CONNECTING ESG AND CORPORATE BOND PERFORMANCE

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INTRODUCTION

There are currently over 1500 Principles for Responsible Investment signatories with over $60 trillion in assets under management. This growing number signals the rapidly increasing commitment to responsible investing worldwide. Nevertheless, the investment community at large has traditionally been cautious of having to trade-off between sustainability and alpha, or the performance of a managed portfolio of securities relative to an appropriate benchmark. Consequently, Environmental, Social, and Governance (ESG) metrics and scores – measuring corporate performance on issues like carbon output, water usage, workforce turnover, or executive pay structure – are becoming ever more integrated into investment decisions to make sure that they do not jeopardize return on investment. While the relationship of ESG to alpha has been well studied in equity markets, the same cannot be said for credit markets.

The Securities Industry and Financial Markets Association estimates that at the end of 2016, the debt outstanding in the US Corporate Bond Market was over $8.5 trillion. The corporate bond market could be a particularly good fit for sustainable investing because it promotes long-term reliability over short-term gains and shareholder pressure. While ESG might not be a strong driver of upside performance, it could potentially reveal insight to the responsible or irresponsible management of a company, thereby reducing downside risk. Elucidating a clear relationship between ESG and improved corporate bond performance could influence investors to favor sustainable companies, encourage companies to become more sustainable, and ultimately dispose of the long held belief that sustainability efforts and company performance are necessarily in opposition with one another.

In this report, we attempt to discover whether the sustainability of a company influences the performance of its corporate bonds. As measurements of sustainability, both aggregated and separated ESG scores from two industry rating and analysis companies – Sustainalytics and MSCI – were used. As a measurement of corporate bond performance, the Credit Default Swap (CDS) is used. The CDS is essentially insurance on the bond in the event that it defaults, and as such, is relatively sensitive measure of the reliability of the credit security. We search for relationship in the relativity of ESG metrics and CDS, in the predictive quality of ESG on CDS, and finally in the predictive quality of the difference in ESG scores from different scoring agencies on CDS.

A 2015 study by Barclays developed corporate bond portfolios of similar character but with different performance in terms of company ESG scores in order to study the effect of ESG 'tilts' on portfolio performance. It showed that those portfolios with positive ESG tilt resulted in a "small but steady

performance advantage", including higher credit ratings and lower spreads (Desclée, Dynkin, Hyman, & Polbennikov, 2016). It also evaluated several other phenomena including that Governance scores had a stronger relationship to performance than Social scores, that issuers with high Governance scores had a lower probability of experiencing a credit rating downgrade, and that these results remained relatively similar when using either MSCI or Sustainalytics ESG scores, despite their different methods of calculation.

A 2016 study done by MIT and Breckinridge Capital Advisors examined the relationship between ESG scores and the option adjusted spread (OAS) of corporate bonds. They found, similarly to Barclays, that ESG scores are "positively correlated with small, stable spreads in corporate debt markets" (Clubb, Takahashi, & Tiburzio, 2016). Similar correlations were found for return on assets and leverage ratios. However, the authors acknowledged the fact that their analyses relied heavily on correlation, and should not be conflated to represent causation.

This paper seeks to build upon of the findings of these two reports. Firstly, the 2016 MIT report assessed the covariances and correlations between ESG, E, S, and G ratings and the option adjusted spreads of all of their companies in aggregate. However, given that E, S, and G operations can have significant differences in importance within different sectors of the economy, it could be reasonably be argued that this level of analysis lacks appropriate granularity. Thus, this paper will address that gap by utilizing a similar analysis, but further broken down by sector in order to give a more granular look into the relationships between sustainability and corporate bond performance. Secondly, while correlations might give a first indication of a possible relationship, many other financial parameters have much greater influence on CDS than ESG scores. Ordinary Least Squares (OLS) regression is used to control for several of these other factors in order to examine the predictive capability of ESG scores on CDS. Thirdly, the ESG scores of Sustainalytics and MSCI were found to be very loosely correlated. This paper evaluates whether or not the difference in ESG scores between Sustainalytics and MSCI bears any relationship to CDS.

The breakdown of the data universe into economic sectors revealed differences in strength ESG correlation with CDS for different sectors. In particular, the healthcare, industrials, and information technologies sectors seems to show stronger correlations. On the other hand, real estate seems to show the opposite directionality. While OLS regression revealed some sector influence on CDS, it also revealed certain limitations of the data. Given the number of companies under examination and lack of necessary financial control factors, the sector-specific E, S, and G interactions could not be statistically proven. Given the weakness of correlation between the Sustainalytics and MSCI ESG scores, the absolute difference between the two scaled scores was tested for strength as a predictor of CDS. The regression of CDS of on the difference, as well as on the S&P credit ratings and economic sector revealed, again revealed a lack statistically significant results. Ultimately, the confidence of the regressions were limited by the assumptions of a OLS regression tool, as well as the narrow width of the data.

DATA

The ESG data was provided by Breckinridge Capital Advisors, a Boston-based investment advisory firm focused on fixed-income securities and a leader integrating ESG into their investment decisions. The ESG data includes Sustainalytics ESG scores for the Standard & Poor's (S&P) 500 – an index of 500 companies with common stock listed either on the NYSE or NASDAQ stock exchanges – as well as ESG scores from MSCI on 3876 companies. Sustainalytics and MSCI are both leaders in ESG research and ratings. They provide investors with data and analysis on ESG and other sustainability performance indicators in order to provide greater transparency in financial markets. CDS data for the S&P500 in January, 2017 was collected with DataStream from Thomson Reuters.

