Back on Bond ratings, Bond Yields and United States Financial Regulation[*]

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Abstract

A multivariate analysis has been used in order to investigate the relationship between bond yields, bond ratings and standard control variables (default risk and marketability) for corporate (NYSE) issues outstanding on December 31st 1971, 1973 and 1975. While evidencing an explanatory power for bond ratings may be interpreted as a proof of their informational value, the exercise is aimed at testing the robustness of such a value to the enactment of financial regulations using bond ratings as an input. The contribution of bond ratings in the explanation of the variability in bond yields has been validated for the three dataset but appears stronger for the one gathered once the chosen regulation had been fully enacted (1975).

Key words: bond ratings, bond yields, financial regulation
JEL codes: G12, G18, G24

Preliminary draft: september 2007

[*] I would Like to thank M. Aglietta, E. Altman, V. Bignon, I. Bilon, G. Capelle-Blanchard, D. Hamilton from Moody's Investor Services, H. McLaughlin from S&P Credit Research, and, last but not least, R. Sylla. The usual disclaimer applies. This work has been done during a visiting scholar stay at the New York University Stern Business School Department of Economics, which benefited from funding by the Georges Lurcy Board of Trustees.

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The financial turmoil following the United States (US) subprime crisis has strongly brought credit rating agencies liability back into question with the unprecedented fact that huge quality problems occured with securities that these firms actively helped to shape. While the role and performance of bond ratings have been recurring issues, regulatory pressures towards a century old rating business had never materialized before the aftermath of the equity « dotcom » bubble crash. When European Union (EU) authorities rather quickly opted for a self regulation approach strongly relying on codifying business ethics, United States (US) Congress launched a process of hearings and reports that ended with the Credit Rating Agency Reform Act of 2006. This legislation added to self regulation the need to increase competition in the credit rating business by ending a form of agencies' designation introduced by the Security and Exchange Commission (SEC) in the 1970s.

In contrast to these late pressures towards a regulation *of* ratings, an interesting fact is that US financial regulation has been working *through* ratings for over 70 years. As soon as in the 1930's, US Federal and State bodies began to use bond ratings for the purpose of regulating bank investments. This spread controversies, but they died out as no other regulatory move occurred and as subsequent decades brought good economic conditions, high quality bond issues and very few defaults. These regulations enacted in the 1930's can be considered as a "first wave" of US financial regulation embodying bond ratings, as opposed to a "second wave" starting in the early 1970's. At this time, the practice of incorporating bond ratings in regulatory rules was revived and expanded by US financial authorities in a movement originated by the Security and Exchange Commission (SEC) in its 1973-1975 regulation of broker-dealers, precisely the one that included granting certain rating agencies a "Nationally Recognized Statistical Ratings Organizations" (NRSRO) status.

The fact that financial regulation uses ratings may prove as a determinant of the relation between bond ratings and yields. While this point has often been made, little evidence has been brought forward to support it. Following the lead of West (1973), one can take advantage of history by performing tests before and after the enactment of these regulations, a strategy that will be followed thereafter for the outset of the "second wave" of US financial regulation embodying bond ratings. Section 1 provides a review of the literature focusing on a cross examination of bond ratings and yields. Section 2 introduces the chosen empirical framework. Section 3 discusses the results.

1. Literature review

An interesting feature of the bond markets is that some firms deal with the established business of rating bonds on the basis of their relative financial quality. These *bond ratings* are meant to proxy for the "expected reliability in meeting future financial requirements" and have become a quite shared measure of bond default risk. Since they are ultimately valued because they are recognized as such by investors, it is then tempting to investigate their relationship with bond yields[1] in order to elaborate on the pertinence of their use. Such a strategy is at the heart of two linked but quite distinct bodies of literature relying on Econometrics, one for each of the following questions:

a) Are bond ratings relevant to explain bond yields?

b) Do bond yields react to a change in bond ratings?

The present paper only intends to deal with a). This statement means a focus on a static cross examination of bond ratings, control variables and yields[2]. A typical review of literature may then be: West (1973), Liu &Thakor (1984), Ederington et al. (1987), Reiter &Ziebart (1991), Levingston et al. (2003). The latest study provides details about the earlier ones that will not be introduced here (pp. 4-6). Levingston et al. (2003) then use a latent variable methodology and yields on new industrial bond issues to focus on whether bond ratings contain non-publicly available information.

In 1959, L. Fisher produced a study of corporate bond yields using a log/log transformation of the common Ordinary Least Square (OLS) regression analysis. This study became classical and, in 1973, R. West investigated the relationship between Moody's ratings and L Fisher's regressions residuals. As opposed to a lack of pronounced relationship in 1927, 1932 and 1937, the behavior of residuals could be linked to the investment grade status in 1949 and 1953. The cross examination of bond ratings, control variables and yields, came to document an impact of the "first wave" of US financial regulation embodying bond ratings[3]. An interesting point is that most of the following studies dealt solely with the neutral position of evidencing *an informational* value of ratings. For example, Ederington et al. (1987) "explores the information content" of Moody's and S&P ratings beyond publicly available accounting variables by relating them to the yield to maturity. The authors

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[1] Bond prices are usually given as percentages of the original face value of the bond. In order to study the behavior of bond market agents, it has moreover been a convention to focus on the annual rates of return implied by these prices or *yields* as they are referred to.

