Investigating the Relationship of Credit Ratings, Credit Default Spreads, and Equity Returns

University of Michigan – FIN 342
Individual Analysis Project
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I. Introduction

Expected equity returns are a function of a company's underlying risk and the incremental risk exposure from borrowing. Therefore, we should expect higher returns of companies with a worse credit rating (where the term "worse" means higher default risk rather than sub-optimal capital structure). I investigate whether there in fact is such a relationship between equity returns and credit ratings and to what degree.

I will analyze data on the companies that are part of the S&P 1500 Composite. For each of these companies, quarterly data on credit ratings, spreads on credit default swaps, and equity returns exist. The analysis consists of comparing the credit rating at the beginning of the quarter with the equity return at the end of the quarter. My hypothesis is that equity returns at the end of the quarter will increase with worse credit ratings and higher spreads on credit default swaps.

This question is of interest because it will assist investors in forming portfolios that align with their risk preferences, or as a starting point in identifying stocks for which default risk is not fully accounted for. If investors don't weight in credit risk enough in their expected return, one might be able to invest in companies with low credit risk and achieve higher risk-adjusted returns. On the other hand, if investors over discount companies with high credit risk, one might be able to invest in companies with a low risk and still achieve high returns.

II. Approach to Analysis

The bases of my analysis are 4 different datasets that I compiled. These are Credit Default Swaps, Credit Ratings, Equity Returns, and Market Caps, all on a quarterly basis for each of today's S&P Composite 1500 companies. Not all data is available for each company, especially credit ratings and credit default swaps. After compiling all of the datapoints for each company, I am left with 287 companies with about 39 quarters of data for each company, on average.

Credit ratings are measured by S&P Equivalent Ranks. The S&P Equivalent Rank is a scale from 27 to 3 that is used to convert ratings of different agencies to a standardized rating, benchmarked against the S&P credit rating scale. Credit Ratings are valid until they are changed or withdrawn, so I was able to calculate the intermediate values between two changes in credit ratings to arrive at quarterly numbers. In the dataset there were various kinds of credit ratings, ranging from ratings of Commercial Paper to Speculative Grade Liquidity. To achieve comparability in the credit ratings, I chose to only use Long-Term Senior Unsecured ratings and Long-Term Issuer ratings. For each quarter, I only kept the most recent credit rating of each agency for a specific company. In many quarters, multiple rating agencies released ratings in the same quarter for the same company. In these cases, I calculated the median of these credit ratings. After doing that, I was left with one median credit rating for each company in each of the quarters. Should a rating have been withdrawn, I did not consider it after that point.

The data on equity returns measures total returns during the current quarter and includes dividend reinvestments. The market cap data is calculated once at the end of the quarter using price and outstanding shares information. The Credit Default Swaps dataset consists of three different datapoints. There is the mid credit default swap spread at the end of the quarter, the implied default probability, and a recovery rate. All of these values are also end-of-quarter values. Because all of these three datasets are end-of-quarter values,

but we want to compare the credit ratings at the beginning of the quarter to the end-of-quarter values, I adjusted the time scale so that the end-of-quarter credit ratings would become the start-of-quarter values of the next quarter.

Next, I aggregated the results of the companies that are in a specific bucket of credit ratings by quarter. I rounded the S&P equivalents to the nearest full integer because many were calculated by the median function earlier which means they otherwise can't be matched to an S&P credit rating. I used the weighted mean, using market cap as the weight, for calculating the resulting quarterly returns, credit spreads, and other metrics. This makes the quarterly returns analogous to the returns an investor is likely to earn on the portfolios, given that portfolio weights are typically larger for companies with larger market capitalization.

III. Credit Ratings and Equity Returns

The core question of my analysis was whether companies with a high credit rating at the beginning of the quarter would experience higher equity returns at the end of the quarter. Taking the weighted mean over all companies and quarters, returns and credit spreads are summarized in Table 1.

Table 1: Quarterly Total Return and Credit Spread by Credit Rating

S&P Rank Equivalent	S&P Rating	Total Quarterly Observations	Unique Companies	Quarterly Total Return (in %)	Credit Spread (in percentage points
27	AAA	88	5	4.61	32
25	AA+	67	6	1.64	35
24	AA	141	12	4.67	58
23	AA-	277	14	2.70	42
22	A+	665	45	1.80	51
21	A	1149	67	2.08	51
20	A-	1298	91	2.15	60
19	BBB+	1546	105	2.85	73
18	BBB+	1985	143	2.51	84
17	BBB-	1330	88	1.98	127
16	BB+	944	73	2.69	178
15	BB	332	51	2.50	240
14	BB-	628	57	1.26	277
13	B+	282	34	2.89	317
12	B	335	26	3.95	499
11	B-	100	18	10.66	589
10	CCC+	44	9	15.98	967
9	CCC	14	5	12.39	1408
8	CCC-	6	3	22.41	3232
7	CC	3	2	46.64	2494
Total		**11234**	**287**	**2.66**	**67**

