovitz, 1981; Panizza et al., 2009). This is because sovereign debt has no bankruptcy mechanism and there is no supranational legal authority to enforce payments to creditors. Consequently, a large theoretical literature has examined various rationales for the very existence of sovereign debt (see e.g. Aguiar and Amador, 2013), while an empirical literature has documented the unique features of sovereign debt and default over time (see e.g. Mitchener and Trebesch, 2023). Moreover, the policy community continues to explore contractual clauses and statutory mechanisms to improve the functioning of sovereign debt markets to bring them closer to corporate bond markets (e.g., Krueger, 2002; IMF, 2013).

While it is widely *assumed* that corporate and sovereign debt differs, there is surprisingly little research that takes a closer look. How do investor experiences in high-yield corporate and sovereign bond markets compare? Do risky sovereign bonds carry a premium over corporate bonds? Are sovereign defaults more frequent, and are these defaults more painful for investors, with longer delays and higher haircuts? We have only limited knowledge of these questions.

This paper fills a gap in the literature by conducting the first in-depth comparison of investor experiences in high-yield corporate and sovereign bonds and the associated default risks. Specifically, we focus on US high-yield corporate bonds ("junk bonds") and compare them to emerging market and developing country sovereign bonds issued in US Dollars (external sovereign bonds). These two asset classes see frequent defaults and attract similar investor types, including distressed debt funds (e.g., Jiang et al. 2012, Ivashina et al. 2016, Schumacher et al. 2021).

We collect granular bond-level data on emerging market sovereign bonds as well as on US high-yield corporate bonds starting in 2002, which is the first year in which granular corporate bond data becomes available.[1] Granularity is crucial for three main reasons. First, the bond-

[1] For sovereigns, granular data are now available going back more than 200 years, see Meyer et al. (2022). For much of history, external sovereign debt was the main financing instrument for developing countries (Reinhart and Rogoff 2009). Over the past two decades, however, domestic debt issuance by EM sovereigns has increased (Du and Schreger 2016), so the share of external EM bonds in total EM sovereign debt has declined in relative terms. Nevertheless, external sovereign bonds remain a large and rapidly growing asset class (Figure 1), with

level data allows to carefully trace the performance of each bond over its lifetime and around default, avoiding the usual attrition bias in off-the-shelf indices, such as those by S&P and J.P. Morgan, which tend to drop bonds as soon as they approach distress territory. Second, we use total returns data that explicitly accounts for missed payments and haircuts bond-by-bond, which is necessary given that bonds of the same entity are often treated differently in defaults and restructurings, especially in the case of sovereigns (see Meyer et al. 2022 for a discussion on the variation in default outcomes across government bonds). Third, the granular data allows us to control for bond-specific factors that affect yields and returns, such as bond maturity or coupon size.

For emerging markets, we rely on the monthly bond-level dataset compiled by Meyer et al. (2022) which replicates and extends J.P. Morgan's Emerging Market Bond Index (EMBI) from the ground up, i.e., bond by bond, and explicitly accounts for missed payments and nominal debt write-downs (haircuts) in default. In total we cover 1,048 emerging market sovereign bonds issued by 81 countries with a total of 75,712 monthly pricing observations between 2002 and 2021 (all of them US dollar denominated). We combine this dataset from our previous work with newly compiled data on high-yield corporate bonds and related bankruptcies. To get to a representative picture on corporate HY bonds, we had to combine information from three datasets: the WRDS Bond Database which provides rich corporate bond data, in particular bond prices and returns. For bond and issuer characteristics as well as bankruptcy details, we complement the bond-level data with information from the Mergent Fixed Income Securities Database (FISD). Third, we fill large gaps in the bond price data, in particular during periods of distress, by adding information from J.P. Morgan (morganmarkets). The sample includes 6,763 high-yield US corporate bonds issued by 2,223 unique firms with a total of 294,600 monthly pricing observations between 2002 and 2021.

Our main insight is that the two markets are remarkably similar when it comes to average investment outcomes, even though one market (corporates) is governed by enforceable, statutory bankruptcy rules and the other is not (sovereigns). More specifically, we show that sovereign EM and corporate HY bonds have:

- Similar average excess bond returns (with strong co-movement in monthly returns between the two asset classes, but a different time profile of returns)

market size doubling between 2014 and 2021. Moreover, sovereign external debt defaults remain costly and of significant international concern, including the ongoing defaults in Africa.

- Similar Sharpe ratios
- Similar average default rates (frequency and probability of default)
- Comparable price-based haircuts (1- the recovery rate upon default), with haircuts on corporate HY bonds being a few percentage points higher, on average.

We also observe differences, in particular:

- The average default duration is slightly higher for sovereigns.
- Several sovereigns have defaulted multiple times in the past 20 years, while such "serial defaults" are not observed for corporate issuers.
- The yields of corporate and sovereign bonds show different co-movement with US and global factors. Most importantly, we find US corporate HY bonds to co-move more closely with US-specific variables such as the VIX, US industrial production, and US monetary policy shocks. We find similar patterns when using total bond returns as dependent variable.
- The differences in reaction to economic and financial shocks may explain the different time profiles in the average returns, yields, and default rates of corporate vs. sovereign bonds.

Table 1 compares the main descriptive statistics and regression coefficients that are presented in more detail in the remainder of the analysis.

Taken together, it is puzzling how similar the outcomes in the two markets are, at least with data from the past 20 years. A priori, one can think of many reasons why the outcomes in the two markets would differ. For example, sovereigns can never be liquidated unlike corporates and can therefore be prone to serial defaults as has been the case in some countries. Also, the discount factor of investors in the two markets may differ (endogenously).

Table 1. Summary of main stylized facts and main estimated coefficients

	HY corporate bonds	Emerging market bonds		*Diff. in means test, p-value*	
		All EM bonds	HY EM bonds	vs. all EMs	vs. HY EMs
Descriptive statistics					
Returns (yearly arithm. mean, in %)	8.23	7.31	8.48	0.81	0.95
Returns (monthly arithm. mean, in %)	0.69	0.65	0.80	0.86	0.62
Excess returns (yearly arithm. mean, in %)	3.56	2.93	4.14	0.91	0.92
Sharpe ratios (yearly arithm. mean)	0.22	0.30	0.34		
Realized default rates (yearly mean, in %)	4.10		2.70		0.14
Default duration (mean, in years)	1.31		2.02		0.00
Haircuts in percent (price-based, by bond)	61.5		61.6		0.93
Regression coefficients (dep. var.: monthly bond-level yield spreads)					
VIX (monthly)	0.19***	0.10***	0.14***	0.00	0.00
US industrial production (monthly real growth, %)	0.10***	0.05***	0.05***	0.00	0.00
US monetary policy shock (Bauer/Swanson)	3.32***	2.57***	3.14***	0.00	0.01
S&P total stock returns (monthly, in %)	-0.08***	-0.05***	-0.06***	0.00	0.00
Global commodity price index (oil & non-oil)	-0.01***	-0.02***	-0.02***	0.00	0.00

Note: This table summarizes our main results building on the data and findings in Sections 2-4 (upper part of the table) as well as the regression analysis in Section 5 (lower part of the table).

Related literature: To our knowledge, there is no systematic study comparing investor performance in high-risk US corporate (with well-established statutory debt restructuring mechanism) and high-risk sovereign bond markets. Recent years have seen an increase in research studying the properties of multiple asset classes simultaneously (e.g., Lettau et al. 2014, He et al. 2017, Haddad and Muir 2021), but this body of work has not paid particular attention to high-yield assets and default events. Another literature compares sovereign and corporate bond yields of the same country but does not take a global view and does not delve into defaults or investor returns (e.g., Bevilaqua et al., 2020; Jappelli et al., 2022; Gilchrist et al., 2022). The literature on corporate defaults seems less developed than that on sovereign defaults. For example, there is no standardized, granular dataset of corporate bond haircuts. There are also surprisingly few studies focusing on investor performance and default outcomes in the HY US corporate bond market. On a more general level, however, there is a notable shift in the literature towards using rich bond-level data, just like in this study (e.g., Bessembinder et al., 2009; Lin et al., 2011; Jostova et al., 2013; Bai et al., 2019). This paper adds to the literature by drilling into the HY US corporate markets and comparing it to the EM sovereign bond market in detail.

The paper proceeds as follows. Section 2 presents our newly compiled dataset of sovereign and corporate high-yield bonds. Section 3 compares risk and returns patterns in these two markets, while Section 4 focuses on investor experiences around corporate and sovereign default events and studies CDS-implied default probabilities. Section 5 adds a regression analysis on how sovereign and corporate bond returns and yields co-move with economic fundamentals and a set of global factors. Section 6 concludes.

2. Data preliminaries

2.1. Sample and data sources

To get a representative picture of both the US corporate and EM sovereign high-yield markets, we aimed at collecting the broadest sample of bonds possible. For each bond, we then collect basic bond characteristics such as coupon, maturity, currency etc. as well as monthly bond yields, bond yield spreads, total returns, bond prices, defaults and their details, as well as credit ratings. We start in July of 2002, because granular and representative pricing data on HY corporate bonds become available only when the Financial Industry Regulatory Authority (FINRA) introduced TRACE (Trace Reporting and Compliance Engine). We end in September of 2021, so we cover 18 full years of data (2003-2020).

For emerging markets, we build on the monthly bond-level dataset compiled by Meyer et al. (2022) which extends J.P. Morgan's Emerging Market Bond Index (EMBI) and covers 1,048 emerging market sovereign bonds issued by 81 countries with a total of 75,712 monthly pricing observations between 2002 and 2021 (all of them US dollar denominated). More specifically, we start by including all bonds that entered the broadest of the J.P. Morgan's EM sovereign index, the EMBIG, which includes foreign currency bonds with a minimum issue size of US$500 million and "easily accessible and verifiable daily price" (J.P. Morgan 1999). We then narrow the sample to government bonds issued in USD, meaning that we drop EMBIG bonds issued by public companies (such as large public banks) and sub-sovereign bonds guaranteed by the government. Furthermore, we exclude local-currency bonds, as well as a few dozen bonds in international currencies other than the USD or GBP, such as the French or Swiss franc. This leaves us with a more homogenous and comparable sample. Moreover, we carefully account for distress and default events, in two ways. First, we reduce attrition problems by keeping distressed bonds in the sample (J.P. Morgan effectively drops all bonds entering distress, leading to bias). Second, we carefully trace bonds in default; by

considering missed or partial coupon payments as well as nominal debt write downs (for details see Meyer et al. 2022). For sovereign ratings, we use S&P bond-level credit ratings from 2013 onwards and S&P country ratings for the period 2002 to 2012.

For US high-yield bonds we mainly draw on the WRDS Bond Database, which aims to cover bond prices and returns for the universe of all US corporate bonds traded in US markets from TRACE.

To classify bonds as "high-yield" (HY) we follow J.P. Morgan's definition, namely as bonds without an investment grade rating (J.P. Morgan 2013). This means that bonds with an S&P rating below BBB- and/or a Moody's rating below Baa3 are "high-yield" bonds, whereas those with better rating are included as "investment grade" bonds. Corporate bonds only appear in the J.P. Morgan data, and thus in our analysis, if they are HY bonds, no classification from our side is necessary. For sovereign EM bonds, we create own buckets of HY and IG bonds using the monthly ratings of each bond as key criterion. Tables A1 and A2 in the Appendix shows summary statistics on the corporate and sovereign bonds included.

For bond and issuer characteristics, including bankruptcy details and ratings, we use the Mergent Fixed Income Securities Database (FISD). We also fill in data coverage gaps using J.P. Morgan data (from morganmarkets), which is important for periods of corporate distress, when WDRS data is often missing. More specifically, WRDS bond prices typically end in the month of default, but by adding J.P. Morgan data we could gather post-default prices, yields, and returns for about 70% of all HY corporate default events. Just like for sovereign bonds, we thus trace each corporate bond over its lifetime, including in periods of distress. The resulting sample includes 6,763 high-yield US corporate bonds issued by 2,223 unique firms with a total of 294,600 monthly pricing observations between 2002 and 2021.

To make the corporate and sovereign datasets comparable, we create a sample of HY corporate bonds that closely follows the eligibility and inclusion criteria that J.P. Morgan uses for both the EMBI and its J.P. Morgan Domestic High-Yield index (J.P. Morgan, 2013). Both indices are widely used as benchmarks of EM bonds and US high-yield corporate bonds, respectively. In the analysis of returns and yields, we drop stark outliers, such as the upper and lower 0.5% of bond returns. Relatedly, in the regression analysis on yield spread determinants, we exclude corporate and sovereign bonds that are in default.