[2] A reader interested with b) (i-e "do Y react to a bond rating change?") may found a review of the relevant literature in Kliger &Sarig, (2000, 2 p. 2280).

[3] Following the Comptroller of the Currency statement on 02/15/1936 (…further defined in his 10/27/1936 ruling), it became common knowledge in bond circles that bond rated below that of "a business man investment "(BBB, Baa, B**, B1+) could almost never be sold to a bank. (see Harold (1938, p. v)).

used a non-linear lest square procedure on data concerning bonds traded on the NYSE on the 02/28/1979 and 02/28/1981[4].

Overall, a concern for the implications of R West's insight may be shown, but the issue of sorting the investigated informational value from a regulatory value is not faced. To my knowledge, the only reference that would make this statement a lie is Brister et al. (1994). Interestingly enough, this paper starts with a reference to studies dealing with the investigation of realized or *ex post* yields, where a focus on the impact of US financial regulation is more common[5]. The authors then proceed with several methodologies in order to evidence an inflation of yields for non-investment grade bonds above the one that could be expected by judging on default risk.

While Brister et al. (1994) duplicates methodologies on a given sample, the present paper intends to replicate a given methodology on carefully selected samples. By chance, the very spacing of L. Fisher's regression allowed R. West to investigate a possible impact of regulations enacted at the end of the 1930s. Following this example, the model introduced below is to be tested on data for Dec 31 1971, 1973 and 1975 in order to investigate a possible impact of regulations enacted by the SEC at the beginning of the 1970s[6].

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[4] The present paper is about to use *actual* yields computed from the prices on the second market as opposed to *offering* yields observed on the primary market. To my knowledge, the literature does not discriminate on this point, which could nonetheless be considered. After introducing a broader picture, I focus here on the only two earlier references that did use actual yields. Note that while mixing studies using actual yields and offering yields has then been common, studies focusing on the impact of multiple ratings on yields at issuance have usually been set aside (see, for example., Liu & Moore (1987), Billingsley et al. (1985), Hsueh & Kidwell (1988), Thompson &Vaz (1990)).

[5] Considering the experience of bond issues for 1900-1943, B. Hickman came to the conclusion that actual loss rates did not completely eliminate the *ex ante* higher yields accorded to bonds with lower ratings (see Hickman (1958) table 1 p10). This finding was then restudied and contested (see Fraine &Mills (1961)), it however remained a piece of evidence that could be interpreted as a claim for a more active trading of high yield debt securities (see, e. g., Fitzpatrick &Severiens (1973)). Then, along with the rise of the high yield (or "junk") bond market came further investigations showing that investors in speculative bonds had been more than satisfactorily compensated for the default risk (see, for example, Altman & Namacher (1985), Altman (1987) and Altman (1989)). Producing evidence on the overcompensation for default risk by high yield debt securities would usually go along with noting that demand for these securities had been constrained by legal restrictions for a number of institutional investors.

[6] cf., supra, introduction, I refer here to the regulation of broker-dealers by Rule 15c3-1, which set forth certain "haircut" requirements. A "haircut" is the percentage of a financial asset's market value a broker-dealer is required to deduct for the purpose of calculating its net capital requirement. Rule 15c3-1 required a different "haircut" based on the credit ratings assigned to the asset and included the creation of a NRSRO status (See Notice of Revision Proposed Amendments to Rule 15c3-1 under the Securities Exchange Act of 1934, Release No. 34-10, 525, 1973 SEC LEXIS 2309 (Nov. 29, 1973): "The Commission to a limited extent has also recognized the usefulness of the nationally recognized statistical rating organizations as a basis for establishing a dividing line for securities with a greater or lesser degree of market volatility."). The formal enactment came in 1975 (See Adoption of Amendments to Rule 15c3–1 and Adoption of Alternative Net Capital Requirement for Certain Brokers and Dealers, Release No. 34–11497 (June 26, 1975), 40 FR 29795 (July 16, 1975)).

2. Empirical analysis

Let us start with the assumption that the yield (Y) on a bond issue (i) will be a function of: 1) the rate of return of riskless debt, 2) issue characteristics defined as whether the bond prospectus mentions several provisions or restrictions, 3) the probability of default of (i)[7].

The first overall specification is then:

$Y_i = f(C_i, R_i, X_i, YREF_i, u_i)$

where Y_i : yield to maturity on the issue i
C_i : issuer's creditworthiness
R_i : bond rating of the issue i
X_i : issue i other characteristics
$YREF_i$: yield on the chosen risk free issue
u_i : random error

A first step is to change the target variable in order to focus on the spread between the yield on the issue i and the yield on the chosen risk free issue[8]. Hence a new variable is defined as follows:

$RYSpread_i = (Y_i - YREF_i) / YREF_i$

2.1. Data

The starting point has been data communications by SP and Moody's according to their archiving of US corporate bond rating histories at the end of the 1960s and the beginning of the 1970s. Datasets for bond ratings outstanding on Dec 31 for the years 1971, 1973 and 1975 are subsets of these files.