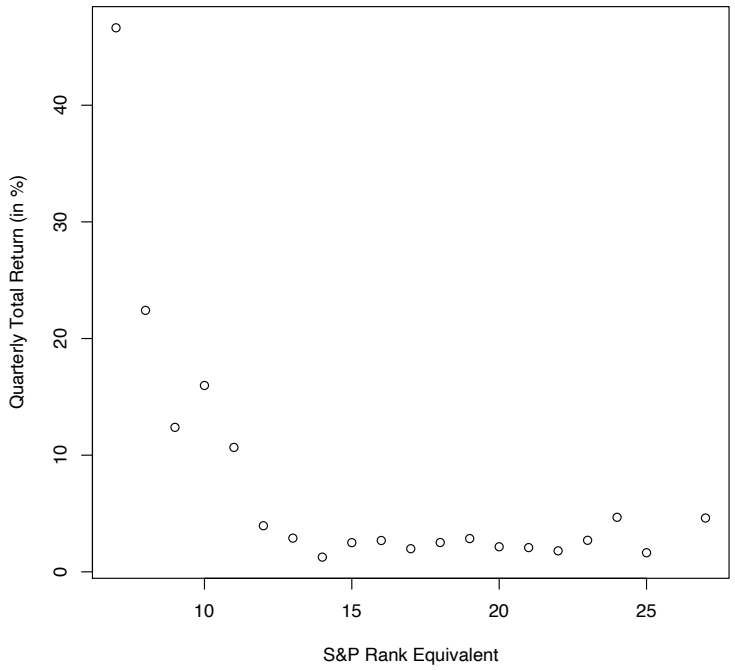
Especially the low and high credit ratings only have a few observations, which is why it makes sense to group the observations into the groups that can be seen in Table 2. The number of individual observations in Table 1 is not large enough to draw reliable conclusions from. Grouping the observations also allows comparisons with statistics stated by Standard & Poor's as they use the same categorization of credit ratings.

Table 2: Quarterly Total Return and Credit Spread by Credit Rating Group

S&P Equivalent Group	Total Quarterly Observations	Unique Companies	Quarterly Return (in %)	Credit Spread (in basis points
AAA to AA-	573	24	3.65	44
A+ to A-	3112	123	2.02	54
BBB+ to BBB-	4861	188	2.58	86
BB+ to BB-	1904	100	2.24	217
B+ to B-	717	41	4.15	423
CCC+ to CC	67	11	19.71	1322
Investment Grade (AAA to BBB-)	8546	246	2.66	59
Speculative Grade (BB+ to CC)	2688	103	2.69	258
Total	**11234**	**287**	**2.66**	**67**

Expectedly, companies with low credit ratings experience higher total equity returns. This is in line with my initial hypothesis. Surprisingly, however, companies with high credit ratings also experience above average quarterly equity returns. This may be the case because investors underestimate the significance of positive credit ratings and thus discount these companies to highly. As we will later see when I analyze implied default probabilities, credit investors also seem to attribute more risk to companies with high credit ratings than it has been the case historically. The relationship between credit ratings and equity returns is even more visible when plotted, as can be seen in Figure 1.

Figure 1: Total Quarterly Equity Returns by S&P Equivalent



IV. Implied Default Probability by Credit Rating

One interesting characteristic of credit default swap spreads is that we can calculate default probabilities implied in the spreads. Credit default swap spreads provide a timely perspective on credit risk, because credit default swaps are actively traded and thus their spreads reflect the opinion of the wide market at any given point in time. The default probabilities embedded in credit default swap spreads can be compared to historical default rates on bonds with different credit ratings. I aggregate implied default probabilities by credit rating so that there is one default probability per credit rating S&P equivalent rank.

As shown in Table 3 and the figure below, there are large differences between the implied default probabilities and the actual default probabilities as recorded by Standard & Poor's. The market estimates that the default probability is much higher than what Standard & Poor's state it historically was. Implied default probabilities for companies with low credit ratings are in line with historical average default rates. For investment-grade companies, the market overestimates the probability of default.

