Incomplete Information, Debt Issuance, and the Term Structure of Credit Spreads

Online Appendix

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This Online Apendix provides further details regarding the empirical facts in Section 2 of the paper.

A Classifying firms based on bond ratings

We collect the entire history of credit ratings given by the three main U.S. rating agencies (Moody's Investor Services, Standard & Poor's Ratings Services, and Fitch Ratings) from the Mergent database. While Mergent contains ratings going back to the early part of the 20^{th} century, ratings are limited to a very small number of debt issues through the mid 1980s. Hence, here we focus on the sample period from 1985 to 2014.

Mergent provides ratings specific to particular bond issues, rather than an overall company rating. Hence, for a given issuer, each month we collect all ratings awarded on that month to any of its outstanding bonds and use that information to classify the company.[1] We divide individual bond ratings into three categories: investment grade (IG), higher-quality speculative grade (B), and lower-quality speculative grade (C and lower), where the last two categories, B and C, together comprise the universe of speculative grade ratings. We then assign the company to one of the three categories when the majority of the company's bond ratings are in that category. When no fresh ratings are given by any agency to the outstanding bonds of that company, we classify the firm based on ratings collected in the previous month. If no new ratings were issued the previous month, we go further back, up to 12 months. In case no new ratings are available in the entire 12 month period, we do not classify the firm. This approach mitigates the problem of classifying companies based on stale ratings.

To document default rates among rated firms, we obtain the entire history of bankruptcy filings starting from 1985 (also available through the Mergent database). Each month, after we classify firms in the three rating categories, we identify those that filed for bankruptcy over the next 12 months. We record the number of months that have elapsed between the month of the classification and the bankruptcy time. Then we count bankruptcies that occurred within the first, second, and third month of the classification (0-1, 1-2, and 2-3 months), the second, third, and fourth quarters (3-6, 6-9, and 10-12 months), and the entire year (0-12 months). For ease of comparison across periods of different length, we annualize all count

[1] We focus on U.S. domiciled companies and exclude ratings on government agencies' bonds (e.g., U.S. Treasury, U.S. and foreign agencies, municipalities).

variables.[2] The results are in Table Table 1 of the paper; we discuss them in Section 2 of the paper.

B Classifying firms based on CDS premia

In the previous section, we have classified firms based on credit ratings that are up to 12 months old. Such ratings might not fully reflect the information available to market participants at the time of the classification. Hence, here we consider an alternative classification of firms into the same three rating categories that is based on CDS data from Markit Financial Information Services.

CDS contracts provide insurance in case of credit events that affect the value of a reference entity (such as the bond issued by a company that files for bankruptcy). Therefore, CDS premia reflect market participants' assessment of default risk for the company that issues the reference bond. The CDS market is generally liquid. Thus, CDS contract are a useful source of real-time information about a company's credit worthiness.

To translate CDS premia into a proxy for a company's credit rating, we compare the cost of insuring bonds issued by that company with that of insuring portfolios of investment-grade and high-yield bonds (the CDX-IG and CDX-HY indices constructed by Markit Financial Information Services). Each month from 2001 to 2014 we aggregate daily five-year CDS premia from the Markit database into an average monthly CDS premium.[3] Similarly, we compute monthly averages of daily five-year CDX-IG and CDX-HY premia. If the CDS premia on a firm's bonds do not exceed the CDX-IG index by more than 100 basis points (bps), then we classify that firm as investment grade (the IG category). We use the 100 bps threshold to avoid excluding creditworthy companies whose CDS premia lie slightly above the CDX-IG level, i.e., the average IG premium. In unreported results, we find the analysis to be robust to the choice of the threshold value. In contrast, when CDS premia on a firm's bonds exceed the CDX-HY premium we classify that firm as lower-quality speculative grade (the C category). Finally, if CDS premia lie in between the IG and C thresholds, then we classify the company as higher-quality speculative grade (the B category).

[2]We multiply the count variables for the 0-1, 1-2, and 2-3 periods by 12, and those for the quarterly periods by 4.