Figure 1. The US corporate bond market – amounts outstanding

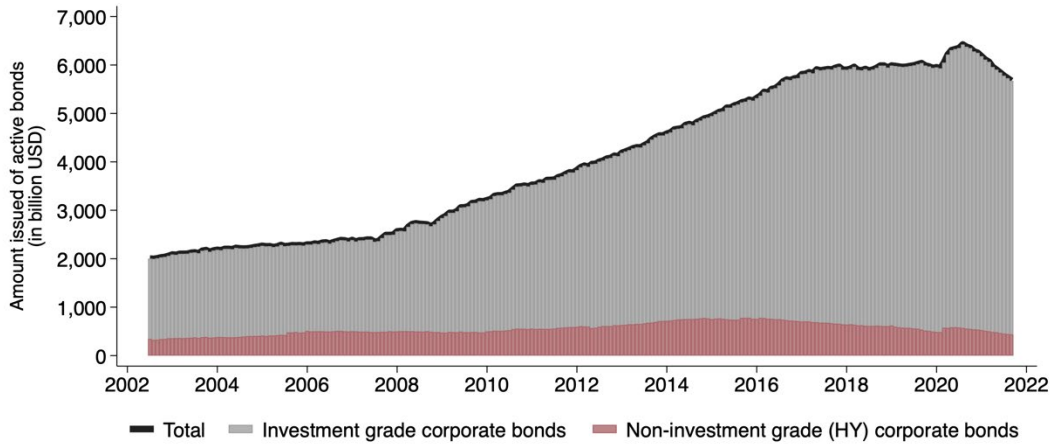


Figure 2. EM sovereign USD bonds – amounts outstanding

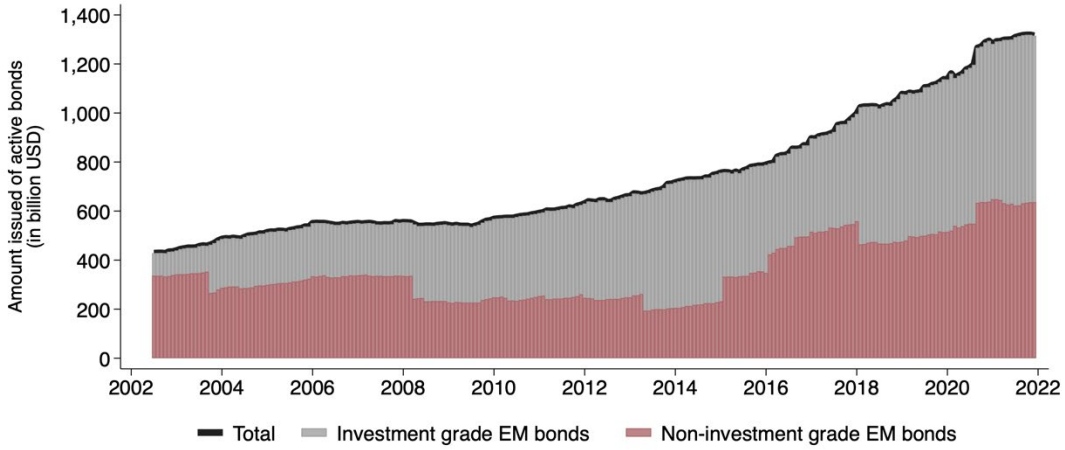
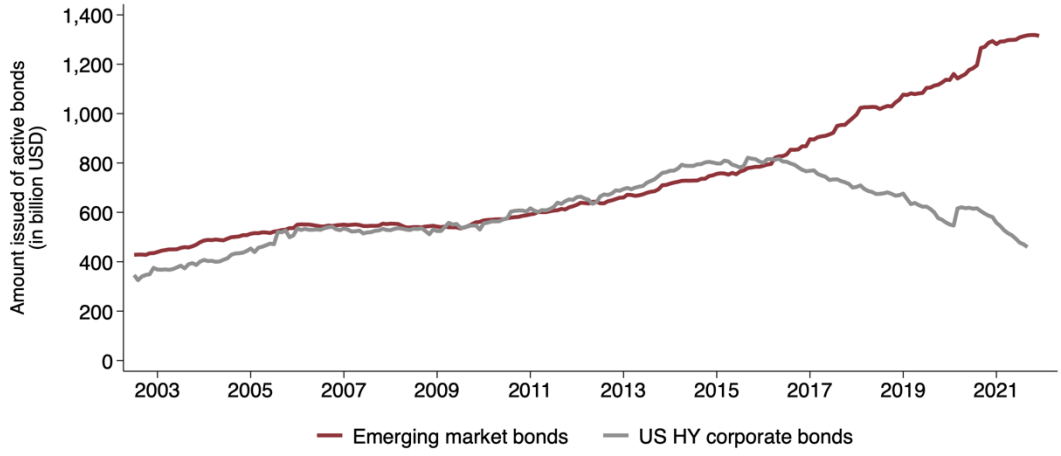


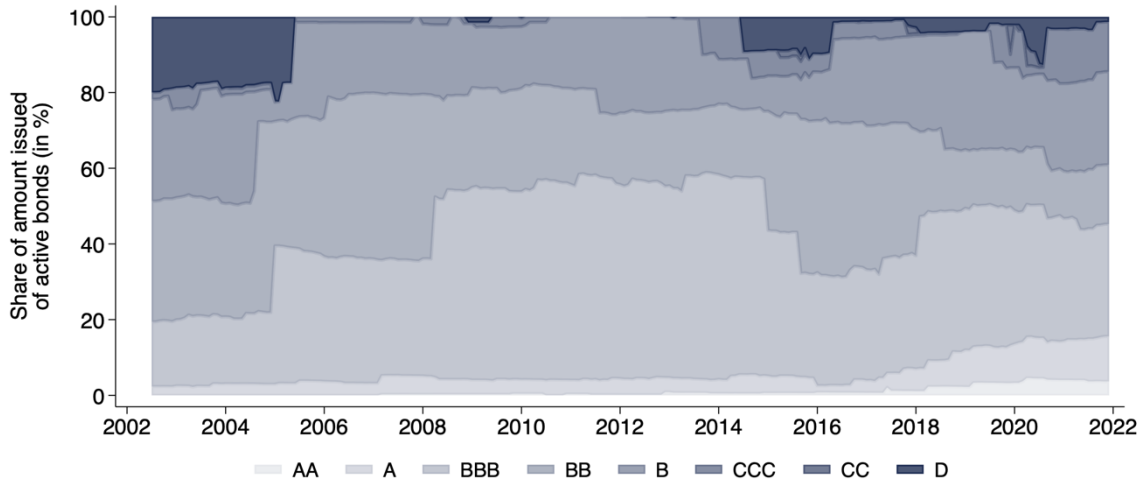
Figure 3. Comparing market size: corporate vs. EM high-yield bonds



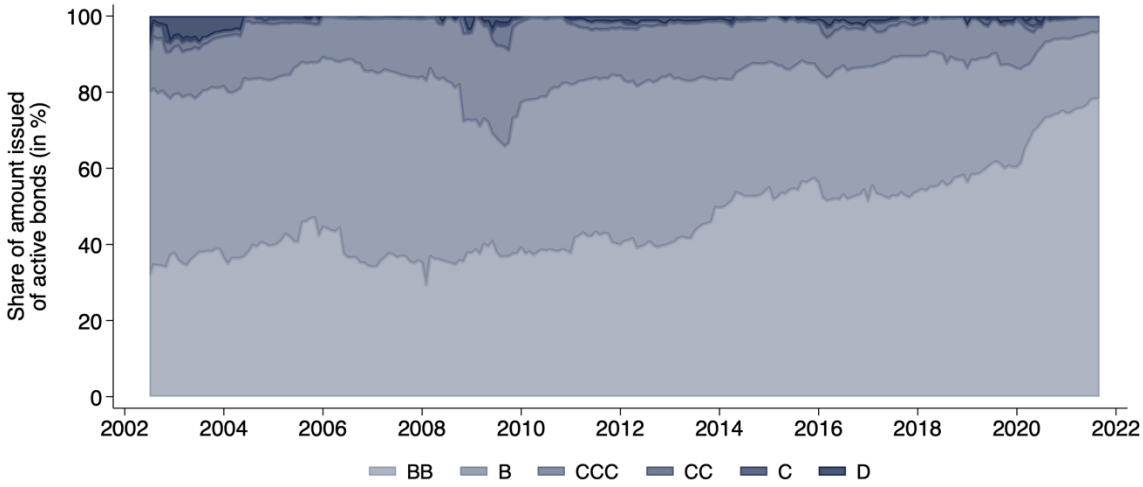
Figures 1-3 and Table 2 provide an overview of the resulting samples of 6,763 corporate HY and 1,048 sovereign EM bonds. Figure 1 shows the total size of the US corporate bond market, and the smaller market segment of "junk bonds" with a below-investment grade rating, a market that has been shrinking in recent years. The analogous Figure 2 shows that the EM external sovereign bond market has grown substantially over the past 20 years, with half of the market having below-investment-grade bonds. Lastly, Figure 3 compares outstanding debt amounts of the two markets. Until 2015 bond amounts outstanding are similar in size, since then, however, the EM sovereign bond markets has continued to grow, while the size of the US corporate "junk bond" market has declined notably (see also Appendix A1).

Figure 4. Credit ratings over time

(a) EM sovereign bonds



(b) High-yield US corporate bonds



Note: The two figures show the composition of active bonds in the EM bond and HY US corporate bond markets, using S&P credit ratings and weighting bonds by amount issued.

Figure 4 tracks the average credit risk in both high-yield markets, based on S&P ratings. As can be seen, both markets have become less "junky" over time. For corporates, the share of BB bonds increased from about 40% in 2008 to about 60% more recently. For EM sovereigns in the EMBIG, we observe a small but growing share of AA and A rated bonds, which went from zero in the mid-2010s to about 10% recently.

Table 2. Bond characteristics: summary statistics

	Mean	Median	SD	Min	Max
Bond size in m USD					
Corporate HY	465	325	441	75	5,401
EMs	2,000	1,500	2,319	135	21,218
Coupon rate in %					
Corporate HY	7.8	7.6	2.1	0.0	15.5
EMs	6.8	6.8	2.4	0.0	14.5
Time to maturity (years)					
Corporate HY	7.2	5.8	6.9	1.1	99.8
EMs	11.5	8.3	9.8	1.1	100.2
Credit rating (S&P, numeric)					
Corporate HY	9	9	2	1	12
EMs	11	11	4	1	20

2.2 Measuring bond returns and yields

The monthly total bond returns $R_{i,j,m}$ of country, or firm j in month m can be defined as follows:

$$R_{i,j,m}=\frac{P_{i,j,m}+C_{i,j,m}}{P_{i,j,m-1}}-1 \quad (1)$$

where $P_{i,j,m}$ is the price of bond i of country, or firm j in month m and $C_{i,j,m}$ are coupon payments. As is standard practice, coupon payments are considered as accrued interest, meaning that they are equally distributed over the coupon payment period.

Based on Equation (1), we calculate portfolio returns (e.g., to average returns by firm or country) by weighing monthly returns across bonds *i* in month *m*:

$$R_m^{Portfolio}=\sum_{i=1}^{N} R_{i,j,m} * \frac{w_{i,j,m}}{\sum_{i=t}^{N} w_{i,j,m}} \quad (2)$$

where $w_{i,j,m}$ denotes the amount issued of bond i. Furthermore, we use yearly aggregate returns that can be defined as follows:

$$R_{yearly}^{Portfolio} = \prod_{m=1}^{12}\left(1 + R_m^{Portfolio}\right) - 1 \tag{3}$$

As a baseline, we use pre-calculated return series of bonds as reported by the above-mentioned databases.

In the second part of this paper, we also use monthly yield-to-maturity (YTM) series, which is typically defined as follows.

$$YTM_{i.j.m} = \frac{C_{i.j.m} + \frac{FV_{i,j} - Price_{i.j.m}}{n_{i.j.m}}}{\frac{FV_{i,j} + Price_{i.j.m}}{2}} \tag{4}$$

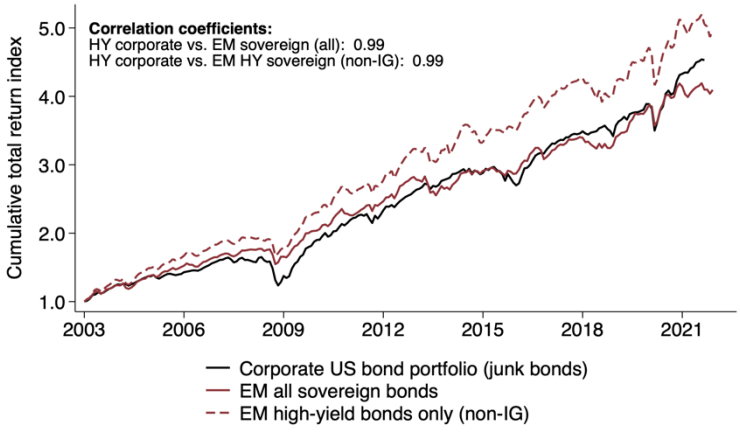
Where $C_{i,j,m}$ are coupon payments of bond i of country or firm j in month m, $FV_{i,j}$ is the face value (principal) of the underlying bond, $Price_{i.j.m}$ is the market price and $n_{i.j.m}$ are the years to maturity of bond i.

3. Comparing risks and returns

3.1. Total returns

This section uses the time series of total returns that we created for both high-yield sovereign and corporate bonds, building on Equation (1).

Figure 5. Cumulative total bond return indices – corporates vs. sovereigns



Note: We weight nominal returns by the market capitalization of bonds (the product of amount issued/offered and price at t−1). January 2003 is the starting date.

Figure 5 compares the resulting cumulative total return indices. Both series co-move strongly, with a correlation coefficient of 0.99.

Table 3 reports summary statistics for the HY corporate bond and the EM sovereign bond portfolio. Annual average EMBIG bond returns across 2003 to 2020 (arithmetic mean) are roughly equal to the returns on HY corporate bonds. If we take out investment-grade EM bonds and focus on the high-yield bond samples only, then the average return on sovereign bonds is about one percentage point higher than on the corporate bonds, on average. However, the differences are not statistically significant throughout.