Figure 2: Implied Default Probability by Credit Rating

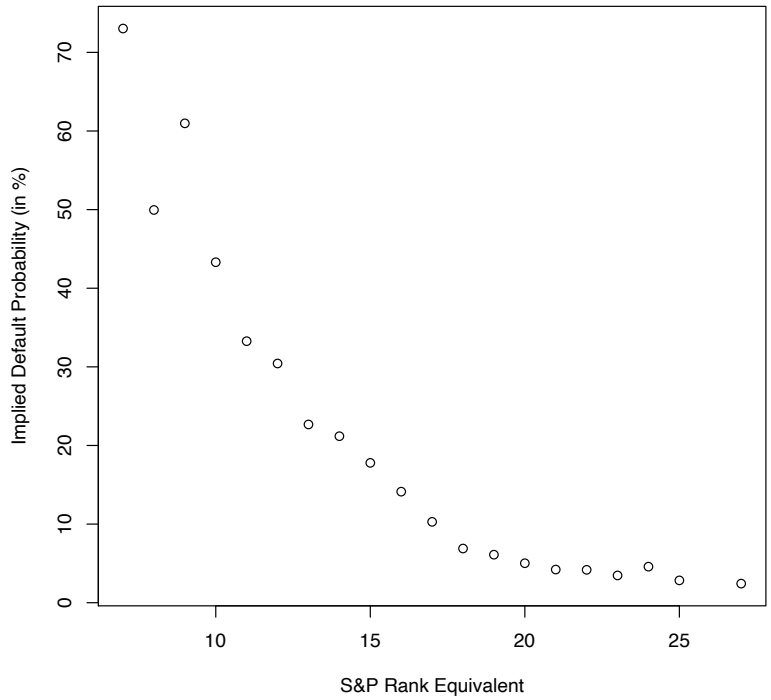


Table 2: Implied Default Probabilities and Historical S&P Default Rates

S&P Equivalent Group	Implied Default Probability (in %)	S&P Historical 1-Year Default Rate (in %)	S&P Historical 5-Year Default Rate (in %)	S&P Historical 15-Year Default Rate (in %)
AAA to AA-	3.49	0.01	0.33	0.96
A+ to A-	4.48	0.05	0.47	1.89
BBB+ to BBB-	7.10	0.16	1.58	4.69
BB+ to BB-	16.82	0.61	6.52	14.67
B+ to B-	27.14	3.33	16.93	27.12
CCC+ to CC	48.99	27.08	46.19	52.59
Investment Grade (AAA to BBB-)	4.84	0.09	0.88	2.71
Speculative Grade (BB+ to CC)	18.56	3.61	14.26	23.28
Total	5.41	1.48	6.04	10.32

Historical default rates are stated by Standard & Poor's. It tracks default rates by the credit rating over the period from 1981-2019. (Standard & Poor's, 2020)
Standard & Poor's separates AAA and AA+ to AA-, which is why I averaged the two groups to receive the default rate of 0.01, 0.33, and 0.96. The original numbers were 0.00, 0.35, and 0.91 for AAA and 0.02, 0.31, and 1.02 for AA+ to AA-.

V. Conclusion

The data allows a comprehensive view at by how much investors expect to be compensated for companies with high credit risk. The hypothesis at the start of my analysis holds true: the expected return increases as credit ratings decrease.

More interesting is that investors also seem to over discount companies with high credit ratings. Equity investors had higher expected quarterly returns over the timeframe of my analysis and debt investors payed higher credit default spreads than it would historically be expected measured by default probability. Despite that, it is hard to derive an investment hypothesis from the results. A plausible explanation is that credit ratings cluster by industry and that during the period of study, industries with higher credit ratings happened to earn relatively high returns. There is a directional relationship between default rates implied by prices of credit default swaps and actual default rates for bonds with different credit ratings. For instance, speculative grade debt has an historical average 5-year default rate of 14%, an historical average 15-year default rate of 23% and a default rate inferred from credit default swap prices of 19%. In contrast, investment grade debt has an historical average 5-year default rate of 1%, an historical average 15-year default rate of 3%, and a default rate inferred from credit default swap prices of 5%. However, it does seem that investment-grade debt defaults less often than suggested by prices of credit default swaps.

A limitation of the data on stock returns is that it doesn't include companies that actually defaulted, because the starting point for sample formation is the current suite of S&P 1500 companies. This data set is useful to help us understand whether investors are adjusting their expected return on risky companies, but it unfortunately doesn't allow to analyze whether a portfolio that consists of lower percentile credit ratings companies will outperform those of the upper percentile credit ratings or the other way around. In the data that I worked on, this would of course be the case, but it wouldn't be clear whether this relationship still holds when companies that went bankrupt along the way are included. Additionally, there is some survivorship vias inherent in analyzing credit ratings because distressed companies oftentimes choose to withdraw their credit ratings. This is because companies would rather have no credit rating instead of a bad one and so they decide to withdraw their credit rating once it gets below a certain threshold. Therefore, there are very few companies that possess a low credit rating.