In order to compute yields, information on the bond issue bearing the rating is needed (name, coupon, maturity, etc.). In the case of the Moody's communication, such information is missing and then gained by merging the dataset with the Mergent Fixed Income Securities Database (FISD) database[9]. Once this common dataset of outstanding ratings has been built, it is merged with the

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7 See, for example, Merton (1974, p. 449). This assumption is standard but may be considered simplistic… for instance, Fisher (1959) raises the issue of marketability; while Ederington et al. (1987, p.218) or Elton et al. (2001, p. 247) raise the one of taxation.

8 The computed yield spread is *relative* as opposed to the common *absolute* yield spread ($ABSYSpread_i = Y_i - YREF_i$). Lamy &Thompson (1988) show how the relative yield spread appears to be a more stable measure considering changes in interest rates. The basis of $YREF_i$ is the yield of US Treasury bond according to the CRSP monthly Treasury database (for detail on the computation see annex A). These issues are of course not perfectly exempt from risk but it is extensively common to consider their yield as a pure rate.

9 Given this added merging and also that the Moody's communication is by far more numerous, I focus on Moody's ratings *that do not duplicate the S&P ratings*. My rationale for doing so is that I am not interested in multiple/split ratings issues, which is of course a limitation of the following results.

Compustat North America Industrial Annually database in order to get information on the issuing company.

Lastly, the main data in the computation of actual yields, which is the price of the bond on the second market, is still missing[10]. I followed L. Fisher's methodology and then hand-computed bond prices based on the New York Stock Exchange (NYSE) quotations as reported by the Bank and Quotation Report relevant issues (see Annex A for details on this point).

A huge loss in the data is induced by this whole merging process[11]. The outcome is a sample of bond ratings, prices, etc., *per bond issue* and then can sometime produce a certain number of observations identical according to the gathered information. These observations are computed in order to build an average yield spread given a rating for the issuer[12]. Working on a test *per issuer* further reduces the size of the datasets, the final samples descriptive statistics are given in Annex B.

2.2. Variable selection

A balance has to be stricken between a full account of ratings determinants (see Chan&Jegadesh (2001), Appendix p. 23) and a final set that has to be easily computable for an average investor. It should moreover be noted that the exercise of replicating bond ratings may not end up with an acknowledged default probability prediction model when it is desirable that the set of control variables be viewed as a potential standard for the typical investor.

2.2.1. On default risk (C_i)

With these requirements in mind, a first step can be to focus on financial ratios, for example broken down by i) liquidity, ii) profitability and iii) capital structure (see Tang (2006, appendix B p. 48). The next step is then to pick a number of these ratios (for instance, previous studies may be interpreted as pointing out the choice of: (1) firm size, (2) any measure of leverage, (3) profitability as

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[10] This is not a problem for an investigation focusing on the offering yield (i-e the yield offered when the bond was issued on the primary bond market). The offering price and sometime the offering yield is reported in any dataset describing bond issues (e.g. Mergent FISD).

[11] Statistics are available upon request to the author

[12] Of course, unless it can be linked to (a) a different level of security or (b) a difference between SP and Moodys ratings (a split rating, the account of which is very rare because of the decision I described earlier). In these cases, different observations are conserved.
When needed, this computation is done regardless of the agency that produced the rating. That is, if one company has, say, two outstanding bond issues each one bearing the same rating but one from Moodys and the other from SP, an average is computed based on the respective outstanding amount of the issues and a single observation is created. The outstanding amounts on Dec 31 are found in the relevant issues of the Moodys Industrial and Public Utilities manuals.

measured by interest coverage or operating margin and (4) profitability as measured by return on assets, see Livingston et al. (2003, p. 17 and table 1 p. 39)).

The present study will somewhat depart from the above framework. If one looks for a standard way to analyze default risk, the success and common use of the Z score models must be outlined (Altman (1968) introduced these models while Altman (2000) provides an extended introduction to them). To my knowledge, while it has been quite common to plot Z scores against ratings, only Brister et al. (1994) imported them in a cross examination of ratings and yields. They replicated a Z score methodology in order to use the computed scores as default risk proxies. This meant a two stepped process starting with a Multi Discriminant Analysis (MDA), which goes along with several hypotheses and computational complexity. Rather than focusing on the output of Z score models, the input, that is the very variables constituting the model, constitute an interesting set of predictors for credit risk. Including them as control variables for the present investigation follows Altman &Rijken (2005) using them in an ordinal logit regression to build a rating prediction model.

I further follow Altman &Rijken (2005) by supplementing the common Z score determinants with a variable accounting for the number of years since a company was first rated by a company. This kind of variable is quite common in investigations of ratings determinants but remain somewhat absent in the typical cross examination of yields and ratings. To put it in a nutshell, my set of predictors accounting for credit risk is the "agency ratings prediction model" as introduced by Altman &Rijken (2005).