Table 3. Summary statistics HY corporate & EM bond portfolio total returns, 2003-2020

	Arithm. mean	Median	Min	Max	SD	Skew.	Geom. mean	*Difference in means, p-value of t-test*
Yearly returns								
Corporate HY returns	8.23	7.12	-21.00	45.24	13.24	0.67	7.05	
EM sov. bond returns	7.31	8.72	-5.44	22.75	7.65	-0.15	7.48	0.81
EM Investment grade	6.84	8.91	-7.58	16.56	6.71	-0.58	6.64	0.70
EM High-Yield (non-IG)	8.48	10.07	-11.76	33.13	10.52	0.24	8.00	0.95
Yearly excess returns								
Corporate HY returns	3.56	3.23	-35.67	58.65	18.78	1.02	2.37	
EM sov. bond returns	2.93	3.72	-22.13	34.84	11.15	0.66	2.02	0.91
EM Investment grade	2.43	2.11	-18.82	28.21	9.24	0.55	2.05	0.83
EM High-Yield (non-IG)	4.14	6.79	-27.48	45.97	15.14	0.54	3.11	0.92
Monthly returns								
Corporate HY returns	0.69	0.83	-11.75	7.90	2.11	-1.16	0.64	
EM sov. bond returns	0.65	0.76	-8.36	5.32	1.92	-0.98	0.67	0.86
EM Investment grade	0.58	0.68	-8.00	7.16	1.88	-0.81	0.20	0.56
EM High-Yield (non-IG)	0.80	0.97	-9.60	8.89	2.47	-0.74	0.39	0.62
Monthly excess returns								
Corporate HY returns	0.33	0.48	-15.63	11.46	3.26	-0.73	0.27	
EM sov. bond returns	0.30	0.51	-11.45	7.54	2.36	-0.89	0.28	0.91
EM Investment grade	0.22	0.33	-10.54	7.02	2.05	-1.06	0.20	0.68
EM High-Yield (non-IG)	0.44	0.75	-13.74	9.06	3.26	-0.70	0.39	0.72

Note: All returns reported in nominal terms. To compute excess returns, we use as benchmark the Refinitiv US 10-year government total return index. Excess return is the difference between the monthly portfolio return and the 10-Treasury bond return. Bond-specific credit ratings for EMBIG bonds are available from 2013 onwards and we use S&P country ratings before that. We start in 2003 because we show yearly average returns (12 full months of data needed).

Table 4 shows excess returns for different rating categories. For lower rating categories, we see higher excess returns for the EMBIG bond portfolio in comparison to the HY corporate bonds sample. This is also true if we zoom into distress or default episodes, during which sovereign yields increase more sharply. However, the differences are not significantly different, except for very low rating classes where the number of observations is very small and prices noisy (last column).

Table 4. Monthly excess bond portfolio returns by credit rating, 2003-2020

	EM sovereign bonds					HY corporate bonds					*Difference in means, p-value of t-test*
	Mean	Median	SD	Min	Max	Mean	Median	SD	Min	Max	
Investment grade ratings											
AA-	0.01	0.06	2.24	-11.6	5.65						
A+	0.14	0.24	1.56	-6.76	4.48						
A	0.02	0.03	1.99	-7.37	8.76						
A-	0.10	0.15	1.78	-6.26	5.41						
BBB+	0.11	0.17	1.99	-10.83	5.93						
BBB	0.25	0.16	2.06	-8.96	9.90						
BBB-	0.26	0.45	2.06	-7.40	6.53						
Non-Investment grade ratings											
BB+	0.55	0.53	2.38	-6.07	10.99	0.29	0.35	2.96	-13.33	12.35	0.34
BB	0.25	0.35	2.35	-9.10	9.55	0.25	0.23	2.66	-11.83	11.48	0.99
BB-	0.41	0.49	2.81	-9.91	10.59	0.29	0.36	2.92	-14.98	13.23	0.68
B+	0.65	0.51	3.87	-12.65	19.20	0.31	0.35	3.08	-13.18	13.12	0.33
B	0.29	0.43	3.59	-15.38	13.78	0.35	0.38	3.36	-14.85	12.64	0.87
B-	0.29	0.75	3.62	-11.27	13.13	0.42	0.53	3.46	-15.75	13.21	0.71
CCC+	1.16	1.60	5.67	-15.04	15.53	0.32	0.53	4.15	-24.55	12.86	0.14
CCC	0.86	1.52	7.56	-15.23	15.91	0.15	0.35	5.28	-24.89	18.88	0.44
CCC-	-3.12	-2.24	8.21	-17.36	11.84	0.62	0.68	5.90	-21.15	15.81	0.01
CC	6.06	6.86	8.73	-9.82	17.34	0.61	1.06	6.38	-23.56	22.58	0.01
C						0.07	0.51	8.95	-25.79	24.87	
D	1.59	1.01	4.67	-8.47	14.19	-2.22	-1.51	9.93	-29.38	25.92	0.00

Note: All returns reported in nominal terms. To compute excess returns, we use the Refinitiv US 10-year government total return index as benchmark, so that excess return is the difference between the monthly portfolio return and the 10-Treasury bond return. Bond-specific credit ratings for EMBIG bonds are available only from 2013 onwards and we use S&P country ratings before that. We start in 2003 because we show yearly average returns (12 full months of data needed).

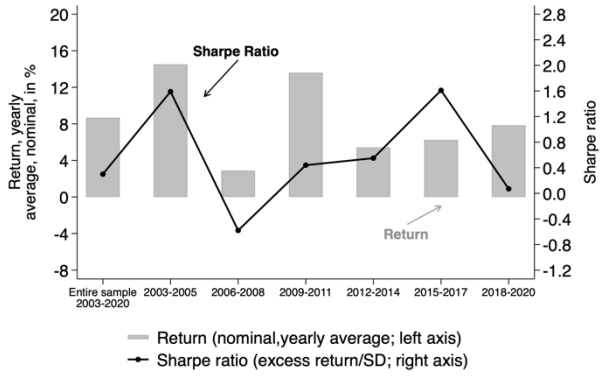
3.2. Volatility and Sharpe ratios

Figure 6 compares the Sharpe ratios for the HY corporate and EM sovereign bond portfolio for the full sample as well as for different sub-periods. The Sharpe ratios for EM sovereign

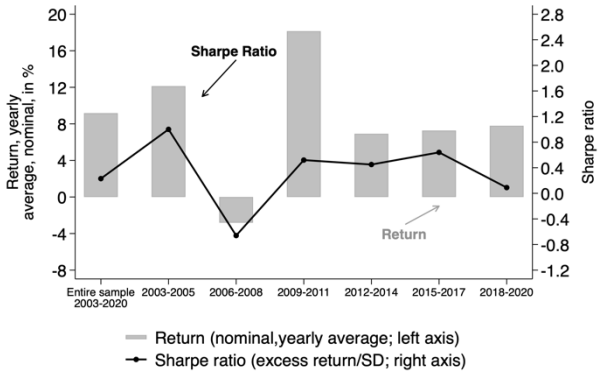
bonds and high-yield corporate bonds are broadly similar (Panels a and b), except for the sub-periods with financial and sovereign crises (2006-2008 and 2009-2011). Overall, the Sharpe ratios across asset groups are not statistically different. This is true both for the full sample and when controlling for rating categories. For the latter, we compute annual Sharpe ratios for each bond and group them into portfolios by rating category (for all EM bonds and for high-yield EM bonds only). We then ran difference-in-means tests against corporate bonds within each of the rating buckets, similar to the exercise in Table 4. The resulting coefficients were often insignificant and did not provide a conclusive picture, as the Sharpe ratios were higher in some rating buckets and lower in others.

Figure 6. Sharpe ratios

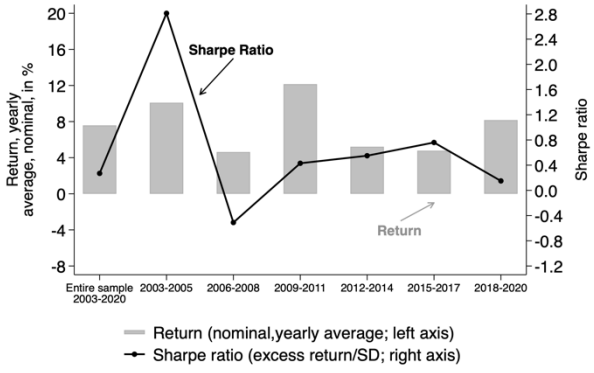
(a) EM sovereign bond Sharpe ratios



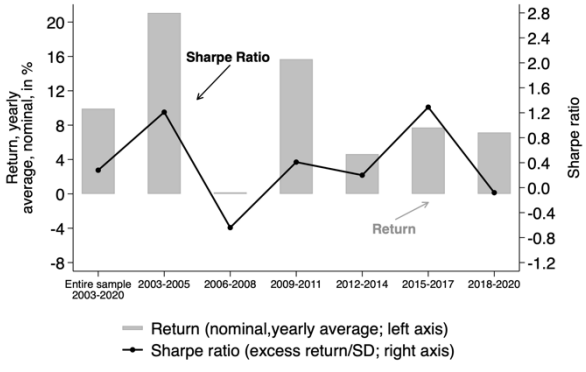
(b) HY corporate bond Sharpe ratios



(c) EM IG bond Sharpe ratios



(d) HY EM bond Sharpe ratios



4. Comparing default risk and recovery

This section tracks the performance of corporate and sovereign high-yield bonds in and around default. For our comparisons, we include default spells starting during the sample period (March 2002 to September 2021). The one exception is Argentina's 2001 default, which started in November 2001 and is also included because it was a major default that occurred just 4 months before our sample starts (in March 2002, WDRS starts to provide representative data on corporate bonds, which is the basis for our benchmarking analysis).

4.1. Default rates

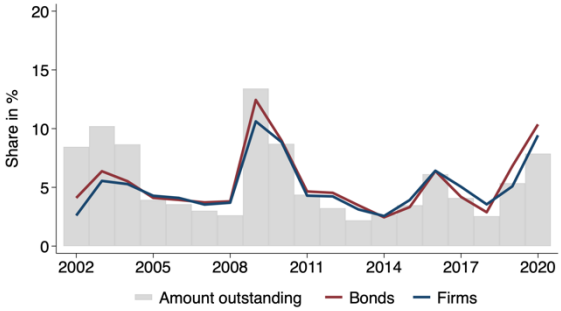
We first examine realized default rates for both markets by calculating the ratio of the sum of the face value of defaulted bonds to the face value of all active bonds:

$$Default\ rate_t = \frac{Defaulted\ bonds_t}{Outstanding\ bonds_t} \tag{5}$$

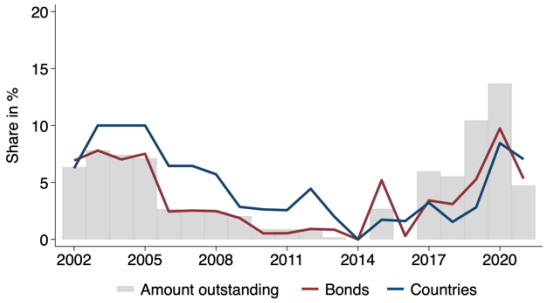
Figure 4 shows that the EMBIG default rate reached a new high in 2020, covering a total of six sovereign defaults (Argentina, Belize, Ecuador, Lebanon, Suriname, Zambia). Table 5 then shows averages default rates at annual frequency. Overall, the default rates in the two markets are broadly comparable.

Figure 7. Bond default rates over time, 2002-2021

(a) HY corporates default rates



(b) EM default rates



Note: The sovereign default sample includes the following cases: Argentina (2001, 2017, 2020), Belize (2012, 2020) Cot d'Ivoire (2000, 2010), Dominican Republic (2004), Ecuador (2006,2020), Lebanon (2020), Russia (1998), Suriname (2020), Ukraine (1998, 2015), Uruguay (2003), Venezuela (2017), Zambia (2020). We do not include the external defaults of Antigua and Barbuda (2009), Barbados (2018), Chad (2014), Rep. of Congo (2016), Dominica (2003), Gabon (1999), Greece (2011), Indonesia (1998), Mali (2012), Moldova (1998), Solomon Islands (1998), St. Kitts and Nevis (2011), Tajikistan (2010), Zimbabwe (1999). The reason is that the EMBIG does not include external bonds of these countries (or drops in the years around default). The default events come from Meyer et al. (2022), Farah-Yacoub et al. (2020), Asonuma and Trebesch (2016), Cruces and Trebesch (2013).

Table 5. Average yearly bond default rate, 2002-2021, in %

	Mean	Median	Min	Max	SD	Skewness
EM sovereign default rates						
Bond issue-weighted	2.3	1.5	0	9.7	2.7	1.0
Country-weighted	3.1	2.4	0	10.0	3.1	0.7
Amounts-weighted	2.7	0.9	0	13.7	3.3	1.2
US HY corporate default rates						
Bond issue-weighted	4.2	3.7	1.1	12.4	2.1	1.5
Firm-weighted	4.0	3.5	0.8	10.6	1.9	1.7
Amounts-weighted	4.1	3.1	1.0	13.4	2.6	1.3

Note: See Figure 7 for sovereign default events included.

Notably, there are no multiple defaults in the HY corporate bond markets. However, we identify three countries (Belize, Cote d'Ivoire, Ecuador) that default at least twice in our sample period 2002-2021 (Belize 2012, 2016, and 2020, Cote d'Ivoire 2000, and 2010, and Ecuador 2006, 2008, and 2020). "Serial defaults" are a distinguishing feature of sovereign debt markets.

4.3. CDS implied default risk

In this section, we follow Longstaff et al. (2011) to compute risk-neutral default probabilities as implied by CDS data and compare the estimated default probabilities with realized default rates, for both corporate and sovereign bonds. For sovereigns, the analysis is based on a subsample because CDS data are available for only 34 out of 81 countries included in our main analysis (sovereign bonds that have been part of the EMBIG index at some point in time).

Longstaff et al. (2011) build on the Pan and Singleton (2008) model and show that, under the assumption of risk-neutral investors as well as for newly written, at-market CDS contracts, the CDS premium $CDS_{t,i}$ is approximately equal to $\lambda_{t,i}(1 - R^i)$, where $\lambda_{t,i}$ is the risk-neutral credit-event intensity of entity *i* (firm or sovereign) at time *t* and R^i is the risk-neutral recovery rate[2], so that $1 - R^i$ is the risk-neutral loss rate (or "haircut").

