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Recovery Ratios and Survival Times for Corporate Bonds

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Abstract

This paper analyzes the determinants of the recovery ratios and survival times (time until default) for U. S. corporate bonds. We show that seniority, the type of industry in which the firm operates, and the type of restructuring attempted after default are the major determinants of the cross-sectional distribution of individual bond recovery ratios. On an industry level, physical asset obsolescence, industry growth, and industry concentration are the most important factors. We also analyze survival times for corporate bonds and find that initial time to maturity and the general economic conditions at maturity and default explain a large fraction of the cross-sectional variation of survival times.

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SUMMARY

The willingness of creditors to lend to risky borrowers and the price of lending depend critically on the percentage of the loan that can be recovered in case of default--the recovery ratio. This paper examines individual and industry recovery ratios, using data for defaulted U.S. corporate bonds. It also analyzes the importance of the industry-average recovery ratio in determining the time to default, or the survival time of corporate bonds.

The research reported in the paper indicates that on the individual level the most important variables determining the cross-sectional distribution of recovery ratios are debt seniority, the growth rate of the industry in which the firm operates, and the type of reorganization attempted after default. By considering a subsample of bonds for which debt restructuring has been informal, the analysis confirms that there are significant violations of the rule that more senior creditors are given priority over less senior ones in the satisfaction of claims.

On an industry level, a somewhat different set of variables is important for the explanation of the cross-sectional distribution of recovery ratios. The proxies for physical asset obsolescence--the ratio of fixed to total assets, industry growth, and industry concentration--are the single most important variables. The ratio of fixed to total assets has a negative sign and industry growth has a positive sign, as is to be expected in both cases, but it is puzzling that more concentrated industries have higher industry recovery ratios.

On an individual level, both the recovery ratios and the time to default (survival time) are mutually dependent. This potential endogeneity is addressed by using average industry recovery ratios, and not individual recovery ratios, in examining the impact of recovery ratios on survival time. The initial time to maturity, the industry average recovery ratio, and the economic conditions at issue are the most important determinants of the cross-sectional distribution of survival times.

I. INTRODUCTION

The willingness of creditors to lend to risky borrowers (corporations and sovereign states alike) and the price of lending depend critically on the percentage amount that could be recovered in case of default relative to the size of the loan–the recovery ratio. Naturally, for individual bonds those ratios are determined at the time of default. For the purposes of bond pricing, however, these ratios are typically assumed to be relatively stable over time, even for a particular industry or initial risk class (Kim, Ramaswamy, and Sundaresan (1993), Izvorski (1997)). Looking at the other side of the issue, it is important to understand how these ratios are determined and the role they play in determining the cross-sectional distribution of the time to default as well as the default probability of individual bonds.

This paper examines the determinants of the cross-sectional distribution of individual and industry recovery ratios, using data for 281 defaulted U.S. corporate bonds for the period 1983-93. We also analyze the importance of the industry-average recovery ratio for the determination of time to default, or the survival time of corporate bonds. We build on several papers in the literature documenting individual recovery ratio levels (Altman (1984, 1991), Altman and Kishore (1996), Fons (1987, 1994), to name a few). Combined, these papers present a long time series of averages (1971-95) across initial agency ratings and different initial seniorities. Bonds with higher seniority have commanded higher recovery ratios, almost 58 percent for senior secured debt versus 31 percent for subordinated debt according to Altman and Kishore (1996), with a similar standard deviation of 23 percent for both categories.

Although there have been published estimates of recovery ratios across seniority classes and initial agency ratings, there are no estimates of recovery ratios computed for lines of business. In this paper we compute recovery ratios across 4-digit standard industrial classification (SIC) code formed industries. The results are useful as a component of bond pricing models but to determine whether industry averages are stable across time, as the researchers tend to agree, would require a much longer time series of observations.

What determines the levels of the observed recovery ratios? Since the recovered amounts on corporate debt are computed net of the direct and indirect costs of financial distress (by definition), factors that tend to affect each of these components would immediately affect the recovery ratios. To us, the concept of indirect costs of distress is a bit unintuitive (Izvorski (1996)). By the value preservation identity, the value of the firm should be split into amounts recovered by the claimants, direct, and indirect costs. From that aspect, indirect costs are a residual and researchers have not tried to identify the factors determining the residual, although much has been written in the literature about the direct and indirect costs of financial distress. In general, researchers tend to agree that while the various legal, administrative, and accounting fees are trivial and account for no more than 1-2 percent of the market value of the firm prior to distress, the indirect costs, that is, the residual from the pre-bankruptcy market value less direct costs and claimants distributions, are quite sizable–on the order or 11 percent to 17 percent of the firm value up to three years prior to distress (Altman (1984)). On the other hand, examining the determinants of the recovery ratio is a more promising exercise since it interplays with the amounts recovered by other claimants, as well as the amounts lost to distress resolution.

In liquidation, Williamson (1988) argues that if assets are redeployable, i.e., have alternative uses, creditors would get higher recovery rates. Schleifer and Vishny (1992) focus on liquidity and demonstrate that the presence of parties who can bid the best-use value of the assets leads to higher recovery ratios. The issues of liquidity and marketability in determining the values of (distressed) bonds have also been explored in Altman (1990); Fridson (1989); and Shulman, Bayless, and Price (1993), among others. In the extreme case, a bond issued by a monopoly will be associated with a lower recovery ratio as the value in best-use of the assets will never be bid, nor will creditors have much leverage in the renegotiation process. In addition, bonds in an industry characterized by rapid obsolescence will also fetch lower recovery ratios. If a software company defaults, its assets are likely to depreciate fast because the industry is growing rapidly and equipment is replaced quite often. On the other hand, rapid growth may be accompanied with higher quality assets and cash on hand, thus providing two possible interpretations that must be carefully distinguished in the empirical work.

The data set we work with comprises all U.S. corporate bonds issued and defaulted after 1982. We are able to compute recovery ratios for 153 of these bonds using only market data for the prices of the securities distributed to the bondholders after the distress resolution. To obtain industry recovery ratios, the individual estimates are aggregated across 4-digit SIC code industries. Thus, under the hypothesis that these averages are relatively stable across time, we are able to examine not only the determinants of the individual but also of the industry recovery ratios.

Our research indicates that on the individual level the most important variables determining the cross-sectional distribution of recovery ratios are debt seniority, the growth rate of the industry in which the firm operates, and the type of reorganization attempted after default (whether a formal Chapter 11 filing, an informal reorganization, or a similar prepackaged bankruptcy filing). By considering the subsample of bonds for which debt restructuring has been informal, it is confirmed that there are significant violations of the absolute priority rule–seniority is weakly significant for the determination of the cross-sectional distribution of the recovery ratios for these bonds. We hypothesize that the type of the industry the firm operates in, as well as the general state of the economy at default, would be important factors for the attempted explanation, but the empirical analysis confirms our intuition only for the case of a significantly positive effect of the growth rate of the industry in which the firm operates.