[3]Prior to analysis, we exclude CDS contracts written on bonds issued by Government and sovereign entities.

Similar to Section A, each month we identify firms that filed for bankruptcy within the following 12 months. We then compute the average annualized default rates within the first, second, and third month of the classification (0-1, 1-2, and 2-3 months), the second, third, and fourth quarters (3-6, 6-9, and 10-12 months), and the entire year (0-12 months). The results are in Table 1, Panel C in the paper; heteroskedasticity- and autocorrelation-robust (Newey-West) standard errors are in parentheses. The main point of the table is to show that at horizons from one to three months, IG default rates are virtually zero: the point estimate for the annualized default rate is 0.01% and statistically insignificant.

When we restrict our attention to firms that held IG status for at least one of the 12 months preceding the default event, we find that the great majority of these companies exhibit a considerable run-up in credit spreads for many months before they default. This provides investors with a signal that the credit worthiness of such companies has deteriorated below IG well before their bankruptcy. Figure B.1 shows the difference between the average CDS premium on those firms and the CDX-IG index. This spread is very small 12 months prior to bankruptcy and then increases in the ensuing months as the firms drop out of the IG group and approach bankruptcy. This evidence suggests that an investment policy that (1) holds bonds issued by firms in the IG category, and (2) unwinds these positions when the firm loses IG status, faces virtually zero default risk. Hence, the jump-to-default premium for this portfolio should be negligible.

C Robustness checks

In the paper, we classify firms in the IG, B, and C rating categories over the period 1985–2014 using the Mergent dataset. We then compute empirical default rates for companies that have experienced bankruptcy within a year of the classification. Here we check the robustness of our findings using data from the Moody's Default and Recovery Database (DRD). There are two advantages to this dataset. First, the database spans a longer sample period starting from 1920. Second, Moody's reports a default flag that captures not only bankruptcies but also other credit events such as missed payments beyond the grace period and debt restructuring that reduces the value of the bondholder claim.

While the Moody's data go as far back as 1920, we find many early ratings to be stale. In unreported results, we find that, for most IG defaults that occurred over 1920–1940, Moody's

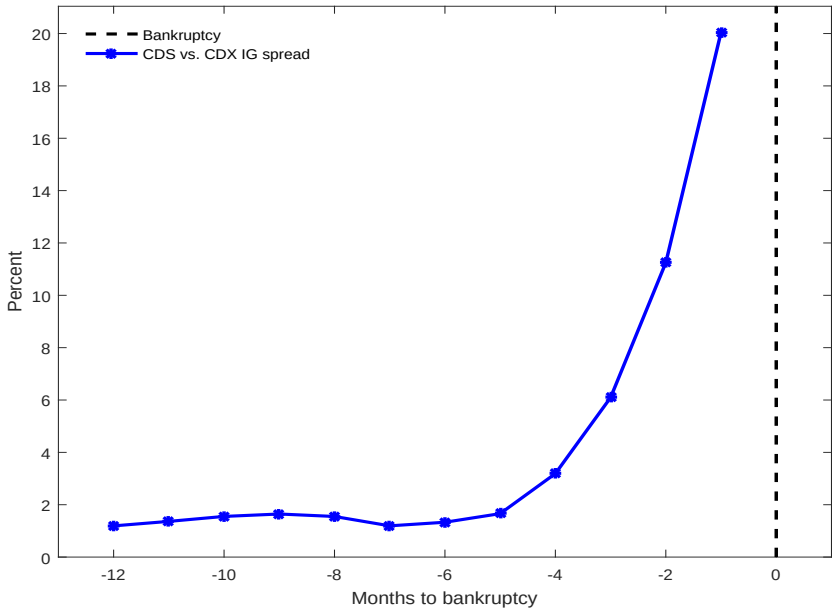

Figure B.1: **Average CDS Premium on Investment Grade Firms up to Bankruptcy.** Among the firms that went bankrupt from 2001 to 2014, we classify as investment grade those that had CDS contracts trading at a premium no higher than 100 basis points of the CDX Investment Grade Index for at least one of the 12 months preceding the bankruptcy time. The plot shows the average CDS premium, in excess of the CDX Investment Grade Index, on those investment grade firms in the 12 months leading up to their bankruptcy.

did not update the IG rating past the default event. Hence, we only use data starting from 1940.