2.2.2. On other issue characteristics (X_i)

Turning to issue characteristics other than default risk can be a rather difficult task since the bond prospectus may include numerous features, the relevance of which for the bond pricing process being left open to discussion. A cautious strategy can be to gather a sample of bond issues with similar features and hence focus on ratings and default risk variables (cf. Livingston et al. (2003, 2 p. 22)). Information on the subordination and security level of bond issues could be gathered while building the datasets and is then included in the model with the help of two dummies variables: SUB coding for subordination and SEC coding for security. It should however be noted that I do not account for other common features such as the presence of a call and/or the one of a sinking fund.

Furthermore, the original datasets mixed ratings for industrials and for public utilities, which are usually considered as two different categories. Instead of splitting my datasets, I took the other option of including a dummy variable coding for public utilities (UTILITY) to my model.

2.3 model

The above remarks are summarized the table below:

	Name	Definition	Source
Numerical	Y	Annual yield to maturity computed according to the price of bonds on Dec 31	Bank and Quotation Record
	YREF	Annual yield to maturity of chosen risk free rate	CRSP Monthly Treasury fixed term indices complemented with CRSP Monthly Treasury Fama risk free rate for maturity below a year
	RYSpread	(Y - YREF) / YREF	---
	SIZE	log(book value of total liabilities/total value of US equity market)	The total value of US equity market is found in the CRSP database Book value (BL) is Compustat data 181
	1+ln(ME/BL)	ME = market value of equity BL= book value of total liabilities	ME is Compustat data 24 by Compustat data 25 BL is Compustat data 181
	WK/TA	WK = working capital TA = total assets	WK is Compustat data 179 TA is Compustat data 6
	ln(1-(RE/TA))	RE = retained earnings TA= total assets	BL is Compustat data 181 TA is Compustat data 6
	1-EBIT/TA	EBIT=Earnings before taxes TA=total assets	EBIT is Compustat data 170 plus Compustat data 15 TA is Compustat data 6
Categorical	AGE	years since a firm was first rated by an agency*	S&P and Moodys communications
	R	Bond ratings	S&P and Moodys communications
	SUB	Dummy for subordination	S&P dataset and Mergent FISD
	SEC	Dummy for security	S&P dataset and Mergent FISD
	UTILITY	Dummy for public utilities	Compustat issuer codes

* The upper limit of AGE is set to 10 (see Altman &Rijken 2005 note 4 p. 38)

Note that bond ratings are going to be treated as a categorical variable. For the created categories to be displayed in an order following the rating scale, I have had to "rename" ratings categories and chose to do it as follows:

Moody's	S&P	RATING
Aaa	AAA	1
Aa	AA	2
A	A	3
Baa	BBB	4
Ba	BB	5
B	B	6

This is *not* a numerical conversion… the categorical nature of bond ratings is to be respected thanks to the use of a General Linear Model following the overall equation:

$RYSpread_i = f\,(SIZE_i,\ 1+\ln(ME/BL)_i,\ WK/TA_i,\ \ln(1-(RE/TA))_i,\ 1-EBIT/TA_i,\ AGE_i,\ R_i,\ SUB_i,\ SEC_i,\ UTILITY_i,\ YREF_i,\ u_i)$

Lastly, in 1973 and 1975, the target variable RYSpread was clearly right tailed and then changed to[13]:
$LNRYSpread_i = LN\,(RYSpread_i)$.

3. Results (Interpretation and analysis)

The model has been tested on data for December, 31st 1971, 1973 and 1975[14]. When residuals exhibited non-constant variance, a weighted analysis has been found helpful[15]; the three final outputs may be found in Annex C.

These outputs start with analysis of variance tables that help to assess whether the predictors of the model are related to the variability in the target variable. This is done by looking at the respective *F* statistics and related *p* values. Only 3 variables did show up as significant predictors for every investigated year: SIZE, AGE and RATING. Then, 1+ln(ME/BL) and ln(1-(RE/TA)) proved significant for two years (respectively 1973-1975 and 1971-1973). The remaining variables reached statistical significance only once with the exception of UTILITY, the poor performance of which goes against a constant switch between utilities and industrials.

Due to the reliance on weights, the displayed R^2 measures are not straightforward goodness of fit measures as in the standard Ordinary Least Squares analysis[16]. Judging by this limited criterion, the model performs reasonably well by explaining always more than 75% of the variability in the yield spread.

The next part of the outputs gives the estimated coefficients for the numerical variables. As for the categorical variables, least squares means for the target variable given all predictors equal to their mean value are displayed per category. An overall interpretation of the respective factors is however difficult due to an always changing set of significant variables.

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[13] One may have noticed that most of the variables in the "agency ratings prediction model" were logged so this new transformation does nothing than turning a semi-log model into a log/log model.