On an industry level, a somewhat different set of variables is important to explain the cross-sectional distribution of recovery ratios. Our proxy for physical asset obsolescence–the ratio of fixed (non-current) to total assets, industry growth, and industry concentration–are the single most important variables. While the first two variables have the expected negative and positive signs, respectively, we find that more concentrated industries have higher industry recovery ratios. This is puzzling as it is much more appealing that in more competitive industries the best-use valuation of assets can more easily be bid and, correspondingly, that the recovery ratios should be higher.

On an individual level, both the recovery ratios and the time to default (survival time) are mutually dependent. Although no evidence has been presented in the literature, it is plausible that bonds which tend to default later in their lives carry higher recovery ratios. We address this potential endogeneity by using average industry recovery ratios, and not individual recovery ratios, in examining the impact of recovery ratios on survival time. In particular, we analyze whether bonds issued by firms operating in higher recovery ratio industries tend to default later given that they have defaulted *ex-post*. We control for a number of variables, including the time to maturity, the general economic conditions at issue and default, and bond characteristics such as face amount and coupon rate. Besides the time to maturity at issue we find that the industry recovery ratio is the most important variable determining the cross-sectional distributions of both the time to default (survival time) and the time to default normalized by the time to maturity at issue (normalized survival time).

The rest of the paper is organized as follows. Section II discusses the data set and explains the construction of the variables used in the empirical analysis. Section III describes the methodology of computing the individual and the average industry recovery ratios and motivates our choice of variables to be used in the analysis of the cross-sectional distributions of the recovery ratios. This section also presents the results from the estimation and their interpretation. Section IV analyzes whether the average industry recovery ratio is an important determinant of the survival time (time to default) and the normalized survival time (time to default divided by time to maturity at issue) of our sample of defaulted bonds. The paper concludes in Section V.

II. DATA OVERVIEW

The universe of bonds used in this paper consists of all bonds issued in the United States between 1983 and 1993 inclusive, a data set compiled by the Board of Governors of the Federal Reserve System and cleaned up by Tim Opler (see Guedes and Opler (1995) for details). There are 10,295 issues in the sample with annual coupon rates ranging from 0.0 percent to 20.0 percent and an unweighted average of 8.95 percent. Somewhat surprisingly, the highest coupon bond was issued by Merrill Lynch

& Co, a 20.00 percent 1988 maturity issue. The bonds have face values ranging from $0.10 million up to $2,260 million (RJR Nabisco Holdings Group's direct placement of its 13.71 2009 issue). The average amount issued is $109.4 million. Time to maturity at issue ranges from less than a year to 99 years, producing an average time to maturity at issue of 14.1 years.

We have identified 281 bonds that defaulted between 1983 and 1993, inclusive, by using Moody's Bond Record, Standard and Poor's (S&P) Bond Guide, the *Wall Street Journal*, the *Capital Changes Reports*, and the all-issued universe database described above. Following Fons and Kimball (1991), we include distressed exchanges in our sample if the new security contains a diminished financial obligation or the exchange has the apparent purpose of helping the borrower avoid default. The annual coupon rates on the 281 defaulted bonds range from 0 to 18.0 percent with an average of 12.44 percent, which is slightly higher than the average coupon rate Fridson (1989) reports for all bonds in the high-yield universe he studies (1982-89), and is considerably higher than the average coupon rate of 8.94 percent for the all-issued universe. The defaulted bonds have an average time to maturity at issue of almost 12 years (time to maturity ranges from less than 3 years to 30 years) and an average time to default of 4.37 years, or about 37 percent of the average initial time to maturity. The average amount of the defaulted bond issues is $120 million, even though bonds with as little as $1.51 million and as much as $744 million have been issued. Table 1 summarizes some of the characteristics for the two datasets.

The target of this study is the recovery ratio, i.e., the fraction of the present value of the promised cash flows that creditors are able to recover in case of default (see Section III for a detailed discussion, definition, and comparison with other studies). We are able to compute recovery ratios for 153 bonds using data from the *Capital Changes Reports* in the manner outlined in that Section. As computed in that section, the defaulted bonds in our sample have recovery ratios ranging from 0.0-98.2 percent with an equally weighted average of 35.35 percent. This average is lower than those reported in Altman and Kishore (1996), who work with a longer sample period, 1978-95, and Fons (1996), who uses the period 1970-1995. As explained below, the main reason for the differences is in the definitions of recovery ratio.

As expected, the defaulted bonds have much lower agency ratings at issue compared to the all-issued universe. The results in Izvorski (1996) suggest that if recovery ratios by risk classes, as defined by agency ratings, remain relatively stable across time, initial ratings are a good proxy for the expected levels of recovery ratios in case of default. Unfortunately, because of the small sample size, we can only hypothesize about this stationarity across risk classes.

Accounting data for the bonds in this study are extracted from Compustat. Table 2 lists all the original (extracted) and constructed variables used in the empirical

Table 1. All Bonds Issued in the United States and All Defaulted Bonds, 1983-93.

	All bonds	Defaulted bonds
	(In millions of U.S. dollars)	
Minimum amount	0.1	1.5
Maximum amount	2260.0	744.0
Average amount	109.4	120.0
	(In percent)	
Minimum coupon	0.0	0.0
Maximum coupon	20.0	18.0
Average coupon	8.95	12.44
	(In years)	
Minimum time to maturity	0.25	3
Maximum time to maturity	99	30
Average time to maturity	14.1	12

Source: For column 1, Federal Reserve Bank of New York and Tim Opler, as described in the text. For column 2, a dataset collected by the author for this study using *Moody's Bond Record*, *S&P's Bond Guide*, *the Wall Street Journal*, and the *Capital Changes Reports*.

Table 2. Summary of the Variables Used in the Empirical Work

44	Total assets	54	Total liabilities
40	Current assets (CA)	49	Current liabilities (CL)
51	Long-run debt	59	Book Common Equity
61	Number of shares outstanding		Stock price
Ttmat	Time to maturity at issue	Tdef	Time to default
Coupon	Annual coupon rate	Amount	Log (face value)
D/E	Long-term debt to equity	FA	Total assets less current assets
Rec	Individual bond recovery ratio	Ind.recovery	Average 4 digit SIC recovery ratio
Bankrupt	1 if firm has filed for Chapter 11 and 0 otherwise	Senior	1 if debt is senior, 0 otherwise.
Short	3-moth Tbill yield	Long	10 year T-bond yield
AAA	AAA rated corporate bond yield	Index	5 year return on a S&P industry index
Ishort	Short rate at issue	Iterm	(Long-Short) at issue date
Dshort	Short rate at default	Dterm	(Long-Short) at default date
Irisk	AAA-Long at issue date	Drisk	AAA-Long at default date

Sources: Compustat and Ibbotson and Associates.
Note: Original Compustat variables, derived variables, bond characteristics, interest rates and spreads variables (available from Ibbotson and Associates), and other data used in the empirical analysis. The first and third columns give either the item number from Compustat (original variables) or the names of the variables as reported in the rest of this paper.

analysis. It also includes several bond characteristics of interest as well as interest rate data, the 3-month Treasury bill rate, the yield on ten year Treasury bonds, AAA corporate bonds, and the returns on the various S&P industrial indices, extracted from Ibbotson and Associates.