First, we document the average rating of firms that experienced a delinquency, i.e., they were issued a D rating, along their path to default. Figure C.2 shows results for the 1940–2017 (top panel) and the 1985–2017 (bottom panel) sample periods over the ten-year window leading to the default event. The results are nearly indistinguishable across the two periods and consistent with the evidence in Figure 4 in the paper: ten years prior to delinquency, the typical firm starts out with a BB+ rating, which progressively deteriorates as the firm approaches its default time.[4]

Next, we compute empirical default rates using Moody's DRD data, similar to the analysis in Section 2 of the paper where we relied instead on individual bond ratings from the Mergent database. The results for the 1940–2014 sample period are in Panel B of Table C.1. They are similar to those reported in the paper over the shorter 1985–2014 window based on the

[4]For ease of comparison with the results in Figure 4 in the paper, we map the letter designations for Moody's ratings into those of Standard & Poor's.

stricter bankruptcy classification flag. For completeness, panels C and D show results for the 1985–2014 and 2001–2014 windows, which show results consistent with those in the main text for the same two periods.

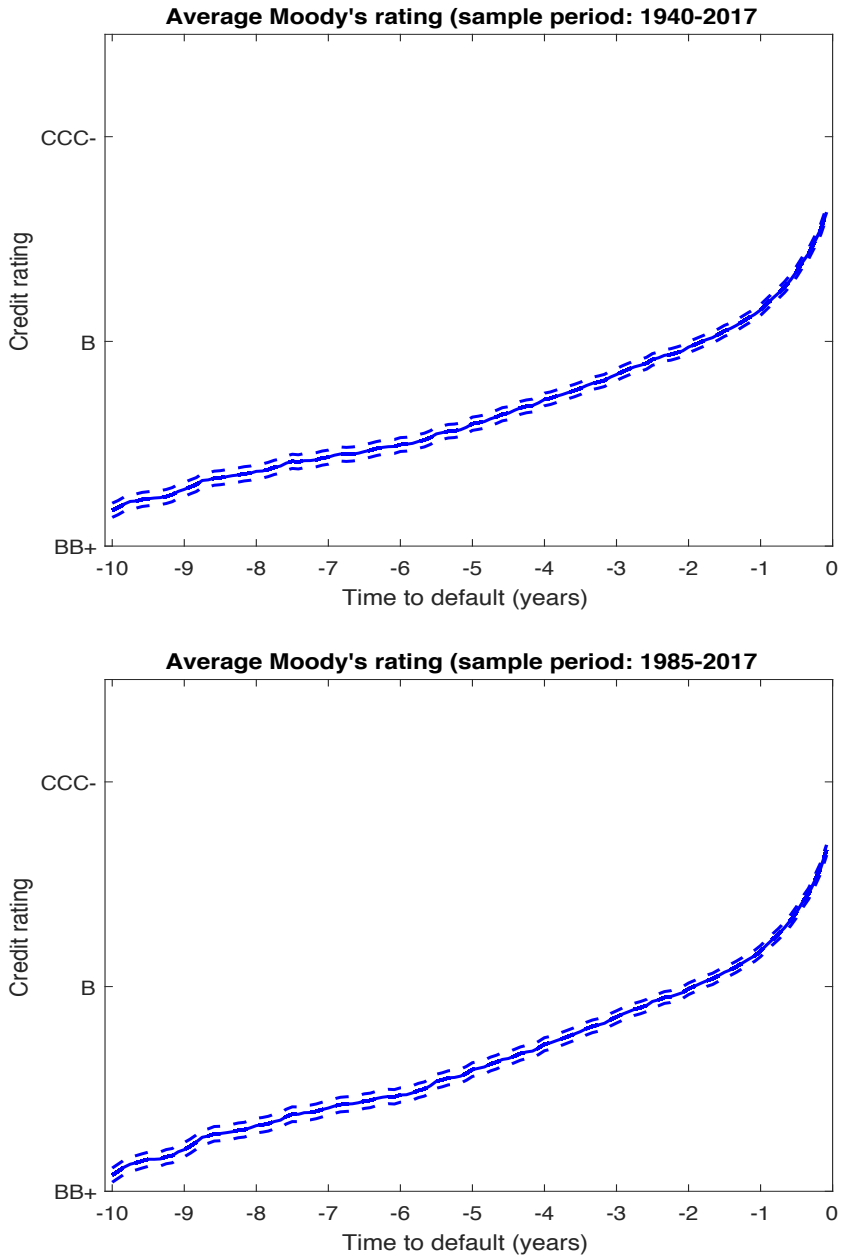

Figure C.2: **Average Moody's Rating along the Default Path.** The plots show the average credit rating for defaulted firms as a function of time to default. The dashed lines denote the 90% confidence bands. Sample periods: 1940-2017 (top panel) and 1985–2017 (bottom panel). Source: Moody's Investment Services Default and Recovery Database.