[2] More specifically, Longstaff et al. (2011, p. 90) write that R^Q is the "constant risk-neutral fractional recovery of face value on the underlying cheapest to deliver bond if there is a relevant credit event".

We can thus write:

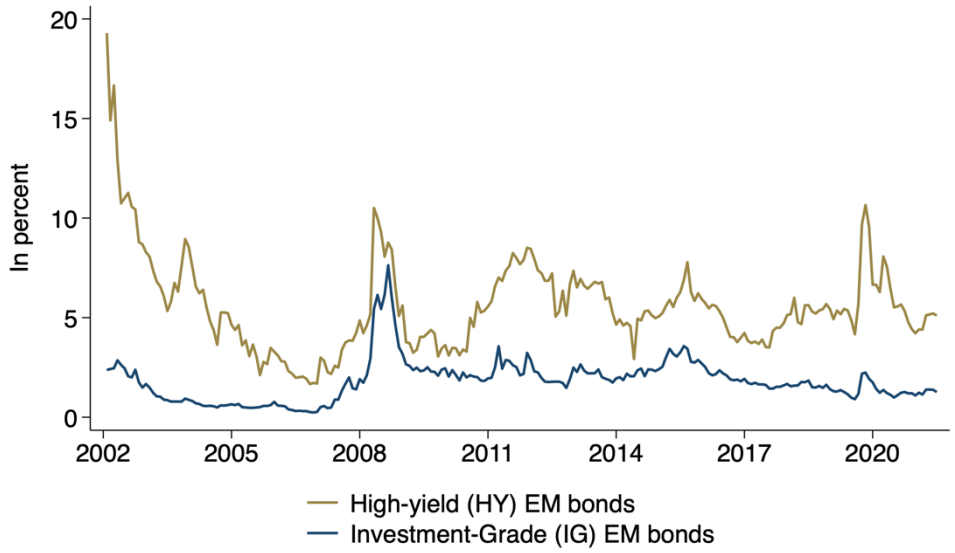
$$CDS_{t,i} = \lambda_{t,i} * (1 - R^i) \quad (6)$$
$$\lambda_{ti} = \frac{CDS_{t,i}}{1 - R^i}$$

To measure $CDS_{t,i}$ we use country- level CDS premia for sovereign bonds (sovereign CDS) as well as CDS premia by industry to approximate default risk for the high-yield corporate bonds in our sample (industry-sector CDS). CDS data at the level of individual bonds were only available for a small sub-sample of bonds and not sufficient to conduct a systematic analysis. The data source for the CDS time series is J.P. Morgan (morganmarkets.com). Table A1 and A2 in the Appendix shows the coverage and descriptive statistics for sovereign CDS and corporate sector CDS, respectively.

To approximate R^i we follow Longstaff et al. (2011) and Pan and Singleton (2008) and assume constant rather than time-varying recovery rates. Unlike them, however, our baseline approach is not to assume a fixed, across-the-board recovery rate of 0.25. Instead, we compute country-specific and industry-specific recovery rates using the approach discussed in Section 4.5 below. Specifically, we use bond prices at default (30 days post-default) as a proxy for recovery rates and then compute sector- or sovereign-level averages, (average price-implied recovery rates across all default events by sector or by sovereign in our sample 06/2002 to 12/2021). As an alternative, we also compute λ_{ti} using the 0.25 across-the-board recovery rate assumed by Longstaff et al. (2011). The results are shown in compact form in Appendix A2.

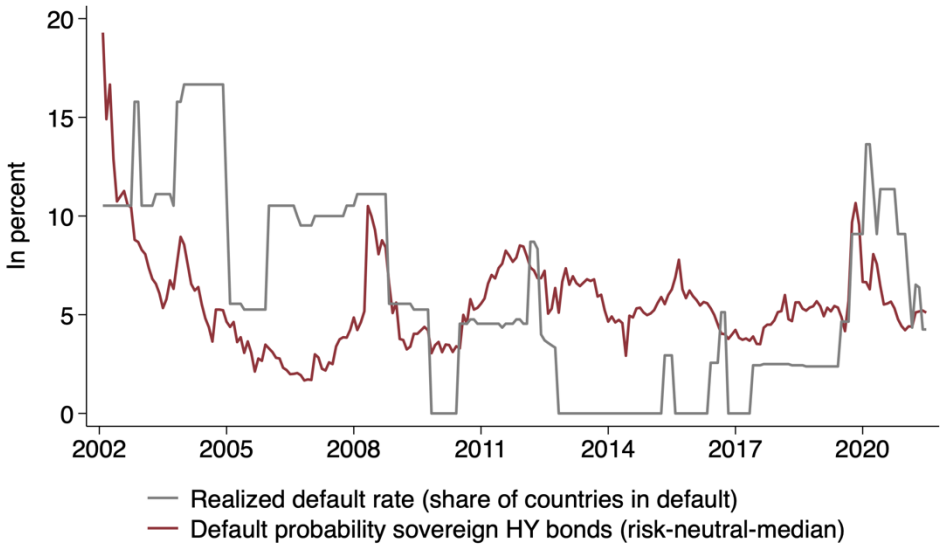
We start by focusing on sovereign default risk. Figure 8 shows the estimated risk-neutral default probabilities for two sovereign CDS samples: sovereigns with investment grade rating (IG sovereigns, blue line) and those without (HY sovereigns, brown line). To create this figure, we first compute risk-neutral default probabilities on a country level and then take the unweighted median in each of the two groups. The estimated default risk is substantially higher for HY sovereigns than for IG sovereigns, with peaks in 2001/02, around Argentina's default, as well as during the financial crisis of 2008-09 and the Covid-19 shock of 2020. In fact, as stated above, no sovereign bond rated as IG has defaulted in our sample period.

Figure 8. Estimated default probability: high-yield vs. investment-grade sovereigns



Note: This figure shows the median risk-neutral default probability for sovereigns with and without investment grade rating (HY = BBB/Ba3 or lower). We first compute the risk-neutral default probabilities on a country level based on Equation (6) and then take the unweighted median thereafter.

Figure 9. Sovereign high-yield bonds: realized default rates vs. default probabilities

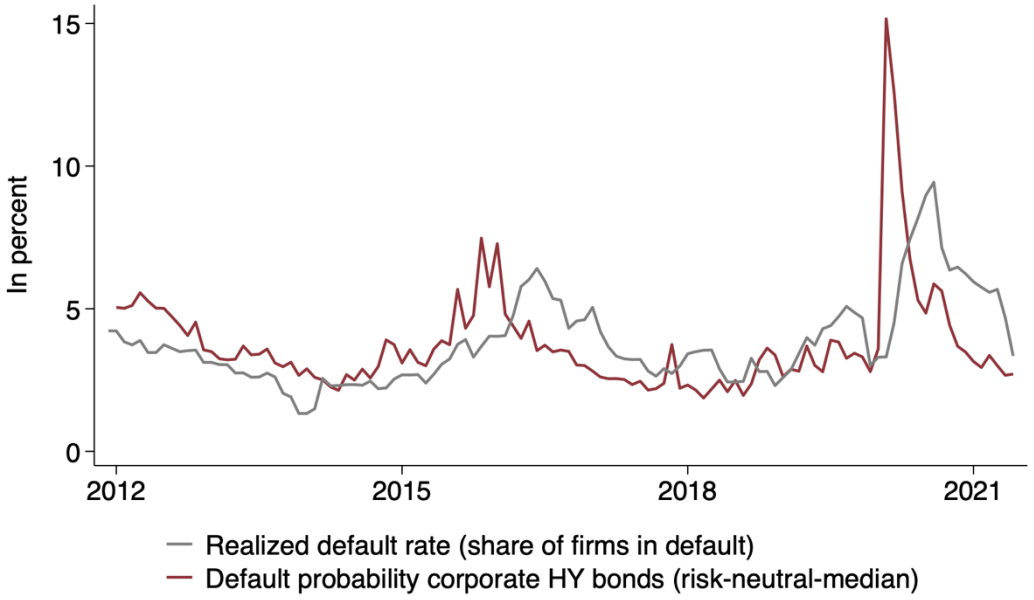


Note: This figure compares the CDS-implied default risk with realized default rates for HY sovereigns. The red line captures the median risk-neutral default probability, as in Figure 8 above and for countries with CDS data. The gray line shows the share of countries in default at each point time in the full sample (rating of BBB/Ba3 or lower). Countries are equally weighted.

Figure 9 compares our estimated default probabilities with the realized default rates, focusing on the HY sovereign sample. Default rates are measured as percent of countries in default

across all high-yield sovereigns for which we have data. As can be seen, the CDS-implied default probabilities correlate with the realized default rates over the sample period.

Figure 10. Corporate high-yield bonds: realized default rates vs. default probabilities



Note: This figure compares the CDS-implied default risk with realized default rates for HY corporates. The red line captures the median risk-neutral default probability, derived from an off-the shelf J.P. Morgan CDS series for high-yield corporate bonds. The gray line shows the share of firms in default at each point in time. Firms are equally weighted.

In Figure 10 we compare the CDS-implied default probabilities with the realized default rates for HY corporate bonds. Default rates are measured as percent of HY corporates in default over time, using the full sample of firms. For this exercise we use CDS data available at a sectoral level and match firms using the industry codes in the Wharton Corporate Bond Database. As can be seen, we find that the market-implied default risk correlate closely with average default rates in this market, again with a lag.

Table 6 combines the estimated default probabilities for HY corporates and HY sovereigns in more detail. For each of the two asset classes, we group the observations by rating category. As can be seen, there is considerable heterogeneity across rating levels. For rating categories B and BB, default probabilities are significantly higher for corporates, while this is no longer the case for lower ratings. In the lowest rating category for which we have data for both markets (CCC), default probabilities look similar for corporate and sovereigns. Note, however, that in both tables the samples in the lower rating categories become very small, making it difficult to draw strong conclusions.

Table 6. Default risk by credit rating category – sovereign vs. corporate bonds, 2012-2020

	EM sovereign bonds					HY corporate bonds					
	Country-level yield spreads		CDS-implied default probability			Bond yield spreads		CDS-implied default probability			*Difference in means, p-value*
	Mean	Median	Mean	Median	SD	Mean	Median	Mean	Median	SD	
Investment grade											
AA	1.4	1.3	0.9	0.8	0.4						
A	1.2	0.9	0.8	0.6	0.6						
BBB	1.8	1.6	2.7	1.2	5.8						
Non-investment grade (HY) ratings											
BB	3.2	2.5	3.4	2.1	5.9	4.2	4.0	41.3	36.0	27.6	0.00
B	15.7	4.5	24.5	5.2	94.3	6.0	5.4	45.4	35.6	50.0	0.00
CCC	19.2	17.5	41.7	23.8	56.1	17.7	11.0	60.1	48.5	39.1	0.80
CC	46.8	44.0	614.8	227.2	729.1						

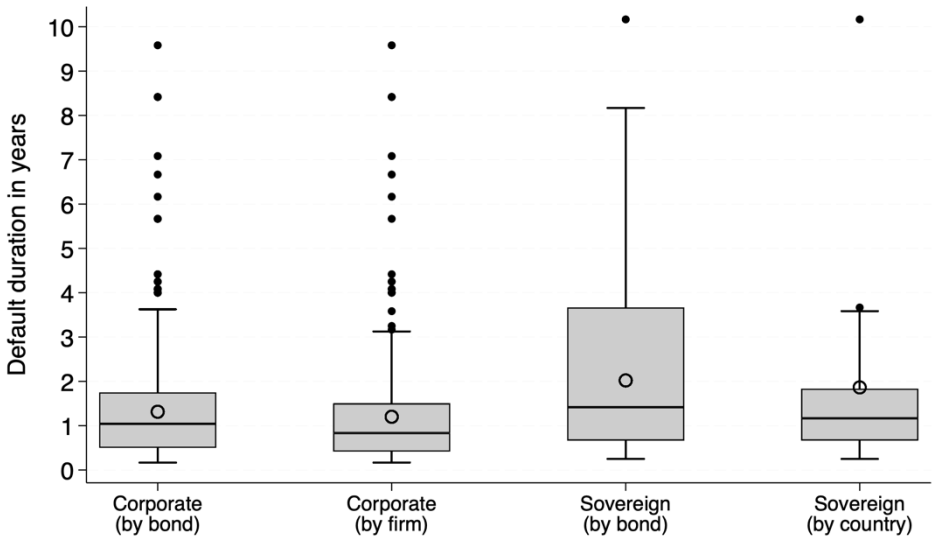
Note: We drop the C and D categories due to a low number of observations. We also drop outlier cases with CDS spreads higher than 2000 basis points. For the US high-yield corporate bonds we match sectoral CDS data that become available after 2012 only. For EMs we use CDS data on the country level for 34 sovereigns. In both samples we estimate CDS-implied default probabilities based on Equation (6).

4.4. Default duration

Figure 11 compares default duration for HY corporate bonds/issuer and sovereign bonds/issuer defaults. We follow Asonuma and Trebesch (2016) and measure default duration as the time between the start of distress (missed payments or announced restructuring) and the finalization of the restructuring. More precisely, we define the start of a default/restructuring process as the month of first missed payments and/or the month in which a distressed restructuring is announced. Following standard practice by S&P and Moody's we define distressed restructurings as those with an exchange of bonds at less favorable terms than the original bond (typically involving a loss to investors). The spell ends with a final restructuring agreement and/or the implementation of the debt exchange.

The average default duration is longer for sovereigns (2.0 years) in comparison to HY corporate bond defaults (1.3 years). However, the median duration is almost the same at around 1 year, respectively (see Figure 11 below). Indeed, the difference in means is mainly driven by three cases with messy defaults in politically unstable countries: Cote d'Ivoire (2000), Argentina (2001) and Venezuela (2017).