VI. Appendix

Figure 3: Time Series of Default Probability, Quarterly Total Equity Return, and Credit Default Spreads for Investment Grade Companies

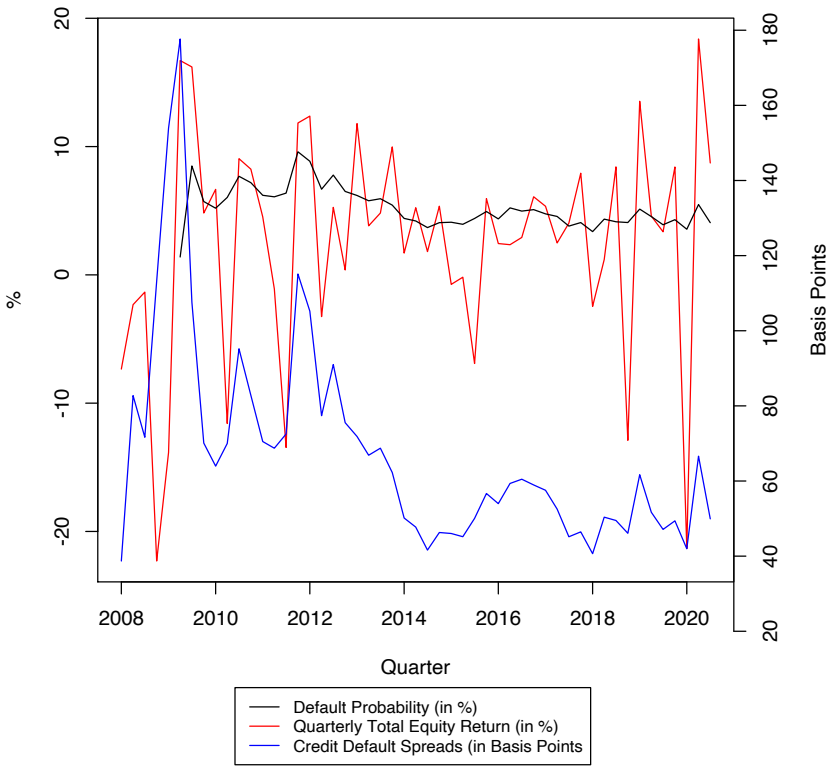
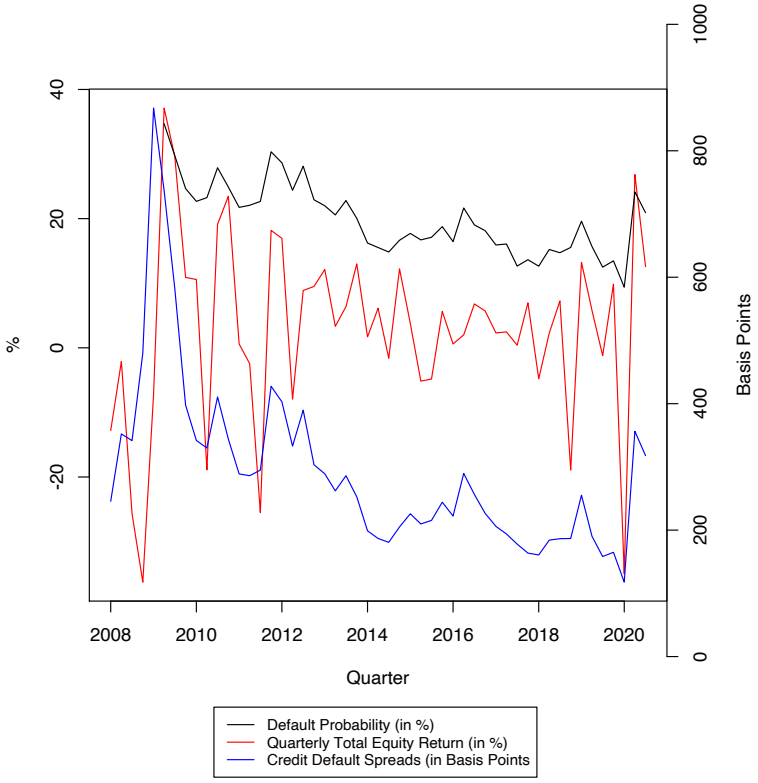


Figure 4: Time Series of Default Probability, Quarterly Total Equity Return, and Credit Default Spreads for Speculative Grade Companies



VII. References

Standard & Poor's, 2020: Default, Transition, and Recovery: 2019 Annual Global Corporate Default And Rating Transition Study: https://www.spglobal.com/ratings/en/research/articles/200429-default-transition-and-recovery-2019-annual-global-corporate-default-and-rating-transition-study-11444862