[14] Cf. note 6: at the end of 1971, the "second wave" has not yet started; at the end of 1973, the enactment of Rule 15c3–1 by the SEC is pending; at the end of 1975, the rule is on for 6 months.

[15] Details about this analysis are available upon request to the author.

[16] The reported value are not $R^2 = 1 -$ (Residual Sum of Square/Total Sum of Square) but approximations defined by $R^2 = (pF) / (pF + n - p - 1)$.

While the explanatory power of RATING has been evidenced for the 3 years, it is interesting to wonder whether the full rating scale is relevant given all the other predictors. Since the model does not include interactions, this is assessed with the help of Tukey comparison tests. The reports of these tests are in Annex D. For 1971 and 1973, the surprising result is that most rating categories fail to prove as statistically different. In contrast, in 1975 most of the rating scale proves significant beyond the 5% level.

As in any multivariate analysis, the relevance of bond ratings stands given the level of all other variables in the model. Hence, the results above may be interpreted as evidencing an informational value of bond ratings given a fair appraisal of credit risk and some marketability features (subordination and security). Following this interpretation, it is to be noted that (i) this informational value proved quite stable in comparison to the other predictors of the model and (ii) bond ratings proved the most relevant in 1975.

Concluding remarks

Beyond a concern for the impact of US regulation, Brister et al. (1994) shares with West (1973) the overall assumption that what has to be evidenced is an unexplained premium in the yields of non-investment grade bonds. The common methodology is to use a straightforward reading of the "first wave" of US financial regulation in order to reach conclusions on a possible impact of these regulations.

First, one may argue that an attention to the overall significance of the ratings may also be welcome. Another straightforward effect of the ruling could be an increase in the reliance on bond ratings for the pricing of all bond issues. Secondly, even if a focus on this unexplained premium for non investment grade bonds is agreed, its mere evidencing would not be enough. One has at least to raise the issue of other developments that could have challenged such a straightforward effect (for instance, Glenn (1976) argues that proponent of such a regulatory induced premium need to investigate why arbitrage by unconstrained investors has not taken place). Lastly, if one truly intends to focus on the impact of US financial regulation embodying rating, the present framework may be restrictive. For example, Harold identifies this first "practical effect" on non-investment grade yields but also mentions "more far reaching effects" (such as the development of other more yielding avenues of investment like real estate mortgage, see Harold (1938, pp. 33-34)).

Departing from a focus on the over-inflation of non investment grade bond yields as an impact of US Financial regulation, the present paper intends merely to provide a test for the results evidencing an informational value of bond ratings. Is this informational value robust to the presence or not of US financial regulation using ratings? On one hand, the relevance of bond ratings in the pricing of corporate bond issues has been established for 1971, 1973 and 1975. On the other hand, the rating scale exhibited a true statistical significance only once new regulation had been enacted. Provided that one agrees with the introduced methodology, this finding may be interpreted as the informational value of ratings increasing significantly with the outset of the "second wave" of US financial regulation embodying bond ratings.

Annex A – The computation of yield spreads

The first step is to compute bond prices as of Dec 31 starting with the quotation as reported by the Bank and Quotation Report issue for the following January. The methodology below follows Fisher (1959, appendix A p.52).

The standard way is to get the last sale price on 12/31 and the first sale price on following business day and then compute their arithmetic mean. If this arithmetic mean is inside the closing Bid &Ask spread on Dec 31 then it is taken as price. Otherwise, what is taken as price is the Bid or the Ask quote that is the nearest to this arithmetic mean. Then there are of course cases when this standard way cannot be performed:

- If only one sale price is found, when it comes on Dec. 31, what is taken as price is the arithmetic mean of this price with the following bid quote, because the latter brings new info; when it comes on the opening day of January, it is taken as price because it usually resolves the Bid &Ask spread on Dec. 31.
- If only 1 Bid &Ask spread is found, the arithmetic mean is taken as price
- If only 2 bids quotations are found, their arithmetic mean is taken as price
- If only 1 bid quotation is found, it is taken as price
- If only 1 or 2 ask quotations are found, the data is rejected

The second step is to compound yields to maturity based on these prices, which is quite straightforward.

The third step is to gather yields that are to be considered as risk free[17]. This is done thanks to the CRSP Monthly Treasury fixed term indices on Dec 31st, complemented with the CRSP Monthly Treasury Fama risk free rates (for 1 month and 90 days maturities). In order to match every yield on a bond issue to a comparable risk free rate according to maturity, I use these yields to build a risk free rate curve given the years to maturity. That YREF curve is built with the help of a regression equation based on these first observations, which is given in the table below[18].

Year	Curve equation	R^2
1971	$YREF = 0.001\ YTM^3 - 0.0463\ YTM^2 + 0.584\ YTM + 3.5614$	0.9673
1973	$YREF = 0.0001\ YTM^4 – 0.0048\ YTM^3 + 0.076\ YTM^2 – 0.4719\ YTM + 7.5278$	0.8962
1975	$YREF = 0.5136\ LN(YTM) + 6.2369$	0.9633

[17] As stated before, the fourth and last step is to compute a relative yield spread: $RYSpread_i = (Y_i - YREF_i)/ YREF_i$

[18] Regressions are found to work well but not trusted enough to be followed for out of sample prediction… for maturities above 30 year, I take the conservative view of setting YREF to the value of the 30 year fixed term indice.