III. RECOVERY RATIOS

This section first introduces the methodology for computing the individual and average industry recovery ratios and motivates the choice of variables used in the cross-sectional regressions. Later is presents and interprets the empirical results.

A. Measurement and Statistics

Suppose that when a firm default on a risky bond with face value of F dollars creditors recover R dollars. Suppose that the present value, discounted at the riskless rate, of all promised cash flows is B. Equivalently, B is the price of a riskless bond with coupons, principal, and time to maturity, which is identical to the risky bond. Then, we define the recovery ratio on the risky bond as:

$$\phi = \frac{R}{B} \tag{1}$$

Other researchers (notably Altman and Kishore (1996)) scale the recovered amount R by the face value of the bond F, instead of B. As argued in the introduction, since $B > F$, our method produces uniformly lower estimates of the recovery ratio.

Note, also, that we compute recovery ratios net of the direct costs of renegotiation. One can include the lawyers, accountants, and others in the pool of the claimants (as done in Chapter 11 proceedings) and study the total amount recovered. Since the direct costs of distress are small, it is possible that the two approaches would yield similar results. Nevertheless, we prefer to concentrate on the recovery ratios for the original creditors.

The following example illustrates the computation of recovery ratios. The *Capital Changes Reports (CCR)* has data indicating that in March 1991 the prepackaged reorganization plan of Southland Corp. under Chapter 11 of the Federal Bankruptcy Code was consummated in U.S. Bankruptcy Court. Per \$1,000 of the `15.75 note, due 12-15-1997`, the plan provides \$650 first priority note `5s, due 12-15-2003`, 40.5 shares common stock, and 7.5 warrants. The *market* values of these securities[1] are: common \$1.34375, first priority note 40.625 (i.e., \$40.625 per \$100 face

[1]Unlike most other papers, this paper uses only market data to compute recovery ratios, thus, there are fewer data points.

value), warrants \$0.625. The spot interest rate (3-month Treasury bill rate) for March 1991 was 6.09 percent, while the ten-year rate was 8.5 percent. We then compute that the price of a riskless security that has identical characteristics to the risky Southland bond would be $135.1(per100$ face value). The recovery ratio with this price, therefore, would be:

$$\phi = \frac{(0.650)(406.25) + (40.5)(1.34) + (7.5)(0.625)}{1,351} = 0.2391 \qquad (2)$$

If the recovery ratio is computed with the face value of the bond in the denominator, it gives:

$$\phi_1 = \frac{(0.650)(406.25) + (40.5)(1.34) + (7.5)(0.625)}{1,000} = 0.3230 \qquad (3)$$

Some authors include in the denominator of (3) interest accrued from the date of default to the date of consummation. For the above example, the accrued interest from the date of default, 12-15-89, until the date of consummation, 3-5-91, i.e., 14 months worth of interest, is $(14/12)(0.1675)(1,000) = 195.42$. Then the recovery ratio is:

$$\phi_2 = \frac{(0.650)(406.25) + (40.5)(1.34) + (7.5)(0.625)}{1,195.42} = 0.2720 \qquad (4)$$

We use the first method for computing the recovery ratios as this definition provides the most consistent interpretation–a 100 percent recovery ratio means a 100 percent recovery of the originally-promised cash flows, a situation identical to no default. On the other hand, a 100 percent recovery ratio in the second example produces a very different outcome than that of no default; in fact, recovering 100 percent using the second definition would leave the bondholders better off after default.

Altman and Kishore (1996) compute recovery ratios for the period 1978-95 for senior secured, senior unsecured, senior subordinated, subordinated, and zero coupon bonds. Similar results are presented in Fons (1994), who uses data for the period 1970-93. Their results are compared with our estimates of recovery ratios by seniority in Table 3.

The equally-weighted average of the above figures for the Altman and Kishore's study is 38.58 percent while for the Fons' study it is 39.82 percent. For our sample period, 1983-93, on the other hand, the average recovery ratio is 35.35 percent. While higher seniority is associated with higher recovery ratios for all studies, our results are uniformly lower across seniority classes. As emphasized above, the most important reason for these differences is the way recovery ratios are computed. In general, B can

Table 3. Summary of Studies on Recovery Ratios (in percent)

Study	Senior secured	Senior unsecured	Senior subord.	Subord.	Average
Altman&Kishore	57.89	47.65	34.38	31.34	38.58
Fons	64.59	48.38	39.79	30.00	39.82
Our results	57.23	38.19	38.13	28.85	35.35

Source: Altman and Kishore (1996), Fons (1995), our computations.

be greater or less than F depending on the relation between the spot interest rate and the coupons. Since the risky bonds in our sample are sold at par, the coupon rate is always higher than the spot interest rate at issue.

Following Franks and Torous (1994), we examine the recovery ratios according to the type of reorganization the issuing firm undergoes following default. There are 136 cases in which the issuing firm filed for Chapter 11, typically after unsuccessfully trying to renegotiate the debt privately. For 99 of the defaulted bonds the informal renegotiation process has been successful (i.e., filing for Chapter 11 has been prevented), while in 11 cases the firm used a prepackaged bankruptcy that combines filing for protection with submission of the reorganization statement. For 23 of the cases we were unable to obtain data on the reorganization process, which suggests that the firms may have entered Chapter 11 and not been able to emerge from it successfully (i.e., were liquidated under Chapter 7). Twelve of the bonds in our sample were issued by banks and thrifts–organizations which cannot seek protection under Chapter 11.

These results confirm Franks and Torous's (1994) findings that firms which reorganize informally are able to restructure their obligations more cheaply (incurring lower direct and indirect costs) than under a formal Chapter 11 filing, and thus have higher recovery ratios on their debt. For the 136 firms that entered Chapter 11 the data on 81 of them (60 percent of the total) show an average recovery ratio of 30.36 percent. On the other hand, the average recovery ratio for the informal reorganizations and exchanges is about 36.23 percent–computed from data for 46 defaulted bonds (39 of the 99 firms which have succeeded in the informal renegotiation process plus 7 of the 11 prepackaged bankruptcies).

The difference in the mean recovery ratios for bankruptcies and informal renegotiations are statistically significant: the standard deviation for the bankrupt companies is 0.2383; for the informal reorganizations it is 0.2343. To proxy for this systematic pattern, in the empirical analysis we use the dummy variable `Bankrupt` with a value of 1 if the firm has filed for Chapter 11 and 0 otherwise.