Figure 11. Default duration in years – corporates vs. sovereigns



4.5. "Haircuts" (investor losses)

To measure investor losses or "haircuts," we follow the standard approach in the finance literature and by rating agencies such as Moody's (2011) and use bond prices shortly after the start of default as a proxy for loss-given-default (e.g., Jankowitsch et al. 2014). Specifically, we use market bid prices 30 days after the default date. This approach differs from the one proposed by Sturzenegger and Zettelmeyer (2006) and Cruces and Trebesch (2013) who estimate losses for foreign debt investors by comparing the net present value of the old, defaulted bonds to that of the newly issued bonds in a debt exchange, measured at the exit form default (for a discussion see Meyer et al. 2022).

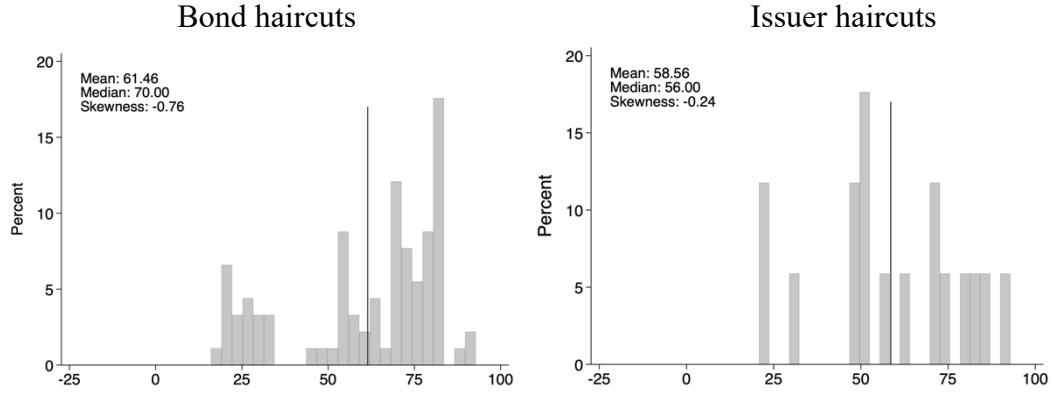
The reason we use market prices rather than net present value haircut estimates is simple. There is no reliable or representative dataset on restructurings and haircuts for corporate bonds that could be used for comparative purposes. In fact, it is surprising that the literature on sovereign debt is much more advanced when it comes to estimating investor losses than the literature on corporate debt. We therefore resort to prices as the market's estimate of the expected recovery rate.

Also note that, in this sub-section, we focus entirely on high-yield sovereign EM bonds and drop the better rated (IG) sovereigns. The reason is that no sovereign with an IG rating ever defaulted in our 20-year sample. All defaulted EM bonds had a low initial rating at issuance (at best BB, most were lower) and their ratings further declined as they approach default.

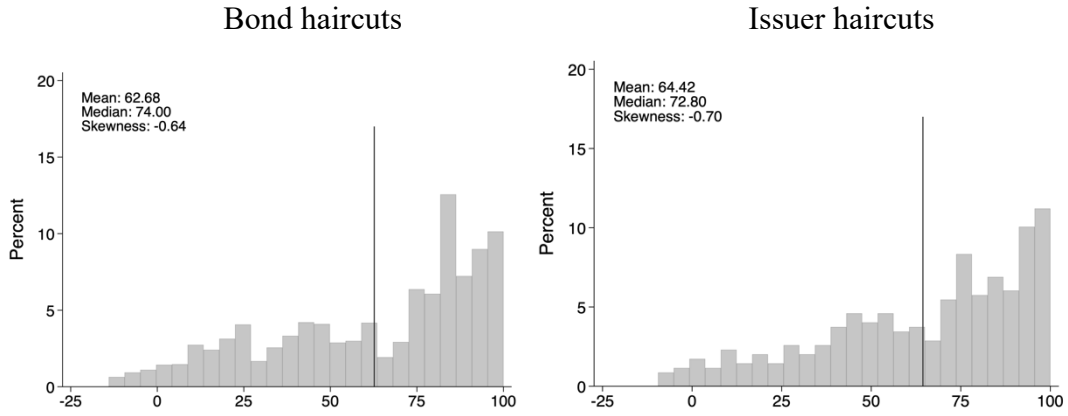
Figure 12 shows the distribution of price-based haircuts, differentiating between bond-level averages (haircuts across individual bonds in the sample) and averages when aggregating haircuts by default events (haircuts for each firm or country default spell). To compute country-default or firm-default haircuts, we use bond amounts outstanding as weights.

Figure 12. Distribution of price-based haircuts

(a) EM sovereign HY sample



(b) Corporate HY sample



For HY corporate bond default events we find average price-based haircuts of 62 percent. This is in line with a Moody's (2011) report on corporate defaults which finds average haircuts between 64 to 70 percent for the years 1982 to 2010. It is also notable that the average price based haircut on corporate bonds is almost the same of that on sovereign EM bonds in this sample (both stand at 62%).

In Appendix A3 we make a systematic comparison across haircut measurement approaches. The main take away is that NPV haircuts are highly correlated with the price-based haircuts we use here. The correlation is less tight when using prices at default (our baseline, following Moody's), but very close when using prices pre-restructuring. The closer correlation at

restructuring is intuitive because NPV haircuts are also computed at the restructuring date, so there is less of a time lag between the measures. Indeed, it is no surprise that investors price in the expected NPV haircut of the restructuring just before it is implemented.

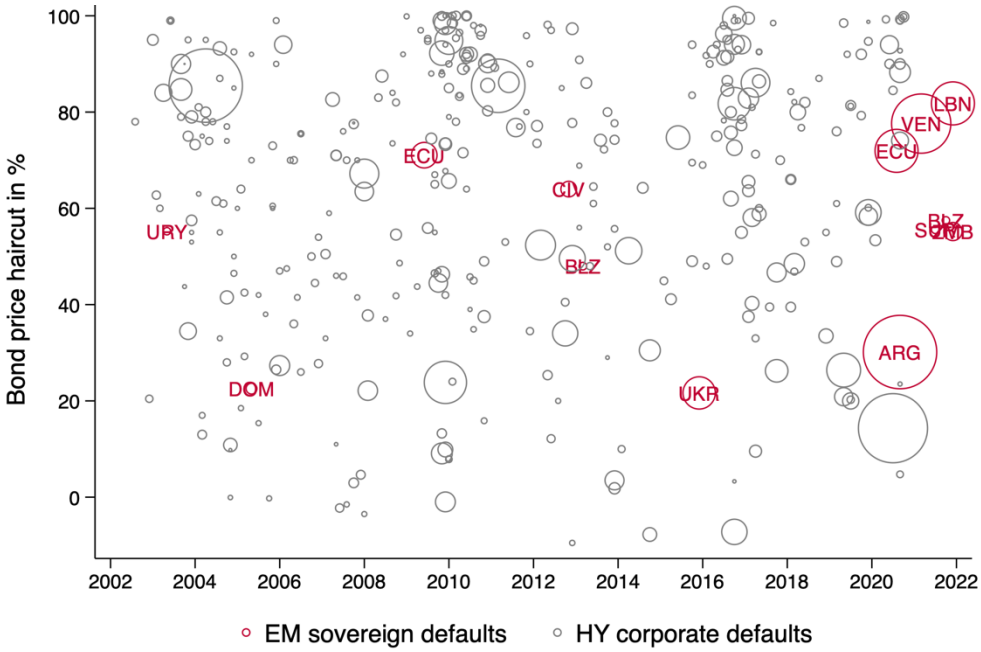
Table 7. Summary statistics of bond price-based haircuts

	No Bonds/ deals	Mean	Median	Min	Max	SD	Skewness
By bonds							
EM sovereign HY (unweighted)	91	62.2	73.0	15.8	94.0	24.2	-0.8
HY corporates (unweighted)	673	62.5	73.5	-14.0	100.0	30.6	-0.6
EM sovereign HY (face value-weighted)	91	61.6	73.0	15.8	94.0	27.3	-0.8
HY corporates (face value-weighted)	673	61.5	74.0	-14.0	100.0	31.3	-0.6
By country/firm							
EM sovereign HY (unweighted)	17	58.6	56.0	20.8	92.8	21.4	-0.2
HY corporates (unweighted)	348	64.4	72.8	-9.5	100.0	28.5	-0.7
EM sovereign HY (face value-weighted)	17	62.2	72.0	20.8	92.8	27.7	-0.2
HY corporates (face value-weighted)	348	61.0	73.3	-9.5	100.0	30.7	-0.7

Note: See Figure 7 for the list of sovereign default events included.

Figure 13 shows price-based haircuts computed for each issuer-default event. The size of the circles represents the default amounts in current US Dollars. The recent defaults on external bonds by Lebanon, Venezuela and Ecuador were the largest defaults for the sovereign bond sample. In the HY corporate sample, Worldcom (2002), Intermedia Communication (2002), General Motors (2009), Citigroup (2009), and Pacific Gas and Electric Company (2019), were the largest defaults in terms of debt volumes affected.

Figure 13. Price-based haircuts by country/firm default events



Note: The circles represent bond amounts outstanding in current USD at the time of default. The Figure shows only defaults starting during the sample period (March 2002 to September 2021).

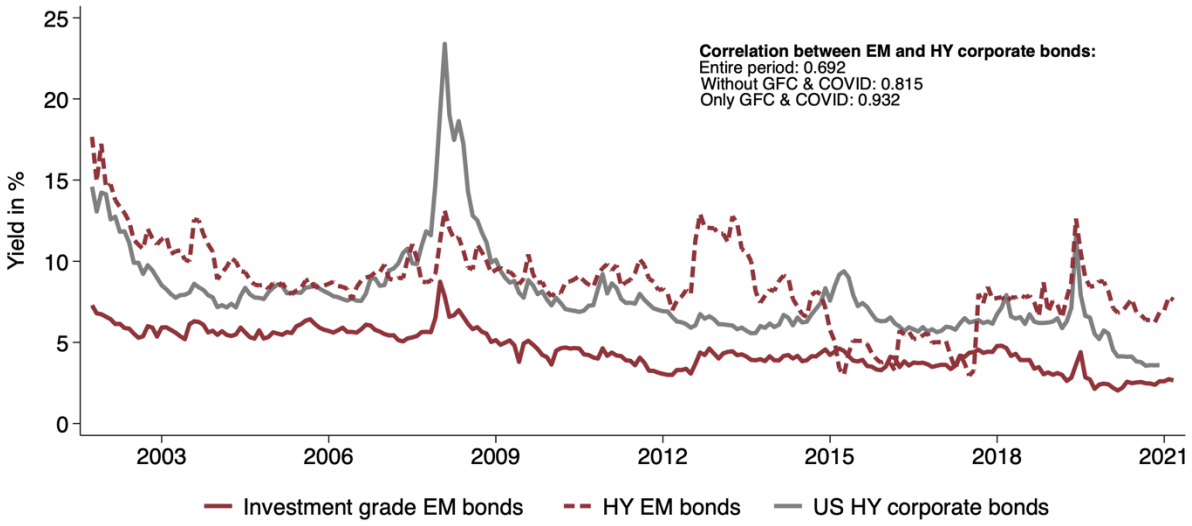
5. Co-movement with US and global risk factors

In this section, we explore how sovereign and HY corporate bond markets co-move with a wide set of financial and macroeconomics variables. For this purpose, we move beyond returns and focus on bond yields and yield spreads instead, thus building on a vast literature on sovereign and corporate bond risks that almost entirely focuses on yields or CDS premia rather than returns (e.g. Duffie et al. 2003, Longstaff et al. 2005, Longstaff et al. 2011, Borri and Verdelhan 2011, Du and Schreger 2016, Bocola and Dovis 2019).

5.1. Bond yields of sovereigns vs. corporates

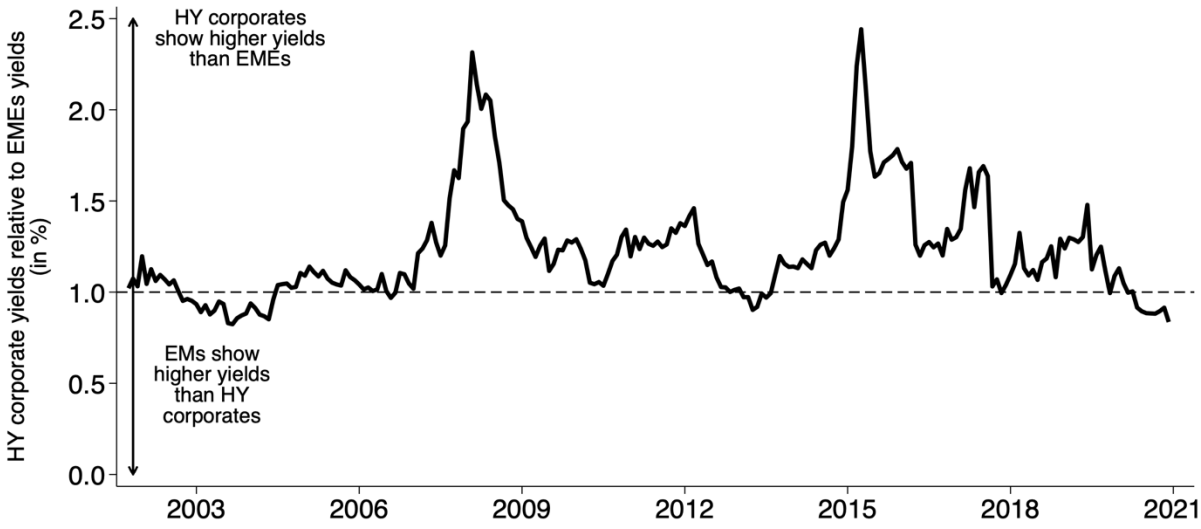
Figure 14 illustrates the close correlation between corporate and sovereign yields over the past 20 years. Both the level and dynamics of the yield series are similar, when comparing HY US corporate bonds (gray line) to HY EM sovereign bonds (dotted line).