Annex B – Sample statistics

1971 (N = 110) Descriptive Statistics: RYSpread

Variable	RATING	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median
RYSpread	1(Aaa/AAA)	10	0	0.3311	0.0572	0.1809	0.0565	0.1837	0.3261
	2(Aa/AA)	25	0	0.4480	0.0344	0.1721	0.1656	0.3094	0.4533
	3(A/A)	53	0	0.6233	0.0268	0.1955	0.0075	0.5335	0.6367
	4(Baa/BBB)	15	0	0.6419	0.0533	0.2063	0.2660	0.4793	0.6878
	5(Ba/BB)	3	0	0.813	0.169	0.292	0.516	0.516	0.824
	6(B/B)	4	0	0.993	0.218	0.436	0.540	0.584	0.982

Variable	RATING	Q3	Maximum
RYSpread	1(Aaa/AAA)	0.5012	0.5882
	2(Aa/AA)	0.5794	0.8008
	3(A/A)	0.7589	0.9449
	4(Baa/BBB)	0.7934	0.9543
	5(Ba/BB)	1.100	1.100
	6(B/B)	1.411	1.466

1973 (N = 123) Descriptive Statistics: LNRYSread

Variable	RATING	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median
LNRYSread	1(Aaa/AAA)	11	0	-2.458	0.234	0.778	-4.351	-2.694	-2.279
	2(Aa/AA)	31	0	-2.159	0.105	0.587	-4.562	-2.394	-1.968
	3(A/A)	57	0	-1.8376	0.0467	0.3527	-2.6417	-2.0944	-1.8225
	4(Baa/BBB)	14	0	-1.188	0.135	0.504	-1.860	-1.554	-1.345
	5(Ba/BB)	4	0	-1.060	0.701	1.401	-2.862	-2.516	-0.728
	6(B/B)	6	0	-0.418	0.292	0.715	-1.352	-1.286	-0.143

Variable	RATING	Q3	Maximum
LNRYSread	1(Aaa/AAA)	-1.915	-1.624
	2(Aa/AA)	-1.795	-1.478
	3(A/A)	-1.6353	-0.7045
	4(Baa/BBB)	-0.792	-0.355
	5(Ba/BB)	0.064	0.078
	6(B/B)	0.119	0.354

1975 (N = 151) Descriptive Statistics: LNRYSpread

Variable	RATING	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median
LNRYSpread	1(Aaa/AAA)	15	0	-2.510	0.124	0.481	-3.313	-2.801	-2.661
	2(Aa/AA)	31	0	-2.111	0.102	0.566	-3.789	-2.406	-1.979
	3(A/A)	79	0	-1.6041	0.0590	0.5242	-4.8257	-1.7542	-1.5181
	4(Baa/BBB)	18	0	-1.034	0.191	0.811	-3.357	-1.233	-1.042
	5(Ba/BB)	3	0	0.163	0.273	0.473	-0.383	-0.383	0.418
	6(B/B)	5	0	-0.456	0.492	1.099	-1.720	-1.290	-0.702

Variable	RATING	Q3	Maximum
LNRYSpread	1(Aaa/AAA)	-2.141	-1.611
	2(Aa/AA)	-1.697	-1.329
	3(A/A)	-1.3134	-0.6409
	4(Baa/BBB)	-0.498	0.062
	5(Ba/BB)	0.454	0.454
	6(B/B)	0.500	1.270

Annex C – Final Statistical Reports

1971

General Linear Model: RYSpread versus AGE, UTILITY, RATING, SUB, SEC

Factor	Type	Levels	Values
AGE	random	8	1, 2, 3, 4, 5, 6, 8, 10
UTILITY	fixed	2	0, 1
RATING	fixed	6	1, 2, 3, 4, 5, 6
SUB	fixed	2	0, 1
SEC	fixed	2	0, 1

Analysis of Variance for RYSpread, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
SIZE	1	15.7476	1.0507	1.0507	14.48	0.000
1+ln(ME/BL)	1	0.7503	0.0028	0.0028	0.04	0.845
WK/TA	1	0.2057	0.3737	0.3737	5.15	0.026
ln(1-(RE/TA))	1	4.1345	1.0450	1.0450	14.40	0.000
1-EBIT/TA	1	1.8864	0.0103	0.0103	0.14	0.707
AGE	7	3.2574	2.6820	0.3831	5.28	0.000
UTILITY	1	0.0001	0.0423	0.0423	0.58	0.447
RATING	5	1.0291	1.0954	0.2191	3.02	0.015
SUB	1	0.0739	0.0695	0.0695	0.96	0.330
SEC	1	0.2279	0.2279	0.2279	3.14	0.080
Error	89	6.4578	6.4578	0.0726		
Total	109	33.7707				