The existing empirical literature does not explore the relation between the type of industry in which firms operate and the average industry recovery ratio. It is only known that the method of restructuring does not vary systematically across industries (Franks and Torous (1994)). Table 4 presents data on the recovery ratios for 25 industries identified by their 4-digit Standard Industrial Classification (SIC) codes. To group firms into 4-digit SIC industries we use the variable `dnum` from Compustat, dropping industries for which there are less than 2 defaulted bonds with computed recovery ratios.

From the table two hypotheses can be drawn; these are discussed in detail in the following section. First, "similar" industries have similar recovery ratios, as is the case of the `Convenience stores` and `Drug and proprietary stores`, as well as that of `Steel` and `Steel works`. Second, more "general" (integrated) industries have higher recovery ratios than the more "specialized" industries, as evidenced from `Crude petroleum`, `Paperboard mills` (examples of general industries) versus `Television broadcast stations`. Of course, these casual observations are no substitute for a more detailed analysis, which is attempted in the following section.

B. Determinants of the recovery ratio

What factors affect the amount that creditors recover in a case of default? As highlighted in the previous section, the type of restructuring imposes different direct and indirect costs. However, the connection between financial distress and the recovery ratios is further complicated by the significant deviations from the absolute priority rule[2] observed in reality.

While the absolute priority rule has been viewed as an extremely important part of the debt contract (Jensen (1991) and Aghion, Hart and Moore (1994) (AHM)), it is frequently violated both in informal renegotiations and in formal bankruptcy procedures (Izvorski (1996)). As shown in this paper, the costs of financial distress are much higher when firms file for Chapter 11 or Chapter 7 than when the parties to the contract agree to restructure informally. In practice, creditors are more likely to agree to more favourable settlements for equityholders when Chapter 11 is avoided. Since the costs of Chapter 11 are higher than the costs of an informal workout, one could

[2]The absolute priority rule requires that senior creditors are satisfied before junior creditors and shareholders

Table 4. Recovery Ratios Across 4-digit SIC Industries

Industry	dnum	#	mean	max	min	std
Crude petroleum & natural gs	1311	5	0.5322	0.8600	0.2400	0.2786
Operative builders	1531	4	0.2086	0.6243	0.0000	0.2943
Sausage,oth prepared meat pd	2013	2	0.2450	0.3300	0.1600	0.1202
Paperboard mills	2631	2	0.5751	0.5751	0.5751	0.0000
Plastics products, nec	3089	3	0.6920	0.8764	0.5558	0.1656
Concrete, gypsum and plaster	3270	3	0.4473	0.9820	0.0210	0.4896
Steel	3310	2	0.1290	0.1330	0.1250	0.0057
Steel works & blast furnaces	3312	4	0.1662	0.2550	0.0800	0.0996
Ordnance & accessories	3480	3	0.3353	0.3353	0.3353	0.0000
Electronic components, nec	3679	3	0.3168	0.3513	0.2570	0.0520
Costume jewlry,button,notion	3960	2	0.5530	0.5670	0.5390	0.0198
Transit & passenger trans	4100	2	0.4075	0.5400	0.2750	0.1874
Air transport, scheduled	4512	11	0.0497	0.0535	0.0472	0.0027
Television broadcast station	4833	3	0.1115	0.1115	0.1115	0.0000
Electric services	4911	3	0.4227	0.4680	0.3620	0.0546
Department stores	5311	5	0.3610	0.4350	0.1040	0.1440
Convenience stores	5412	6	0.2182	0.6067	0.0000	0.2341
Drug & proprietary stores	5912	3	0.2007	0.4410	0.0750	0.2082
Savings instn, not fed chart	6036	4	0.2950	0.2950	0.2950	0.0000
Short-term bus credit, ex ag	6153	2	0.2990	0.2990	0.2990	0.0000
Mortgage bankers & loan corr	6162	3	0.2653	0.3690	0.2130	0.0898
Security brokers & dealers	6211	7	0.3446	0.5805	0.0300	0.2943
Hospital & medical svc plans	6324	2	0.3710	0.6810	0.0610	0.4384
Real estate dealers	6532	6	0.2045	0.3770	0.0130	0.1893

Using data from Compustat, we assign 4-digit SIC codes to the 281 defaulted bonds in our sample (variable `dnum`). We drop industries with less than 2 defaulted bonds, as well as bonds for which there is no data in Compustat allowing us to put them in a 4 digit SIC industry. For each industry we present the number of defaulted bonds in our sample (#), the mean, maximum, and minimum recovery ratio for the industry, as well as the standard deviation of the data.

hypothesize that the recovery ratios for bondholders (taking into account the costs of distress and the deviations in favor of equity) are not much higher than the recovery ratios for Chapter 11 restructurings.

As pointed out in the previous section, however, Franks and Torous (1994) and this paper show that firms that restructure informally have significantly higher recovery ratios on their defaulted debt than firms filing for Chapter 11. The connection, then, is clear–informal restructuring imposes lower direct and indirect costs and even though creditors willingly deviate from absolute priority in shareholders' favor, the recovery ratios on defaulted debt are higher. To control for the type of reorganization, we use the dummy variable `Bankrupt`, which has a value of 1 if the firm has filed for Chapter 11 protection and 0 otherwise.

Having controlled for the method of restructuring, what are the more fundamental reasons for the high or low value of assets used to settle existing debts? Williamson (1988) argues that assets that are *redeployable* (have alternative uses) have high liquidation values. That is why companies with a higher proportion of such assets on their balance sheets are able to borrow more easily than others with less redeployable assets. Default is not always followed by liquidation; nonetheless, Williamson's argument is valid for default in general as the ability to recover is ultimately linked to the ability of a company to generate positive cash flows.

A somewhat related reason is presented in Shleifer and Vishny (1992), who analyze liquidation values when liquidity, not redeployability, is the main issue. This is related to the type of industry the company is operating in - apparently, nobody would have a use for a piece of specialized equipment coming from a monopoly. In addition, if other companies in the industry or in the economy are in financial distress, recovery ratios are also likely to be low.

Therefore, we need proxies for the level of competitiveness of the industry the firm operates in, the state of that industry, and the general state of the economy. To proxy for the level of competitiveness of the industry the firm operates in, we use a concentration measure, the industry Herfindahl index, defined as:

$$H = \sum_i s_i^2 \tag{5}$$

where s_i denotes the market share of firm i. Then, $H = 1$ if there is only a single firm in the industry, and $H = 0$ for a perfectly competitive industry. To compute concentration ratios for the industries in our sample, we process the entire Compustat file and extract the variable `Sales` for all companies for 1983 and 1993. Then we compute the Herfindahl index for each `dnum` (SIC code) for which there is at least one company. The variable `Concentration` used in the empirical work is the average of the Herfindahl indices for 1983 and 1993. Results with the Herfindahl index computed for 1988 are virtually identical and therefore not reported.