Figure 14. Bond yields of HY corporates and EM sovereigns



In a next step, we compare the yields in the two markets more directly. To do so, we use the average HY US corporate bond yield series and divide it by the average yield of all EM sovereign bonds (all rating levels). The resulting Figure 15 shows that HY corporates have higher average yields for most years in the sample, around 2008/09 and during the EM boom years 2015-17.

Figure 15. Relative bond yields of HY corporates and EM sovereigns



Note: Relative yields are the ratio between weighted average HY corporate yields to EME yields. We use the product of prices and amount issued as market capitalization.

5.2 Common factors in bond yield spreads

In this section, we study the commonality or global factor in both corporate and sovereign high-yield bond spreads. To do so, we closely follow Longstaff et al. (2011) who carry out a principal component analysis of CDS spreads for 26 developed and emerging market countries. Specifically, we compute a correlation matrix of monthly changes in bond yield spreads and the estimate the share of the variation that can be explained by one or more principal components.

Table 8 shows the results. The key take away is that the first principal component for sovereign EM bonds is high. At 75% it is even higher than the 64% that Longstaff et al. (2011) find. It is also much higher than the first principal component for the HY corporate bonds (at 26%). The patterns look similar if we differentiate between investment-grade and high-yield bonds.

Table 8. Principal component analysis – corporate vs. sovereign yield spreads (2002-21)

	Corporate HY bonds		Sovereign EM bonds		Sovereign IG EM bonds		Sovereign HY EM bonds (non-IG)	
	Percent explained	Total	Percent explained	Total	Percent explained	Total	Percent explained	Total
First	26.0	26.0	75.4	75.4	68.9	68.9	68.4	68.4
Second	18.0	44.0	9.3	84.7	10.6	79.4	10.4	78.8
Third	11.4	55.5	4.2	88.9	5.7	85.2	6.0	84.8
Fourth	6.9	62.3	1.9	90.8	3.9	89.1	3.6	88.5
Fifth	6.0	68.3	1.6	92.4	1.8	90.8	1.8	90.3

Note: This table reports results from a principal component analysis using the correlation matrix of monthly changes in sovereign bond yield spreads for various sub-samples.

5.3. Empirical approach

To study the correlation between bond yields and financial and macroeconomic variables, we follow the established literature, e.g., Gilchrist et al. (2022), and estimate the following fixed effect regression for our corporate and sovereign bond sample, respectively:

$$YieldSpread_{i,j,m} = \beta_1 X_{j,m} + \beta_2 Z_i + \alpha_i + \epsilon_{i,j,m} \quad (6)$$

where $YieldSpread_{i,j,m}$ is the yield to maturity spread of bond i of country or firm j in month m, $X_{j,m}$is a set of financial and macroeconomic variables, including global and country-

specific factors, Z_i are time-varying bond-specific variables such as the rating, α_i are bond fixed-effects and $\epsilon_{i,j,m}$ are robust standard errors clustered at the bond level.

Furthermore, to test for differences in estimated coefficients of corporate vs. sovereign bonds, we also run a pooled regression that lumps together both samples:

$$YieldSpread_{i,j,m} = \beta_1 X_{j,m} + \beta_2 EM * X_{j,m} + \beta_3 Z_i + \alpha_i + \epsilon_{i,j,m} \qquad (7)$$

where EM is a dummy for emerging market sovereign bonds, which we interact with the key macroeconomic and financial variables of interest. The EM dummy itself, which is an ingredient of the interaction term, is captured by the bond fixed effect α_i and therefore not shown separately.

The main variables of interest include measures of the US stock market, in particular the monthly VIX (CBEO Volatility index), as a proxy of market risk and investor sentiment, as well as the monthly stock market return on the S&P 500, both from Bloomberg. Furthermore, we follow Gilchrist et al. (2022) and include the real yield on the US 2-year bond as well as the difference between 10- and 2-year Treasury bond yields to capture the slope of the US yield curve, again using Bloomberg data.

To capture US monetary policy shocks, we rely on Bauer and Swanson (2022) who compute orthogonalized monetary surprises as residuals from regressing unadjusted monetary surprises on six macro and financial variables.

To account for global factors, we include an inflation-adjusted, monthly index of global commodity prices from the IMF Global Commodity Dataset, which covers both oil- and non-oil commodities. Monthly industrial production growth for the World, US, and China come from the World Bank's Global Economic Monitor and is reported in constant USD with the base year 2005 and not seasonally adjusted. We also include country-specific exchange rates towards the USD using IMF IFS data.

As bond-specific factors, we include the S&P credit rating, with data drawn from WRDS and J.P. Morgan (time-constant variables such as coupon size or bond volume are absorbed by the bond fixed effects). In the case we do not have bond-specific credit ratings for emerging market bonds we use S&P country ratings from the S&P website.

5.4. Regression results

Table 9 shows the results when estimating yield spread regression separately for EM sovereign and HY US corporate bonds. The coefficients are similar across all variables, but corporate HY bonds show higher and more precisely estimated coefficients for US-specific variables. Corporate bond yields are more closely correlated with US stock returns, US stock market volatility (VIX), US industrial production growth, and various measures of US monetary policy shocks.

The results are broadly in line with the previous literature, in particular with papers that study the effects of US stock market volatility on foreign assets prices (Miranda-Agrippino and Rey 2020) and with the literature on US monetary policy shocks on foreign bonds (Gilchrist et al. 2019) as well as on corporate bonds (Guo et al. 2020, Palazzo and Yamarthy 2022). These papers find that monetary policy shocks have a larger impact on lower-rated corporate or sovereign EM bonds, which is in line with the findings of Table 10, which shows separate results for high-yield and investment-grade sovereigns. Indeed, the coefficients for the US monetary policy shocks in Table 10 are larger for high-yield bonds than for investment-grade bonds and the same is true for the estimated coefficient of the VIX.

The results when comparing corporate vs. sovereign bonds are further confirmed when pooling both samples and interacting the main macroeconomic and financial variables of interest with an emerging market dummy variable as in Equation (6). Table 11 shows that the interaction coefficients for the US driven variables are all statistically significant at the 1% level, indicating that EM yields react less to US shocks. More precisely the coefficient is negative and statistically significant for US stock price volatility (VIX), US growth, and US monetary policy shocks. It is positive and significant for US stock market returns (S&P 500 index), negative but insignificant for global commodity prices, while negative and significant for Chinese industrial production growth.

Table 9. Bond yield regressions for corporate vs. sovereign bonds

	Dependent variable: Bond yield spreads												Difference in mean, p-value of t-test
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
	Corporate HY bonds						EM sovereign bonds						
VIX	0.19***						0.10***						0.000
	(0.00)						(0.00)						
US industrial production (real growth, in %)		0.10***						0.05***					0.000
		(0.00)						(0.00)					
US monetary policy shock (Bauer/Swanson)			3.32***						2.57***				0.000
			(0.11)						(0.22)				
S&P 500 stock returns (monthly, in %)				-0.08***						-0.05***			0.000
				(0.00)						(0.00)			
Global commodity price index					-0.01***						-0.02***		0.000
					(0.00)						(0.00)		
Chinese industrial production (real growth, in %)						-0.00***						-0.00***	0.203
						(0.00)						(0.00)	
Real 2-year U.S. Treasury yield (in %)	-0.21***	0.36***	0.36***	0.33***	0.33***	0.37***	-0.21***	0.21***	0.21***	0.18***	0.22***	0.22***	
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	
10y/2y U.S. Treasury term spread (in %)	-0.09***	0.24***	0.24***	0.24***	0.32***	0.24***	0.02	0.24***	0.24***	0.23***	0.38***	0.24***	
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
Exchange rate (to the USD)							0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	
							(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
Numeric S&P rating	-0.52***	-0.49***	-0.49***	-0.49***	-0.50***	-0.49***	-0.57***	-0.56***	-0.56***	-0.57***	-0.50***	-0.56***	
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	
Constant	6.60***	8.68***	8.64***	8.77***	9.95***	8.64***	7.82***	8.89***	8.85***	8.99***	9.85***	8.85***	
	(0.20)	(0.22)	(0.22)	(0.22)	(0.24)	(0.23)	(0.34)	(0.35)	(0.35)	(0.35)	(0.34)	(0.35)	
Observations	238,755	238,755	238,755	238,755	238,755	238,755	54,043	54,043	54,043	54,043	54,043	54,043	
R-squared	0.318	0.072	0.070	0.083	0.077	0.067	0.273	0.146	0.147	0.155	0.185	0.145	
No bonds	6,164	6,164	6,164	6,164	6,164	6,164	801	801	801	801	801	801	
No countries/firms	2,082	2,082	2,082	2,082	2,082	2,082	70	70	70	70	70	70	
Bond fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 10. Bond yield regressions – EM high-yield vs. EM investment-grade bonds

	Dependent variable: Bond yield spreads												Difference in mean, p-value of t-test
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
	EM sovereign bonds - high yield (HY)						EM sovereign bonds - investment grade (IG)						
VIX	0.14***						0.07***						0.000
	(0.01)						(0.00)						
US industrial production (real growth, in %)		0.05***						0.04***					0.870
		(0.01)						(0.00)					
US monetary policy shock (Bauer/Swanson)			3.14***						0.93***				0.000
			(0.32)						(0.16)				
S&P 500 stock returns (monthly, in %)				-0.06***						-0.03***			0.000
				(0.00)						(0.00)			
Global commodity price index					-0.02***						-0.01***		0.000
					(0.00)						(0.00)		
Chinese industrial production (real growth, in %)						-0.01***						-0.01***	0.220
						(0.00)						(0.00)	
Real 2-year U.S. Treasury yield (in %)	-0.25***	0.21***	0.21***	0.18***	0.20***	0.22***	0.01	0.32***	0.32***	0.30***	0.32***	0.33***	
	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	
10y/2y U.S. Treasury term spread (in %)	0.10***	0.39***	0.39***	0.38***	0.52***	0.39***	0.06***	0.19***	0.19***	0.19***	0.27***	0.19***	
	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	
Exchange rate (to the USD)	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	-0.00	0.00	0.00	0.00	-0.00	0.00	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
Numeric S&P rating	-1.03***	-1.02***	-1.02***	-1.03***	-0.88***	-1.02***	-0.17***	-0.17***	-0.16***	-0.17***	-0.11***	-0.16***	
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	
Constant	11.36***	12.79***	12.71***	12.90***	13.51***	12.76***	2.91***	3.54***	3.51***	3.62***	3.70***	3.49***	
	(0.51)	(0.55)	(0.55)	(0.55)	(0.50)	(0.55)	(0.53)	(0.58)	(0.58)	(0.58)	(0.61)	(0.58)	
Observations	29,041	29,041	29,041	29,041	29,041	29,041	25,002	25,002	25,002	25,002	25,002	25,002	
R-squared	0.334	0.192	0.194	0.202	0.228	0.191	0.250	0.107	0.104	0.117	0.138	0.105	
No bonds	547	547	547	547	547	547	436	436	436	436	436	436	
No countries/firms	52	52	52	52	52	52	43	43	43	43	43	43	
Bond fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 11. Pooled bond yield regressions (corporates & sovereigns) with interaction terms

	Dependent variable: Bond yield spreads					
	(1)	(2)	(3)	(4)	(5)	(6)
VIX	0.19***					
	(0.00)					
VIX * EM dummy	-0.08***					
	(0.00)					
US industrial production (real growth, in %)		0.10***				
		(0.00)				
US industrial production * EM dummy		-0.06***				
		(0.00)				
US monetary policy shock (Bauer/Swanson)			3.36***			
			(0.11)			
US monetary policy shock (BS) * EM dummy			-1.06***			
			(0.23)			
S&P 500 stock returns (monthly, in %)				-0.08***		
				(0.00)		
S&P 500 stock returns * EM dummy				0.04***		
				(0.00)		
Global commodity price index					-0.01***	
					(0.00)	
Global commodity price index * EM dummy					-0.00	
					(0.00)	
Chinese industrial production (real growth, in %)						-0.00***
						(0.00)
Chinese industrial production * EM dummy						-0.00**
						(0.00)
Real 2-year U.S. Treasury yield (in %)	-0.21***	0.33***	0.33***	0.30***	0.31***	0.34***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
10y/2y U.S. Treasury term spread (in %)	-0.06***	0.24***	0.25***	0.24***	0.33***	0.25***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Exchange rate (to the USD)	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Numeric S&P rating	-0.52***	-0.50***	-0.50***	-0.50***	-0.50***	-0.50***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Constant	6.73***	8.65***	8.61***	8.74***	9.91***	8.61***
	(0.17)	(0.19)	(0.19)	(0.19)	(0.21)	(0.19)
Observations	292,798	292,798	292,798	292,798	292,798	292,798
R-squared	0.31	0.080	0.079	0.091	0.089	0.075
No bonds	6,965	6,965	6,965	6,965	6,965	6,965
No bonds EMEs	801	801	801	801	801	801
No bonds HY corporates	6,164	6,164	6,164	6,164	6,164	6,164
No countries	70	70	70	70	70	70
No firms	2,082	2,082	2,082	2,082	2,082	2,082
Bond fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

Using granular data since 2002, we show that high-yield corporate and sovereign bond markets share many similarities. This is most surprising when it comes to default outcomes. Corporate bonds are subject to national bankruptcy law (Chapter 11), while for sovereign debt there is no comparable international insolvency procedure and no predetermined legal enforcement mechanism. Given these fundamental differences, it is reasonable to expect major differences in the frequency, process, and outcome of defaults in both markets. And yet, empirically, we find that corporate and sovereign high-risk bonds have similar default rates, a similar average duration of default (the mean is higher for sovereigns, but the median is the same), and comparable haircuts. This is puzzling and deserves further study.