S = 0.269369   R-Sq = 80.88%   R-Sq(adj) = 76.58%

Term	Coef	SE Coef	T	P
Constant	0.0407	0.4825	0.08	0.933
SIZE	-0.13029	0.03424	-3.81	0.000
1+ln(ME/BL)	0.00859	0.04371	0.20	0.845
WK/TA	0.3299	0.1454	2.27	0.026
ln(1-(RE/TA)	0.4151	0.1094	3.79	0.000
1-EBIT/TA	0.1916	0.5079	0.38	0.707

Means for Covariates

Covariate	Mean	StDev
SIZE	-3.324	0.50299
1+ln(ME/BL)	1.344	0.74201
WK/TA	0.210	0.16686
ln(1-(RE/TA))	-0.387	0.21343
1-EBIT/TA	0.894	0.04884

Least Squares Means for RYSpread

RATING	Mean
1 (Aaa/AAA)	0.4264
2 (Aa/AA)	0.4696
3 (A/A)	0.5297
4 (Baa/BBB)	0.4388
5 (Ba/BB)	0.5602
6 (B/B)	0.9656

AGE	Mean
1	0.5802
2	0.5671
3	0.6433
4	0.6210
5	0.5153
6	0.6537
8	0.5375
10	0.4023

UTILITY	Mean
0	0.5308
1	0.5993

SUB	
0	0.6629
1	0.4672

SEC	
0	0.6336
1	0.4965

1973

General Linear Model: LNRYSread versus RATING, SUB, SEC, AGE, UTILITY

Factor	Type	Levels	Values
RATING	fixed	6	1, 2, 3, 4, 5, 6
SUB	fixed	2	0, 1
SEC	fixed	2	0, 1
AGE	random	9	1, 2, 3, 4, 5, 6, 7, 8, 10
UTILITY	fixed	2	0, 1

Analysis of Variance for LNRYSread, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
SIZE	1	31.4063	12.6489	12.6489	32.80	0.000
1+ln(ME/BL)	1	74.4303	13.0833	13.0833	33.93	0.000
WK/TA	1	7.6804	0.2270	0.2270	0.59	0.445
ln(1-(RE/TA))	1	6.6557	1.8772	1.8772	4.87	0.030
1-EBIT/TA	1	6.9473	1.4800	1.4800	3.84	0.053
RATING	5	13.0621	6.3984	1.2797	3.32	0.008
SUB	1	3.1922	1.9877	1.9877	5.15	0.025
SEC	1	0.8484	0.7199	0.7199	1.87	0.175
AGE	8	17.9470	18.1306	2.2663	5.88	0.000
UTILITY	1	0.4717	0.4717	0.4717	1.22	0.271
Error	101	38.9493	38.9493	0.3856		
Total	122	201.5907				

S = 0.620996   R-Sq = 80.68%   R-Sq(adj) = 76.66%

Term	Coef	SE Coef	T	P
Constant	-4.0097	0.7431	-5.40	0.000
SIZE	-0.34440	0.06013	-5.73	0.000
1+ln(ME/BL)	-0.21812	0.03745	-5.82	0.000
WK/TA	0.2175	0.2835	0.77	0.445
ln(1-(RE/TA)	0.4253	0.1927	2.21	0.030
1-EBIT/TA	1.4493	0.7398	1.96	0.053

Means for Covariates

Covariate	Mean	StDev
SIZE	-3.250	0.49969
1+ln(ME/BL)	0.816	0.95092
WK/TA	0.207	0.15606
ln(1-(RE/TA))	-0.380	0.22662
1-EBIT/TA	0.887	0.06904

Least Squares Means for LNRYSread

RATING	Mean
1(Aaa/AAA)	-2.371
2(Aa/AA)	-2.254
3(A/A)	-2.134
4(Baa/BBB)	-1.934
5(Ba/BB)	-1.427
6(B/B)	-1.273

AGE	Mean
1	-2.216
2	-1.976
3	-1.624
4	-1.983
5	-1.799
6	-2.310
7	-1.765
8	-1.646
10	-1.773

UTILITY	Mean
0	-1.842
1	-1.956

SUB	Mean
0	-1.674
1	-2.124

SEC	Mean
0	-1.851
1	-1.947

1975

General Linear Model: LNRYSpread versus RATING, AGE, UTILITY, SUB, SEC

Factor	Type	Levels	Values
RATING	fixed	6	1, 2, 3, 4, 5, 6
AGE	random	10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
UTILITY	fixed	2	0, 1
SUB	fixed	2	0, 1
SEC	fixed	2	0, 1

Analysis of Variance for LNRYSpread, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
SIZE	1	89.422	11.367	11.367	11.08	0.001
1+ln(ME/BL)	1	469.228	15.118	15.118	14.74	0.000
WK/TA	1	4.283	0.110	0.110	0.11	0.744
ln(1-(RE/TA))	1	6.884	1.086	1.086	1.06	0.305
1-EBIT/TA	1	4.957	0.163	0.163	0.16	0.690
RATING	5	56.998	53.309	10.662	10.40	0.000
AGE	9	14.827	15.773	1.753	1.71	0.093
UTILITY	1	1.239	1.199	1.199	1.17	0.282
SUB	1	0.108	0.109	0.109	0.11	0.745
SEC	1	0.008	0.008	0.008	0.01	0.930
Error	128	131.260	131.260	1.025		
Total	150	779.215				