To measure of the overall performance of the industry to which the issuing firm belongs, we put the firms in our sample into one of the S&P industry groups, using the variable `dnum` from Compustat, and proxy industry performance over the 5-year period prior to default (individually for each bond) by the return on the respective S&P industrial index, available from Ibbotson and Associates (variable `Industry Growth`).

To proxy for the general state of the economy, we use the yield on the 3-month Treasury bill as a proxy for the short interest rate (variables `Ishort` and `Dshort` where the prefix `I` stands for the rate at issue and `D` for the rate at default), the difference between the yield on a ten-year Treasury bond and the short rate as a proxy for the term spread (variables `Iterm` and `Dterm`), and the difference between the yield on a AAA corporate bond and a 10 year Treasury bond as a measure of the default spread (`Irisk` and `Drisk`). Izvorski (1996) demonstrates that these spreads are correlated with the rate of economic growth for the United States. The short rate and the risk premium are negatively correlated with the economic growth rate while the term spread is positively correlated. Note that we do not focus on counter- or pro-cyclical behavior, but on correlation with the growth rate.

Asset obsolescence is another important factor determining the level of the recovery ratio. For example, Fridson (1989) comparing the default of Itel, White Motor, and AM International, writes:

> "The lesson here is that the type of asset is critical; Itel's railcar lease fleet provided more value than White Motor's outmoded manufacturing facilities. Technology companies such as AM International are prone to slippage in asset values because of obsolescence and the limited number of buyers of their highly specialized facilities."

How should we measure asset obsolescence? Since fixed (non-current) assets are replaced more slowly (by definition) than current assets they have a higher rate of obsolescence. The higher the fraction of fixed assets, the more expensive it is to prevent obsolescence. This is especially true if the firm is in financial distress and has a harder time raising additional cash to meet its financial obligations. Asset obsolescence is also related to the indirect costs of default and bankruptcy, discussed above: if the firm underinvests because of current or expected financial trouble, it is likely to generate lower revenues in the future, have a lower market value and, therefore, fetch a lower recovery ratio. This motivates the use of the ratio of fixed to total assets (`Fixed to total assets`) as a proxy for asset obsolescence.

Financial leverage is another potentially important determinant of recovery ratios. Castanias (1983) documents that failure rates and leverage[3] are negatively

[3]Leverage is defined as the ratio of long-term debt to total assets, equity to total assets,

correlated (also Ross (1977)). Firms that have accumulated larger amounts of debt have been more thoroughly "screened" by lenders and thus tend to be less default- and bankruptcy-prone. A second explanation invokes an agency argument (see Hart (1996) for a summary) that shareholders increase debt levels in order to monitor managers' behavior and thus higher debt levels may mean that a more comprehensive and healthy monitoring system is in place. Since this screening is related to the quality of the assets on the company's balance sheet, higher leverage is expected to be positively correlated with recovery ratios in case of default. This motivates the use of the variable `Debt to equity` measured at the time of issue as a proxy for the firm's financial leverage, where `Debt` is the stock of long-term debt of the firm.

Finally, in light of the results documented by Altman and Kishore (1996) and Fons and Kimball (1991), as well as the discussion in the previous section, the seniority of the debt instrument is an important factor in determining recovery ratios. If the absolute priority rule is observed, senior bondholders have to be reimbursed before any proceeds go to more junior bondholders. This suggests a strong positive correlation between seniority and recovery ratios. In practice, however, absolute priority is most often violated as more senior bondholders agree to substantial deviations from the rule to allow restructuring to be completed more quickly with lower direct and indirect costs. Thus, while the impact of seniority is expected to be significant, the costliness of the formal reorganization process and the related violations from the absolute priority rule suggest a somewhat more moderate role for debt seniority. In the empirical analysis, we use the dummy variable `Senior` with value 1 if the issued debt is senior and 0 otherwise.

C. Individual recovery ratios

Table 5 presents the results from several logit regressions in which the dependent variable is the individual bond recovery ratio. We have data on the recovery ratios for 153 bonds but Compustat data for only 136 of them. The first two columns report regressions with all 139 defaulted bonds for which recovery ratios have been computed, the third for bonds whose issuers have filed for Chapter 11 protection, and the fourth for bonds for which the informal restructuring has been successful. When referring to the overall regression we will use the results in column 2 of the table.

The most significant result is the strongly negative coefficient on the `Bankrupt` dummy in the overall regression. This implies that firms that have been unable to restructure their obligations informally have lower recovery ratios than those which have not filed for Chapter 11 protection (see also Franks and Torous (1994)).[4] We note that there is no evidence, either here or in the literature, that suggests restructuring patterns differ systematically across industries. Therefore, the `Bankrupt` dummy does

debt to equity, or total liabilities to equity.

[4]In most cases firms file for Chapter 11 after trying to renegotiate informally.

Table 5. Individual Recovery Ratio Logit Regressions

	All	All	Bankrupt	Non-bankrupt
Constant	0.2327	0.2333	0.1872	0.8952
Debt to Equity	0.0038	0.0037	0.0052	-0.0223
	(0.8197)	(0.7280)	(1.0623)	(-1.0669)
Fixed to Total Assets	-0.6351	-0.3608	-0.6511	-1.3185
	(-1.0199)	(-0.9144)	(-0.8273)	(-1.8508)
Industry Growth		0.1087	0.1029	-0.1679
		(1.9385)	(1.6039)	(-2.3566)
Concentration	-0.0707	-0.1205	-0.1813	-0.0919
	(-0.3393)	(-0.4517)	(-0.6688)	(-0.3515)
Bankrupt	-0.1806	-0.2032	–NA–	–NA–
	(-3.5075)	(-2.6863)		
Senior	0.1449	0.1702	0.1855	0.0733
	(3.0052)	(3.0815)	(3.2724)	(0.9201)
Term spread at default	-0.0203	-0.0097	-0.0029	-0.1435
	(-0.5051)	(-0.1936)	(-0.0461)	(-1.8636)
Short rate at default	0.0171	0.0230	-0.0071	0.0213
	(0.4996)	(0.5891)	(-0.1390)	(0.6117)
df	128	127	73	36
R^2	0.2237	0.2498	0.4514	0.8476

The dependent variable is the individual bond recovery ratio. For the first two columns ("all") we use all defaulted bonds (136 for which data are available), for the third ("bankrupt") we use bonds for which the issuing firms have filed for Chapter 11 (81 with available data), and for the fourth column ("non-bankrupt") we use the issues that have been restructured informally, including prepackaged bankruptcies (46 bonds). *t*-statistics are given in parenthesis.

not proxy for the relevant information that is potentially available in the more industry-specific variables `Industry Growth` and `Concentration`.