We should emphasize that the past 20 years have been a particularly benign period for both corporate and sovereign high-yield debt, which might bias our findings. Indeed, when compared to the long-run picture, (i) there were relatively few defaults, especially since 2010, (ii) ex-post returns in both the corporate and sovereign bond markets were unusually high, and (iii) government interventions and bailout packages were large (see Blinder and Zandi 2015, Horn et al. 2020, Meyer et al. 2022, Mitchener and Trebesch 2022). Looking ahead, it is far from clear whether this combination of factors is the "new normal" in high-yield debt markets, as rising debt difficulties can morph into debt distress and default abruptly.

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Appendix

Appendix A1: Additional summary statistics

Figure A1a. Benchmarking our corporate HY total bond return series with J.P. Morgan's

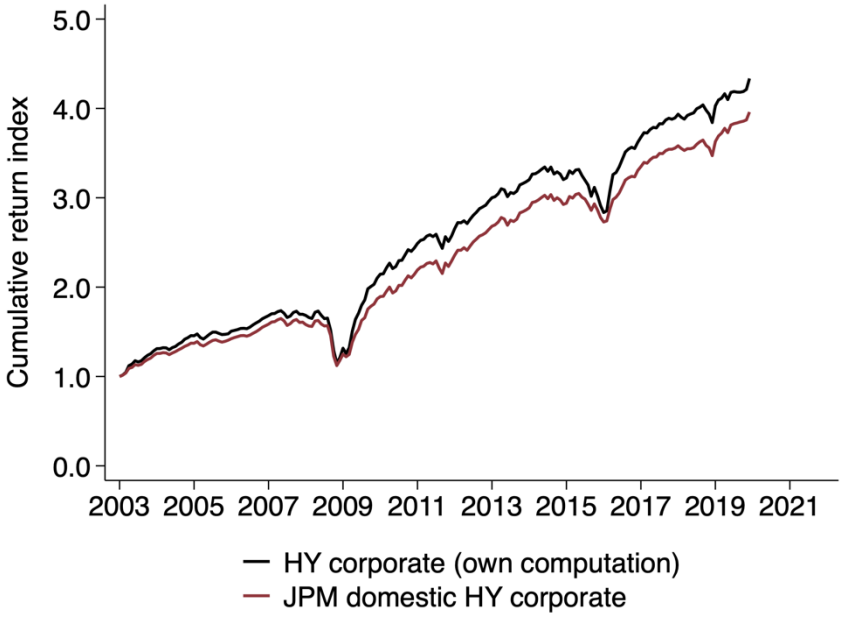


Figure A1b. Outstanding HY corporate bonds in the US as percent of US GDP, 2002-2021

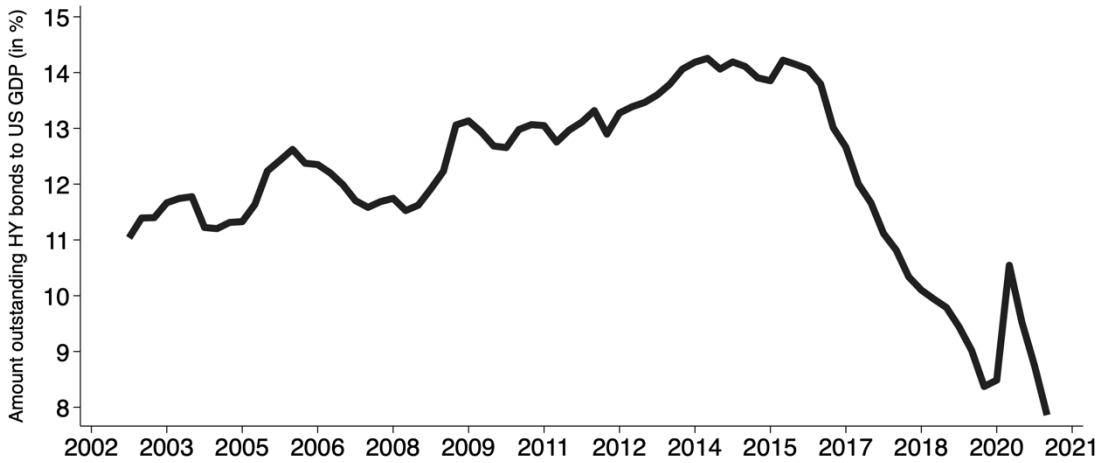


Table A1: HY corporate bond sample by sector: descriptive statistics

Industry	High-Yield firms	Total number of High-Yield bonds	Amount issued of active bonds, in m USD	Average revenue per firm (per year)	Average market capitalization
Manufacturing	880	2,237	3,937,021	1,134,582	24,253,016
Service/Leisure	415	1,049	1,061,367	872,879	6,279,245
Oil and Gas	256	868	1,158,463	865,827	7,177,294
Media/Commn.	246	736	1,237,895	1,303,224	7,813,107
Retail	168	532	695,625	3,676,044	4,416,864
Electric	98	692	873,087	301,378	6,522,546
Financial Services	83	204	1,645,884	2,534,668	10,637,992
Transportation	73	203	268,311	1,222,542	1,930,086
Real Estate	66	208	340,665	54,243	2,061,463
Gas	48	210	250,744	280,262	1,683,331
Credit/Financing	44	331	966,155	1,878,915	5,834,599
Insurance	30	80	444,690	1,265,752	3,322,640
Banking	26	66	1,763,284	5,446,847	9,964,192
Telephone	21	75	295,126	8,858,262	1,684,784
Miscellaneous	13	23	92,177	309,719	333,215
Unassigned	11	20	105,385	893,465	474,369
Leasing	11	31	53,822	212,017	277,409
Savings and Loan	7	10	46,728	731,194	200,051
Railroad	5	13	40,587	772,134	334,597
Water	3	5	15,124	122,500	94,402

Table A2: EME sovereign bond sample: descriptive statistics

Country	Number bonds issued	Amount issued in million USD	Average share of time listed as HY bonds	Country	Number bonds issued	Amount issued in million USD	Average share of time listed as HY bonds
Angola	6	8,500	100	Lithuania	5	7,250	0
Argentina	46	196,809	100	Malaysia	9	8,350	0
Armenia	3	1,750	100	Mexico	57	149,138	0
Azerbaijan	2	2,327	76	Mongolia	8	5,000	100
Bahrain	21	21,975	61	Morocco	6	7,657	47
Barbados	1	531	100	Mozambique	2	1,627	100
Belarus	7	5,050	100	Nigeria	15	16,818	100
Belize	2	1,077	100	Oman	17	29,500	51
Bolivia	3	2,000	100	Pakistan	14	12,835	100
Brazil	53	145,148	60	Panama	23	30,355	40
Bulgaria	4	5,919	10	Papua New	1	500	100
Cameroon	1	750	100	Paraguay	8	6,186	100
Chile	21	27,927	0	Peru	21	33,434	31
China	22	25,500	0	Philippines	41	55,626	56
Colombia	33	47,767	44	Poland	15	26,882	0
Costa Rica	6	5,200	80	Qatar	15	44,900	0
Cote d'Ivoire	4	5,519	100	Romania	7	10,250	0
Croatia	8	10,462	31	Russia	24	123,428	22
Dominican	18	26,452	100	Rwanda	1	620	100
Ecuador	21	43,006	100	Saudi Arabia	24	76,750	0
Egypt	27	34,000	100	Senegal	4	3,100	100
El Salvador	11	8,705	62	Slovak	1	1,500	0
Ethiopia	1	1,000	100	South Africa	21	28,500	9
Gabon	3	3,146	100	South Korea	3	5,000	0
Georgia	3	1,500	100	Sri Lanka	18	17,550	100
Ghana	17	15,525	100	Suriname	1	550	100
Greece	1	1,750	0	Tajikistan	1	500	100
Guatemala	9	6,000	100	Thailand	1	600	0
Honduras	4	2,300	100	Trinidad and	3	2,050	0
Hungary	12	21,000	24	Turkey	55	104,050	83
Indonesia	64	86,400	44	Ukraine	30	40,394	100
Iraq	2	3,700	100	United Arab	25	50,450	0
Jamaica	5	5,644	100	Uruguay	14	19,884	50
Jordan	6	5,500	100	Uzbekistan	4	2,190	100
Kazakhstan	4	6,500	0	Venezuela	26	49,264	100
Kenya	7	7,850	100	Vietnam	3	2,750	100
Kuwait	1	4,500	0	Yugoslavia	6	7,530	100
Latvia	3	2,750	0	Zambia	3	3,000	100
Lebanon	36	35,126	100				

Table A3: Sovereign CDS: descriptive statistics

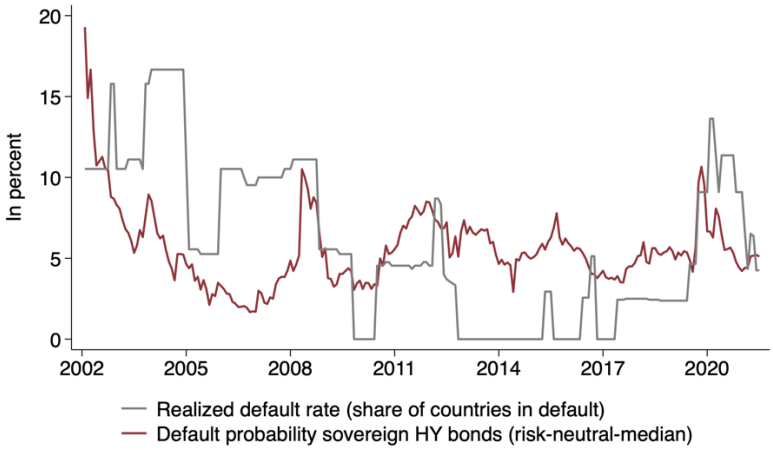
Country	N	Mean	Median	SD	Min	Max	CDS Time Period
Argentina	239	51.34	12.12	105.15	0.00	1366.13	01/2002-12/2021
Bahrain	202	2.20	2.33	1.25	0.09	6.01	01/2005-12/2021
Brazil	239	3.40	1.85	5.10	0.61	39.60	01/2002-12/2021
Bulgaria	239	1.48	1.20	1.14	0.11	6.15	01/2002-12/2021
Chile	235	0.77	0.70	0.50	0.13	2.95	05/2002-12/2021
China	236	0.65	0.58	0.39	0.09	2.50	04/2002-12/2021
Colombia	239	2.24	1.43	2.05	0.72	13.55	01/2002-12/2021
Croatia	237	1.76	1.20	1.26	0.14	5.56	03/2002-12/2021
Egypt	230	3.23	3.25	1.65	0.44	8.61	10/2002-12/2021
Hungary	239	1.50	0.94	1.42	0.12	6.08	01/2002-12/2021
Indonesia	219	2.04	1.63	1.51	0.62	9.00	09/2003-12/2021
Lebanon	188	348.85	4.46	1164.37	1.99	9582.62	03/2006-12/2021
Malaysia	227	0.86	0.82	0.51	0.12	2.95	01/2003-12/2021
Mexico	239	1.31	1.16	0.67	0.28	4.60	01/2002-12/2021
Morocco	175	1.60	1.40	0.63	0.40	3.25	03/2007-12/2021
Oman	54	3.01	2.72	1.13	1.88	7.09	07/2017-12/2021
Panama	239	1.60	1.22	1.15	0.42	6.80	01/2002-12/2021
Peru	239	1.83	1.27	1.69	0.42	11.00	01/2002-12/2021
Philippines	239	1.90	1.31	1.46	0.34	6.20	01/2002-12/2021
Poland	239	0.78	0.65	0.61	0.08	3.65	01/2002-12/2021
Qatar	230	0.76	0.70	0.46	0.09	3.20	10/2002-12/2021
Romania	230	1.72	1.30	1.27	0.16	7.20	10/2002-12/2021
Russia	239	1.98	1.62	1.35	0.39	7.60	01/2002-12/2021
Saudi Arabia	158	0.98	0.86	0.44	0.45	2.75	09/2008-12/2021
Slovak	237	0.62	0.47	0.56	0.06	3.08	03/2002-12/2021
South Africa	237	1.74	1.75	0.80	0.25	4.60	03/2002-12/2021
South Korea	238	0.70	0.55	0.61	0.14	4.30	02/2002-12/2021
Sri Lanka	119	5.50	3.06	5.17	2.24	19.46	02/2012-12/2021
Thailand	224	0.83	0.64	0.52	0.23	2.95	04/2003-12/2021
Turkey	239	3.19	2.50	2.09	1.17	13.00	01/2002-12/2021
Ukraine	220	215.19	9.20	278.79	1.30	698.43	08/2003-12/2021
Uruguay	200	1.96	1.80	0.90	0.70	4.99	03/2005-12/2021
Vietnam	185	2.32	2.18	1.01	0.55	5.99	01/2002-12/2021
Yugoslavia	147	2.27	2.60	1.07	0.80	4.20	08/2009-12/2021

Note: The table reports summary statistics for month-end spreads for 5-year sovereign CDS contracts from January 2002 to December 2021. CDS spreads are measured in percent. The CDS data comes from Morgan Markets and refers to the 5-year maturity mid spread. The highest average CDS spreads are observable for Lebanon, Ukraine, and Argentina. All three countries have recently defaulted.