S = 1.01265   R-Sq = 83.15%   R-Sq(adj) = 80.26%

Term	Coef	SE Coef	T	P
Constant	-2.3749	0.9049	-2.62	0.010
SIZE	-0.28110	0.08443	-3.33	0.001
1+ln(ME/BL)	-0.26188	0.06820	-3.84	0.000
WK/TA	0.0947	0.2897	0.33	0.744
ln(1-(RE/TA)	0.2646	0.2571	1.03	0.305
1-EBIT/TA	0.3766	0.9432	0.40	0.690

Means for Covariates

Covariate	Mean	StDev
SIZE	-3.129	0.50825
1+ln(ME/BL)	0.802	0.81523
WK/TA	0.234	0.15696
ln(1-(RE/TA))	-0.387	0.21777
1-EBIT/TA	0.884	0.05386

Least Squares Means for LNRYSpread

RATING	Mean	AGE	Mean	UTILITY	Mean
1(Aaa/AAA)	-2.147	1	-1.437	0	-1.517
2(Aa/AA)	-1.868	2	-1.512	1	-1.389
3(A/A)	-1.583	3	-1.849		
4(Baa/BBB)	-1.122	4	-1.516	SUB	
5(Ba/BB)	-0.590	5	-1.277	0	-1.412
6(B/B)	-1.407	6	-1.164	1	-1.493
		7	-0.959		
		8	-1.707	SEC	
		9	-1.575	0	-1.448
		10	-1.533	1	-1.458

Annex D – Tukey Tests

1971

Tukey Simultaneous Tests
Response Variable RYSpread
All Pairwise Comparisons among Levels of RATING
RATING = 1 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	0.04323	0.04250	1.0171	0.9111
3	0.10330	0.05339	1.9349	0.3882
4	0.01237	0.08833	0.1400	1.0000
5	0.13377	0.16247	0.8233	0.9625
6	0.53916	0.23400	2.3041	0.2034

RATING = 2 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	0.06007	0.04069	1.4763	0.6801
4	-0.03086	0.07156	-0.4312	0.9980
5	0.09054	0.15783	0.5737	0.9925
6	0.49594	0.22971	2.1589	0.2675

RATING = 3 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	-0.09093	0.05527	-1.645	0.5712
5	0.03047	0.14861	0.205	0.9999
6	0.43586	0.22414	1.945	0.3824

RATING = 4 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	0.1214	0.1456	0.8339	0.9604
6	0.5268	0.2199	2.3953	0.1691

RATING = 5 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	0.4054	0.2617	1.549	0.6339

1973

Tukey Simultaneous Tests
Response Variable LNRYSread
All Pairwise Comparisons among Levels of RATING
RATING = 1 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	0.1172	0.1219	0.9613	0.9290
3	0.2370	0.1267	1.8713	0.4257
4	0.4371	0.1617	2.7026	0.0836
5	0.9443	0.4943	1.9103	0.4020
6	1.0985	0.3116	3.5256	0.0082

RATING = 2 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	0.1198	0.05849	2.049	0.3226
4	0.3199	0.11102	2.881	0.0533
5	0.8271	0.47478	1.742	0.5076
6	0.9813	0.28315	3.466	0.0099

RATING = 3 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	0.2000	0.08895	2.249	0.2252
5	0.7073	0.47011	1.505	0.6622
6	0.8615	0.27668	3.114	0.0283

RATING = 4 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	0.5073	0.4636	1.094	0.8826
6	0.6614	0.2613	2.532	0.1247

RATING = 5 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	0.1542	0.4942	0.3120	0.9996

1975

Tukey Simultaneous Tests
Response Variable LNRYSpread
All Pairwise Comparisons among Levels of RATING
RATING = 1 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	0.2792	0.1004	2.780	0.0673
3	0.5641	0.1082	5.213	0.0000
4	1.0252	0.1613	6.354	0.0000
5	1.5576	0.3011	5.174	0.0000
6	0.7398	0.3566	2.075	0.3071

RATING = 2 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	0.2848	0.07848	3.629	0.0054
4	0.7459	0.14023	5.319	0.0000
5	1.2784	0.28024	4.562	0.0002
6	0.4606	0.33383	1.380	0.7391

RATING = 3 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	0.4611	0.1153	3.9990	0.0015
5	0.9936	0.2470	4.0232	0.0014
6	0.1757	0.3101	0.5667	0.9930

RATING = 4 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	0.5325	0.2381	2.2361	0.2287
6	-0.2854	0.2937	-0.9714	0.9262

RATING = 5 subtracted from:

RATING	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	-0.8178	0.3203	-2.553	0.1168

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