As expected, the past performance of the industry in which the firm operates, as proxied by the variable `Industry Growth`, is very important for the determination of individual recovery ratios. For the overall and the bankrupt sample regressions, the coefficient is positive and significant at standard reasonable levels of significance. For the non-bankrupt sample the coefficient on `Industry Growth` is, interestingly enough, strongly negative. For firms operating in high growth industries that restructure informally, creditors appear ready to reward shareholders by accepting lower recovery ratios, possibly in the hope that the firm will perform well in the future. By contrast, creditors tend to recover a higher fraction of their claims for bonds issued by firms in "laggard" industries. Creditors, apparently, do not expect that rewarding shareholders by accepting lower recovery ratios today will translate into better performance tomorrow when past industry performance has not been strong.

The coefficients on the industry `Concentration` ratios are negative in all the regressions and not significant at reasonable levels. Therefore, there is only weak evidence that firms in more competitive (less concentrated) industries fetch higher recovery ratios. One reason, of course, can be that our measure, which uses only publicly-traded firms in the Compustat database to construct the Herfindahl index, is flawed because of the backward-looking bias of Compustat or because the Herfindahl indices do not do a good job of capturing the competitive level of the industry.

Seniority is positive and strongly significant in both the overall and the bankrupt-firms regressions, which confirms the intuition that more senior bonds fetch higher recovery ratios. On the other hand, for the bonds that have reorganized informally the coefficient, although positive, is not significant. This suggests significant violations from the absolute priority rule when informal renegotiation is pursued.

The proxy for obsolescence, the ratio of `Fixed to Total assets`, is consistently negative in all regressions. However, the coefficient is significant only at the 10 percent level for the no-bankrupt firms. Firms in industries with higher fractions of fixed capital are more likely to fetch lower recovery ratios, especially in liquidation, when issues such as liquidity and redeployability play a more important role.

Although the coefficient on `Debt to Equity` is positive for the whole sample and the bankrupt bonds, it is not statistically significant. For the issues that have avoided filing for Chapter 11, higher leverage does not translate into higher recovery ratios. Informal renegotiations, it may be concluded, punish creditors who have increased leverage without the appropriate monitoring more than the formal Chapter 11 process where leverage does not seem to be very important. Another way of looking at the evidence is that deviations from the absolute priority rule in favor of the stockholders to prevent a Chapter 11 filing are proportionately higher when leverage is higher.

Interest rates do not appear to have an important effect except in the case of non-Chapter 11 bonds, for which the coefficient on `Term spread at default` is negative and significant. The results from this section suggest that "bad times"[1] are associated with comparatively higher recovery ratios, much more so for the sample of firms that have been able to restructure their debts informally.

In summary, the growth rate of the industry in which the firm operates, the seniority of the debt, and the method of restructuring it following default are the most important variables determining the level of the individual recovery ratios. For the sample of firms that have been able to restructure their obligations informally, the ratio of `Fixed to total assets` (a proxy for obsolescence), and the `Term spread at default` (a proxy for the general state of the economy), are also significant. Neither these nor any of the other variables used in the analysis are strongly significant for the determination of the recovery ratios on bankrupt firms.

D. Industry recovery ratios

Table 6 presents the results for average industry recovery ratios regressions. The dependent variable is the equally weighted average recovery ratio for 35 4-digit SIC code formed industries. The variables `Debt to equity` and `Fixed to total assets` are averages for all firms in the respective 4-digit SIC code formed industry over the sample period 1983-1993. `Industry Growth` is the return on the respective S&P industry index over the sample period 1983-93, and `Concentration` is the average of the Herfindahl indices of 1983 and 1993.

The results show that industries with higher overall debt to equity ratios have lower industry recovery ratios although the coefficient is not statistically significant. This result is contrary to the results obtained from the individual recovery ratios for all defaulted firms and the subsample of firms that have filed for Chapter 11. The results are, however, consistent with the evidence obtained from firms that have been able to restructure their obligations informally.

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[1]Meaning low rates of GDP growth rather than recessions.

Industries with a higher fraction of fixed assets have a significantly lower average industry recovery ratio. Again, noting that the explanatory variable is an industry average in this section and an individual firm variable in D, we conclude that the evidence is consistent across the individual and industry regressions.

The variables `Industry Growth` and `Concentration` have the same meaning and definition in the two regressions. Industries with higher growth, as proxied by the appreciation of the industry index, tend to have significantly higher recovery ratios in default. This is consistent with the results obtained with the individual recovery ratios both for the whole sample and with the subsample of bankrupt firms but in contrast to the results obtained with non-bankrupt (but defaulted) bonds.

The coefficient on `Concentration` is strongly positive and significant, thus confirming the intuition that more competitive industries (higher Herfindahl indices) are associated with higher recovery ratios on their defaulted bonds. Recall that with the individual recovery ratios we have found insignificant but negative coefficients–a puzzling result.

Table 6. Industry Recovery Ratio Logit Regressions

`Constant`	0.1716	0.1643
`Debt to Equity`	-0.0033 (-1.3855)	-0.0037 (-1.3779)
`Fixed to Total Assets`	-1.1356 (-4.2372)	-1.1291 (-3.8937)
`Industry Growth`		0.1077 (2.5385)
`Concentration`	0.3840 (3.2602)	0.3836 (3.2407)
df	35	35
R^2	0.1986	0.2498

IV. EXPLAINING SURVIVAL TIME

Survival time, defined as the time from bond issue to default, has been the subject of several studies (Altman (1984), Altman et al. (1995), Guedes and Opler (1995), and others). In this section we explore the determinants of the cross-sectional distribution of survival time (time to default) and normalized survival time(time to default divided by time to maturity at issue) across our sample of defaulted bonds and, in particular, try to investigate the impact of individual and industry recovery ratios on that variable.

The primary hypothesis of this section is that *industry* recovery ratios help to explain the cross-sectional distribution of survival times across defaulted bonds. The intuition is simple: if a financially distressed firm operates in a low recovery ratio industry, creditors would rather see the firm continue to operate in the hope that it may regain profitability, rather than force reorganization that may lead to a low recovery of the principal owed. Thus, for example, financing that could help the firm pay its obligations and avoid default may be more readily available for lower recovery ratio industries.

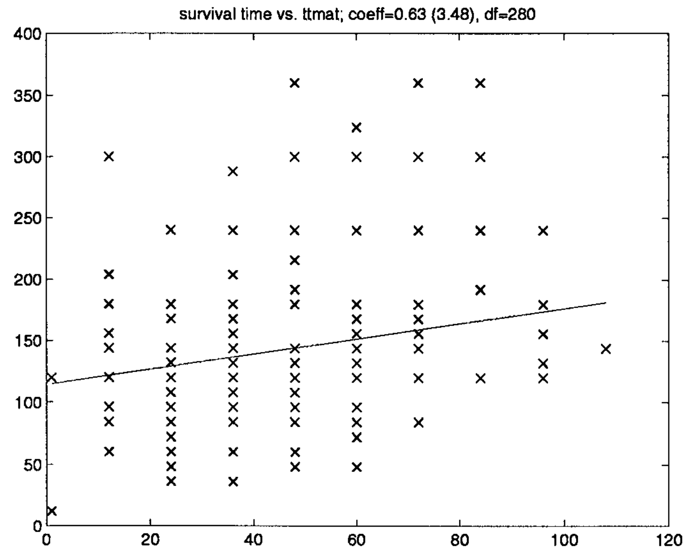
For the empirical analysis we have identified 260 bonds issued and defaulted between 1982 and 1994, for which there are relevant data (as described below) in Compustat. For each bond we use the variable `dnum` from Compustat to determine the 4-digit SIC code of the primary industry in which it operates. Then, treating the industry recovery ratios computed in the previous section as constants across the sample period, we try to assign to each firm an industry-level recovery ratio according to this SIC code. Our sample has 190 bonds for which we can assign industry recovery ratios, the variable `Ind.recovery` in the regression tables.