Table C.1: **Empirical Defaults Rates.** Each month, we classify firms as investment grade (IG), higher-quality speculative grade (B), and lower-quality speculative-grade firms (C) based on ratings issued by Moody's Investors' Services. The panels show average annualized default rates computed over various periods for firms in each rating category that have defaulted in the next 12 months. Heteroskedasticity- and autocorrelation-robust (Newey-West) standard errors are in parentheses. Source: Moody's Default and Recovery Database.

Rating	Annualized Default Rates						
	0-1M	1-2M	2-3M	3-6M	6-9M	9-12M	0-12M
				Panel A: 1920–2014			
IG	0.09	0.10	0.11	0.13	0.16	0.18	0.14
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)
B	1.56	1.78	1.91	2.11	2.35	2.51	2.18
	(0.24)	(0.25)	(0.26)	(0.28)	(0.30)	(0.32)	(0.27)
C	8.39	7.58	7.11	6.47	5.58	4.85	6.15
	(1.22)	(1.11)	(1.04)	(0.89)	(0.73)	(0.62)	(0.79)
				Panel B: 1940–2014			
IG	0.03	0.04	0.04	0.07	0.08	0.10	0.07
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
B	1.16	1.45	1.61	1.88	2.20	2.41	1.97
	(0.20)	(0.23)	(0.25)	(0.29)	(0.33)	(0.36)	(0.29)
C	10.33	9.25	8.66	7.81	6.60	5.73	7.39
	(1.62)	(1.47)	(1.37)	(1.17)	(0.94)	(0.80)	(1.02)

Table C.1, continued

Rating	Annualized Default Rates						
	0-1M	1-2M	2-3M	3-6M	6-9M	9-12M	0-12M
				Panel C: 1985–2014			
IG	0.03	0.04	0.05	0.08	0.11	0.13	0.09
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)
B	1.30	1.68	1.90	2.24	2.65	2.92	2.36
	(0.23)	(0.27)	(0.29)	(0.33)	(0.38)	(0.42)	(0.33)
C	14.36	12.85	12.00	10.76	9.11	7.88	10.20
	(1.83)	(1.66)	(1.55)	(1.29)	(0.99)	(0.84)	(1.05)
				Panel D: 2001–2014			
IG	0.05	0.06	0.07	0.11	0.14	0.16	0.11
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)
B	0.53	0.90	1.07	1.32	1.72	1.98	1.46
	(0.15)	(0.23)	(0.27)	(0.33)	(0.45)	(0.50)	(0.35)
C	14.33	13.10	12.46	11.36	9.65	8.43	10.68
	(2.26)	(2.04)	(1.91)	(1.58)	(1.17)	(0.99)	(1.26)