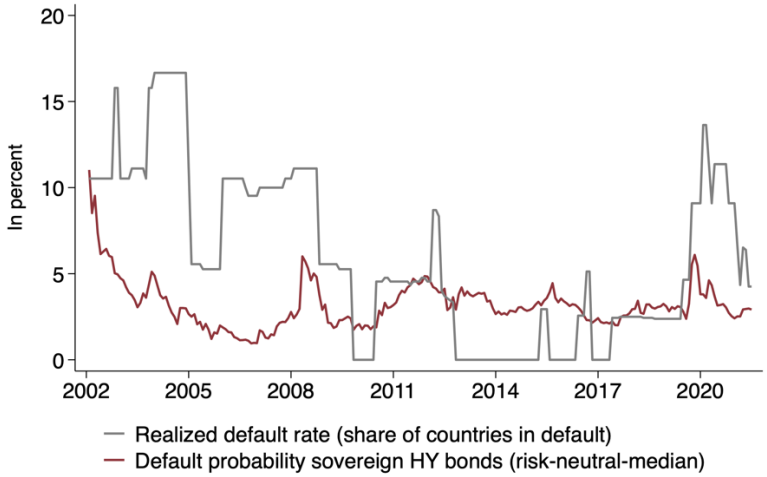
Appendix A2: CDS-implied default probabilities – alternative recovery rates

Figure A2. EM sovereigns: default probability estimates using alternative recovery rates

(a) Country-specific average recovery rates
(our baseline)



(b) Common 25% recovery rate assumption
(as in Longstaff et al. 2011)



Appendix A3: Recovery rates and haircuts – a deeper look

In this section, we zoom into the measurement of haircuts and recovery rates. As explained in Section 4.5 we measure the size of recovery rates for both sovereign and corporate bonds based on the definition by Moody's, namely as the defaulted bond's price 30 days after the default event. The haircut is then measured as one minus this price-based recovery at default.

While common practice, it is an arbitrary decision to use prices 30 days post-default to proxy for recovery rates. One obvious alternative is to use the last available price pre-restructuring, meaning just before the debt exchange takes place (or on the last day a bond has reliable price information). Indeed, as shown in Section 4.5., there is often considerable delay between the start of a default and the time of restructuring and exit from default.

Against this backdrop, Table A4 expands on Table 7 by adding the bond price pre-restructuring. This price is the last available bid price prior to the bond exchange or, in the case of some corporates, the last price before bonds stop trading and/or firms cease to exist. In total we include 17 EME restructurings and 333 HY corporate restructurings, with multiple defaulted bonds in some of these cases.

As can be seen in the upper part of Table A4, the recovery rates measured at default (bond price 30 days post-default) are similar for corporates and sovereigns (both around 37). The difference is much larger when using the last price pre-restructuring. Corporate HY bonds have an average recovery value (bond price) of 48 pre-restructuring compared to just 38 for sovereigns. We thus observe a notable price recovery for corporates during default and bankruptcy while there is no such price recovery for sovereigns, at least on average.

The lower part of Table A4 further differentiates between long and short defaults, as classified by the median default duration at the level of countries and firms. For corporates, the median default duration is 9 months, while it is 15 months for sovereigns (0.75 vs. 1.25 years, respectively). As can be seen, long defaults are associated with much lower recovery rates for sovereigns, with an average bond price of below 30. The opposite is true for corporates, where long defaults see a price recovery to above 50. Possibly, this difference reflects the fact that longer sovereign defaults are often the result of messy and inefficient crisis resolution. A case in point are the particularly lengthy defaults of Cote d'Ivoire 03/2000 (10 years), Argentina 11/2001 (3.5 years) and Venezuela 11/2017 (3.3 years in our

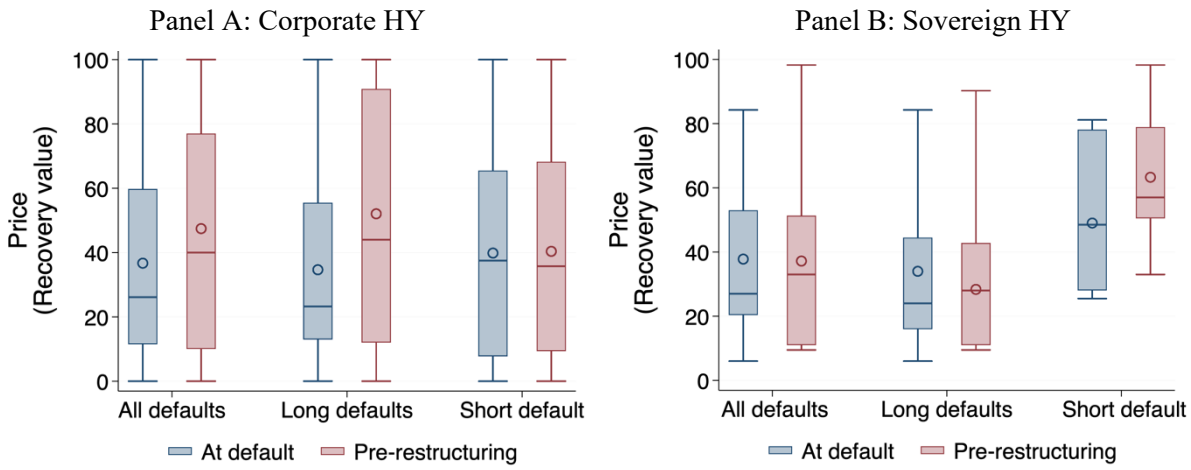
sample, still ongoing). In the case of corporates long bankruptcy processes may instead be the result of a successful firm restructuring process, with a higher likelihood of firm survival rather than a quick dissolution of the firm. Finally, for shorter defaults, there is a notable price recovery for sovereigns, with an average pre-restructuring price of 63. We observe no significant change in recovery rates for corporates in short defaults. Figure A3 illustrates these different trends in price recovery in default (all; short; long) in a more compact form.

Table A4: Summary statistics on prices at default and prior to restructuring

	No. of bonds	Mean	Median	SD	Min	Max	Difference in mean, p-value of t-test (compared to corporate HY)
All defaults							
Price at default							
Corporate HY	652	36.7	26.1	30.1	0.0	114.0	
Sovereign HY	91	37.8	27.0	24.2	6.0	84.2	0.74
Price pre-restructuring							
Corporate HY	652	47.5	40.0	39.3	0.0	156.8	
Sovereign HY	91	37.2	33.0	24.2	9.5	98.2	0.02
Short defaults *(default duration below median, which is 9 months for corporate defaults and 15 months for sovereigns, classified by firm/country)*							
Price at default							
Corporate HY	257	39.8	37.5	31.9	0.0	109.5	
Sovereign HY	23	49.0	48.5	22.6	25.5	81.1	0.18
Price pre-restructuring							
Corporate HY	257	40.4	35.8	32.8	0.0	121.0	
Sovereign HY	23	63.3	57.0	17.8	33.0	98.3	0.00
Long defaults *(default duration below median, which is 9 months for corporate defaults and 15 months for sovereigns, classified by firm/country)*							
Price at default							
Corporate HY	395	34.7	23.2	28.7	0.0	114.0	
Sovereign HY	68	34.0	24.0	23.7	6.0	84.3	0.85
Price pre-restructuring							
Corporate HY	395	52.1	44.0	42.3	0.0	156.8	
Sovereign HY	68	28.4	28.0	19.2	9.5	90.3	0.00

Note: We restrict the default price sample to bonds for which both prices at default and prices pre-restructurings are available. For corporate defaults this decreases the sample from 702 to 652 bonds. All summary statistics are unweighted averages.

Figure A3: Recovery rates (prices) around default and restructurings



In the next step, we compare haircuts (1-recovery rate) derived from bond prices on the one hand to haircut estimates that are based on a net present value estimate as proposed by Sturzenegger and Zettelmeyer (2006) or Cruces and Trebesch (2013) on the other hand. Since we use bond-level data, we draw on the rich new database of bond-by-bond NPV haircuts 1998-2020 published by Asonuma, Niepelt and Ranciere (2023). Their dataset covers more than 500 sovereign bond instruments, including many defaulted domestic bonds as well as many external bonds for which no (liquid) prices exist or which never were part of J.P. Morgan's EMBIG index. Once we match their datasets with ours, we get to an overlapping sample of 41 external sovereign bonds across eight sovereign bond restructuring events.

Table A5 shows that, for the overlapping sample, our baseline bond-price haircuts "at default" (30 days afterwards) are 62%, which is 10 percentage points higher than the NPV haircuts by Asonuma, Niepelt and Ranciere (2023), on average. One potential explanation for this difference is the often long delay between the month of default and the month of the restructuring event (see above). Indeed, once we use the last bond price pre-restructuring as a proxy for recovery rates, then the average price-based haircut drops to 50% (pre-restructuring), which, for this sample, is almost the same average as the NPV haircut (at restructuring) from Asonuma, Niepelt and Ranciere (2023).

Table A5: Sovereign bond haircuts (1-recovery rate): comparing different approaches

	Price-based haircuts – **at default**	Price-based haircuts – **pre-restructuring**	**NPV haircuts** (Asonuma et al. 2023)
Mean	62	52	50
Median	72	50	52
SD	22	23	24
Min	19	2	0
Max	94	83	82
Nr of Bonds	41	41	41
Nr of Countries	8	8	8
p-value t-test in difference in mean with corporate HY		0.21	0.00

Note: This table compares different estimates of creditor losses. We have been able to match bond-level NPV haircuts with price-based haircuts for 41 bonds across eight sovereign debt restructurings.

Figure A4 and A5 complement the comparison of haircut measures. The correlation between price-based and NPV-based haircuts is noisy when using bond prices at default as the baseline for comparison (Figure A6). However, NPV haircuts and bond-price based haircuts are more similar once we use pre-restructuring prices as a proxy for recovery rates. In fact, using prices pre-restructuring is likely the better benchmark for NPV haircuts, because these are also measured at restructuring.

Figure A4: NPV haircuts vs. bond price haircuts (at default)

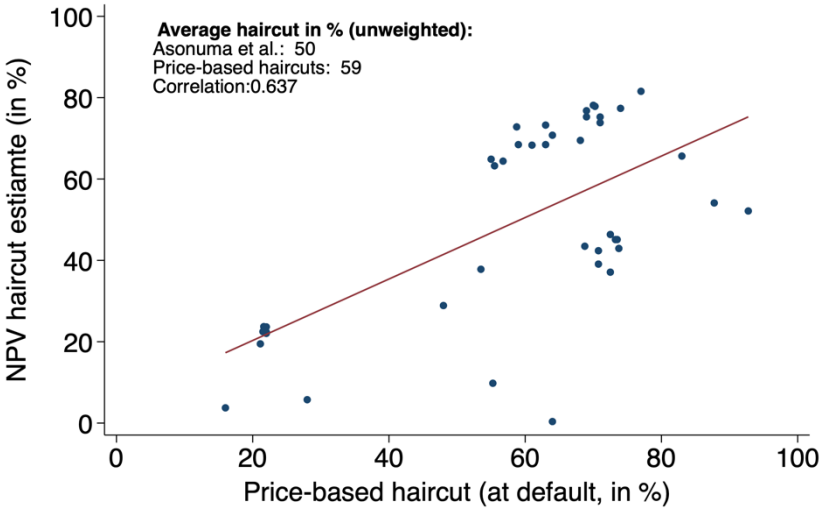


Figure A5: NPV haircuts vs. bond price haircuts (pre-restructuring)

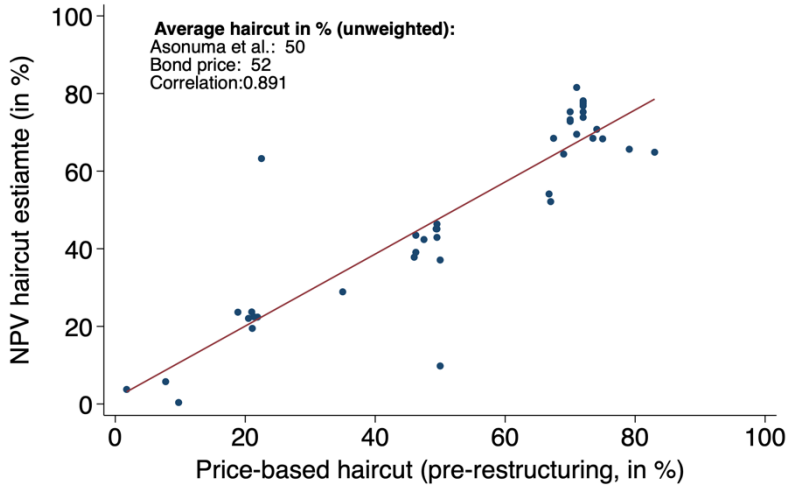


Figure A6: Corporate HY bonds: prices at default vs. prices pre-restructuring

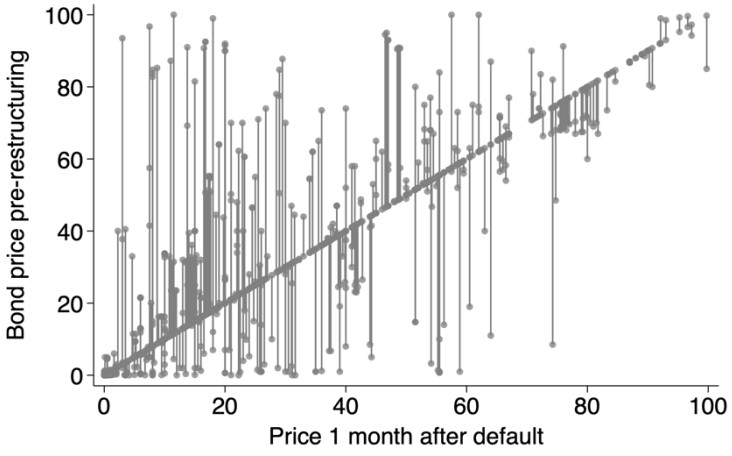


Figure A7: Sovereign HY bonds: prices at default vs. prices pre-restructuring