It is logical to expect that bonds with longer time to maturity would tend to default later as longer maturity typically means a lower debt burden for the borrower. The positive correlation between time to default and time to maturity at issue is illustrated in Figure 1 where we plot the histogram of the logarithm of survival time, using data for 281 defaulted bonds from our sample.

To eliminate this scale effect of time to maturity, the paper also studies the *normalized survival time*. It is interesting to explore whether time to maturity has any effect on the normalized survival time, i.e., whether bonds with longer maturities at issue live proportionately longer than bonds with shorter initial maturities.

In Izvorski (1996) we show that both over the postwar period 1947-95 and over the shorter period 1989-1995 (for which we have aggregate default rate information) the short-term interest rate (proxied by the 3-month Treasury bill rate) has been negatively correlated with the GDP growth rate while the term premium (defined as the difference

Figure 1: **Survival time to time to maturity at issue**



Note: Scatter plot of the survival time to time to maturity at issue for 281 bonds issued and defaulted after 1983 and before 1993, inclusive. The straight line gives the OLS fit.

between the yields on a ten-year Treasury bond and a 3-month Treasury bill) has been positively correlated. We also point out that the risk premium (the difference between the yield on an index of AAA rated corporate bonds and a ten-year Treasury bond), has been negatively correlated with the GDP growth rate.

Interest rates and interest rate spreads have been widely used to predict times of slow growth–recessions in particular and the state of the economy in general (see Stock and Watson (1992)). We follow this idea since we do not want to use the growth rate of GDP as this variable is available only imperfectly and with substantial delay. Therefore, we use the interest rate and interest rate spread data to try to understand whether bonds issued in "bad" times (as defined in terms of low growth) default faster than bonds issued in "good" times (higher growth rates). In other words, are creditors more cautious in "good" times than in "bad" times? Similarly, do some types of bonds (for example, bonds issued by firms in a particular industry) issued in "bad" times default more often and faster than others? In the aggregate, there is a negative correlation between the rate of default and the state of the economy. Does this hold for the individual bonds?

We include the amount of the issue in the analysis (variable `Amount`) to determine whether size proxies for the value of the option to default later rather than sooner ("if a bond is deemed riskier at issue, creditors will tend to lend less").

We argued above that firms with higher leverage have been scrutinized more thoroughly by their creditors and, therefore, only healthier firms are able to borrow more. When firms are in financial distress, however, the value of their equity diminishes and their leverage increases. Thus, shortly before default, the least healthy firms are likely to have higher leverage. To minimize the latter effect (distress causes equity to shrink and leverage increases) we use leverage, as proxied by the ratio of long-term `Debt to equity` at the time of *issue*.

We have been unable to find prices for most of the defaulted bonds in our sample and, thus, cannot accurately compute their yields. Abstracting from callability and discounted prices at issue, however, we can use the coupon rate as a proxy for the promised yield to maturity (variable `Coupon`).

Finally, we include the average industry recovery ratio (variable `Ind. recovery`) in the regressions to analyze whether, under the assumption that industry recovery ratios are constant across time, firms operating in higher recovery ratio industries tend to issue bonds with longer expected lives.

A. Survival time and recovery ratio

Without doubt, the variables "survival time" and "individual recovery ratio" are related to each other. The correlation between the individual recovery ratio and the logarithm of the bond survival time is -0.1773. Similarly, the correlation between the individual recovery ratio and the normalized survival time is -0.1463. The direction of causality is not clear, however, and empirically neither of these variables can be treated as exogenous in determining the other.

To avoid the endogeneity issue, we do not focus on the individual recovery ratio but, rather, on the *industry* recovery ratio when making inferences about the survival time. This is more appealing since, as has been argued in the literature cited above, industry recovery ratios can be treated as relatively stable across time. In our analysis, however, the median number of firms per industry is only 3 which suggests that the endogeneity issue may not be fully addressed. Even if we drop the industries with less than 3 firms per industry to estimate the industry recovery ratio, we still have a median of 4 firms per industry, which is still not sufficient data to avoid the endogeneity problem.

B. Empirical results

Table 7 reports the results from the regression in which the dependent variable is the logarithm of survival time (measured in months) while Table 8 reports similar regressions in which the dependent variable is the normalized survival time. Unless otherwise specified, we will be referring to column 3 of both tables (the regressions with the highest goodness of fit statistic) when discussing the estimates. The last column uses data available at time of issue so that these regressions could be used to generate predictions about the dependent variables.

As hypothesized, the initial time to maturity (`Ttmat`) is positive and significant in the survival time regression but is negative and significant in the regression with the normalized survival time. This suggests that bonds with longer initial time to maturity are likely to default later in their lives but the marginal increase in survival time decreases as initial time to maturity lengthens. We note that the estimates have identical signs and similar levels of significance over the different specifications within the two regressions.

The coefficient on the short rate at issue (variable `Ishort`) is positive and highly significant for both regressions. However, when we include leverage in the regression (see columns 6 in both tables), the coefficients become insignificant which suggests that leverage proxies for the relevant information contained in the short rate at issue.

The risk premium at issue (`Irisk`), on the other hand, is positive and significant across all specifications and the estimates appear robust to the inclusion of leverage in the regression. Since the risk premium is negatively correlated with the growth rate of GDP, the results suggest that defaulted bonds, issued in bad times are (a) likely to default later in their lives, and (b) likely to live proportionately longer the longer the initial time to maturity. The probable cause for these relations is the deeper scrutiny that creditors award to new bond issues in times of low GDP growth.[6]

The short rate at default (`Dshort`) has a coefficient of -0.1777 (t-statistic -7.4972) for the survival time regression and -0.1243 (t-statistic -6.5303) for the normalized survival time regression. The signs on the estimates are identical and the t-statistics are fairly similar across all specifications. Since the short rate is negatively correlated with the GDP growth rate these results suggest that bonds that have lived longer both in absolute and relative terms tend to default more in good times (high GDP growth rates). Coupled with the abundant evidence that credit is more easily secured in good times, it is apparently the case that firms which default in "good" times suffer lesser penalties (mainly in terms of reduced access to capital markets) than firms which default in "bad" times.

This conclusion is further strengthened by the estimates on the risk premium at default which are significantly negative across specifications. For our preferred regressions the coefficient on `Drisk` is strongly significant at -0.9302 (t-statistic of

[6] A similar phenomenon occurred during the recent recovery in the U.S. economy, when credit card companies approved a record number of credit card applications. The trend has been reversed as more moderate growth settled in.

-9.5980) and -0.6374 (t-statistic -8.1866) for the survival time and the normalized survival time regressions, respectively.

As hypothesized, industry level recovery ratios have a significant negative impact both on the survival time and the normalized survival time. The coefficient on `Ind.recovery` is -0.2520 (t-statistic -2.9674) and -0.1788 (t-statistic -2.8803) for the two regressions, respectively. Signs and levels of significance are preserved across all specifications. Assuming that 4-digit SIC code industry recovery ratios are relatively stable across time we find that firms in higher recovery ratio industries (defaulted *ex-post*) tend to default later in absolute and in proportional terms. This result can be interpreted as evidence that creditors are willing to provide financial relief to financially distressed firms for a longer period of time if these firms operate in high recovery ratio industries.

Interestingly enough, the face value of the bond is very insignificant in explaining the cross-section of both the survival time and the normalized survival time. For our preferred regression the coefficient on `Amount` is negative -0.0010 (t-statistic -0.4200) for the survival time estimation and -0.0001 (t-statistic -0.3328) for the normalized survival time regression. The results are robust in terms of sign across all specifications but their t-statistics differ substantially. For the predictive regressions (column 6) the coefficient on `Amount` is -0.0458 (t-statistic -1.0013) and -0.0254 (t-statistic -1.6766), respectively. These results could be rationalized by the fact that interest rates and spread data at default provides additional information that is useful for explaining the cross-sectional distributions of the survival time and the normalized survival time.

The coupon rate is weakly positive for the survival time regression and not significantly negative at any reasonable level for the normalized survival time regression. The coefficient on `Coupon` for the two regressions is 0.0041 (t-statistic 1.0503) and -0.0001 (t-statistic -0.0142), respectively. Bonds, which were considered riskier at issue (higher coupon rates as proxies for the promised yield), tend to default later in absolute time but sooner relative to the initial time to maturity. As before, the results are consistent across specifications.

The last columns in Tables 7 and 8 use only variables known at the time of issue, that is, we include no interest rates or spreads at the time of default. Time to maturity, the general business conditions at issue, firm leverage, and the industry recovery ratio are strongly significant for the determination of the cross-sectional distribution of the bond survival time. The issue amount and promised yield are much weaker in predicting the time of default. The picture is virtually identical for the normalized survival times with the crucial exception of the time to maturity. Bonds with longer initial maturities tend to default later in absolute time (survival time) but earlier relative to the initial time to maturity (normalized survival time).

Table 7. Survival Time Regressions

Constant	0.8334	1.9767	1.9490	0.8519	1.6524
	(5.2434)	(8.5275)	(8.2313)	(1.6623)	(3.0535)
Amount	0.2425		-0.001	-0.0001	-0.0458
	(3.8535)		(-0.4200)	(-0.2141)	(-1.0013)
Coupon	0.4108		0.0041	0.0118	0.0106
	(4.2231)		(1.0503)	(1.0949)	(0.8947)
ln(Ttmat)	0.1235	0.1271	0.1273		0.2434
	(5.1184)	(2.3070)	(2.1902)		(3.2367)
Ishort	0.0722	0.0695			0.0055
	(6.5460)	(5.8869)			(0.1677)
Irisk		0.6417	0.6494	0.9516	0.6889
		(7.3657)	(7.3069)	(4.1961)	(2.6069)
Dshort		-0.1782	-0.1777	-0.0537	
		(-7.5381)	(-7.4972)	(-1.4417)	
Drisk	-0.5262	-0.9257	-0.9302	-1.6765	
	(-5.3233)	(-9.5971)	(-9.5980)	(-7.3842)	
Ind.recovery	-0.2773	-0.1597	-0.2520	-0.8489	-0.6401
	(-3.1239)	(-2.0814)	(-2.9674)	(-4.4155)	(-2.7760)
Debt to equity					-0.0203
					(-2.2073)
df	183	181	179	150	169
R^2	0.3497	0.5388	0.5421	0.4702	0.2772

Dependent variable - logarithm of time to default. T-statistics are in parenthesis. Variables explanation is given in Table 2. The last regression is the "predictive" one - it includes only variables known at the time of issue.

Table 8. Normalized Survival Time Regressions

Constant	1.1935	1.9786	1.9856	0.7911	1.1752
	(9.5818)	(10.6598)	(10.4389)	(1.9835)	(6.5560)
Amount			-0.0001	-0.0001	-0.0254
			(-0.3328)	(-0.2415)	(-1.6766)
Coupon			-0.0001	-0.0018	-0.0001
			(-0.0142)	(-0.4271)	(-0.0314)
ln(Ttmat)	-0.4856	-0.5683	-0.5638		-0.2006
	(-9.9485)	(-12.8872)	(-12.070)		(-8.0505)
Ishort		0.0527	0.0516		0.0023
		(5.9664)	(5.4445)		(0.2107)
Irisk	0.3186		0.4776		0.2220
	(4.2225)		(6.6903)		(2.5356)
Dshort		-0.0586	-0.1243		
		(-2.8233)	(-6.5303)		
Drisk	-0.3523	-0.3667	-0.6374	-0.3774	
	(-4.5952)	(-4.4268)	(-8.1866)	(-4.9457)	
Ind.recovery	-0.2624	-0.1804	-0.1788		-0.2476
	(-3.8124)	(-2.9361)	(-2.8803)		(-3.2416)
Debt to equity				-0.1768	-0.1631
				(-2.7980)	(-2.3146)
df	183	181	179	200	169
R^2	0.4783	0.6056	0.6059	0.4568	0.4271

Dependent variable - normalized survival time (time to default over time to maturity). T-statistics are in parenthesis. Variables explanation is given in Table 2.

V. CONCLUSION

We have collected data on defaulted U.S. corporate bonds (1983-93) and analyzed the determinants of the cross-sectional distribution of both individual and industry average recovery ratios. The type of industry the issuing firm operates in, the seniority of the debt, as well as the type of restructuring used in case of default are the most important variables determining the levels of individual recovery ratios. At the industry level, concentration and the ratio of fixed to total assets, together with industry growth play the most important role.

Results indicate that the industry recovery ratio is a significantly positive determinant of the cross-sectional distribution of both survival time and normalized survival time across the sample of defaulted corporate bonds. All the analysis, however, has been performed under the assumption that industry average recovery ratios are relatively stable across the sample period (1983-93), an assumption made primarily because of the small sample size. It remains to be seen whether this hypothesis is realistic and whether its relaxation will qualitatively affect the results of this paper.

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