Treatment of the data included sub-setting for the required columns, deleting rows containing NAs and blank cells, eliminating duplicate entries, sub-setting to select only the data pertaining to the relevant date, and using credit ratings to filter for investment grade securities. The International Securities Identification Number (ISIN) is a unique number for each issuer's corporate bond and was used to merge the datasets. The Global Industry Classification System (GICS) was used to assign companies of a given industry into an appropriate sector. Once the Sustainalytics ESG, MSCI ESG, and Thomson Reuters CDS data are merged, the intersecting data set of investment grade companies is narrowed to only 203 companies, hereafter referred to as the data 'universe'.

ISIN	Company	GICS Sector	GICS Industry	S&P Credit Rating
US88579Y1010	3M Company	Industrials	Industrial Conglomerates	AA-
US0028241000	Abbott Laboratories	Health Care	Health Care Equipment & Supplies	BBB
US00817Y1082	Aetna Inc.	Health Care	Health Care Providers & Services	A-

TABLE 1. EXAMPLE OF PROCESSED DATA STRUCTURE

Statistic	Mean	St. Dev.	Min	Max
Sustainalytics ESG Score	61.730	7.740	43.140	84.460
Environment Score	61.482	12.347	33.330	91.860
Social Score	59.148	9.935	33.460	89.770
Governance Score	66.803	8.477	42.470	88.060
MSCI ESG	4.724	0.955	2.300	7.100
Scaled MSCI ESG	61.505	12.430	29.945	92.438
MSCI E	5.845	2.128	1.300	10.000
MSCI S	4.175	1.617	0.000	8.900
MSCI G	4.909	1.268	1.300	7.700
Scaled ESG Difference	0.224	10.876	-32.668	29.968
Absolute ESG Difference	8.636	6.587	0.011	32.668
Credit Default Swap	76.314	52.011	14.790	447.100

TABLE 2. SUMMARY STATISTICS OF INVESTMENT GRADE S&P500 COMPANY UNIVERSE OF 203 COMPANIES

The Sustainalytics ESG scores are scored out of 100. The MSCI scores are done so out of 10. A scaled MSCI score was calculated as follows:

$$MSCI_{scaled,i} = MSCI_i * \frac{Average_{Sustainalytics}}{Average_{MSCI}}$$

This not only puts the MSCI score on a scale of 100, but also scales MSCI scores up because Sustainalytics tends to rate its companies in the 50-70 range whereas MSCI tends to rate its companies in the 40-60 range (out of 100). The Scaled Difference is the Sustainalytics ESG score for a given company minus the scaled MSCI ESG score of that same company. The Absolute ESG Difference is simply the absolute value of this difference. Note that the Scaled MSCI ESG score mean does not exactly match the Sustainalytics ESG Score mean in Table 1 because the averages used in the calculation were taken over all available companies, not just those that are investment grade, in order to get a slightly better idea of how Sustainalytics and MSCI tend to rate companies.

Once the Sustainalytics ESG, MSCI ESG, and Thomson Reuters CDS data are merged, the intersecting data set of investment grade companies is narrowed to only 203 companies.

The weighting of MSCI data is straight-forward; for a given industry, a set of weights are applied to the E, S, and G scores, resulting in the Weighted Average ESG Score. This is not so for the Sustainalytics Total ESG Score. The lack of transparency in calculation of this Total ESG Score introduces a source of uncertainty when clustering and comparing researcher-defined groups of companies because the ESG Score may have been calculated differently for each of a set of undisclosed Sustainalytics-defined groupings. Nevertheless, we assumed relative overlap in industry classification and used the GICS to group companies into appropriate economic sectors.

PHASE I

While covariance and correlations between ESG, E, S, and G scores with the CDS give a first approximation for the relationship between corporate sustainability and CDS, it obscures the operation of that relationship within the ESG distribution. In order to give more insight into how CDS is distributed over the distribution of ESG scores, the companies were divided into four sets of quintiles according to their ESG, E, S, and G scores, respectively. The average CDS was then calculated within each quintile. Additionally, in order to explore the difference in importance between E, S, and G factors within specific sectors, these quintile tables were produced for each of the GICS sectors.

As shown in Table 3 below, the quintile analysis showed relatively clear directionality, with the sets of higher performing ESG companies generally having lower CDS.

Quintile	1	2	3	4	5
ESG	95.6	65.7	78.7	76.7	64.6
E	95.9	79.7	75.7	61.3	68.7
S	91.1	69.9	74.6	71.0	74.8
G	76.0	84.5	80.2	71.9	68.9

TABLE 3. AVERAGE CDS PER SUSTAINALYTICS ESG QUINTILES FOR THE DATA UNIVERSE

NOTE: QUINTILE 5 REPRESENTS THE HIGHEST PERFORMING ESG, E, S, AND G SCORES, RESPECTIVELY

As shown in Tables 4a-d, the Healthcare, Industrials, and Information Technology sectors show even stronger relation between ESG performance and average CDS. By contrast, the Real Estate Sector, at least on the extremities, seemed to exhibit the opposite relationship.

Quintile	1	2	3	4	5
ESG	71.02	46.1325	45.6925	54.7475	23.2925
E	60.6	56.1275	38.03	42.4025	46.33
S	58.212	57.6875	63.365	41.53	23.2925
G	67.58	58.685	51.8975	30.4425	33.14

(a) Healthcare

Quintile	1	2	3	4	5
ESG	71.13143	62.53429	52.145	37.77286	50.28833
E	80.68714	55.95143	40.83333	46.91286	47.46833
S	56.25714	66.66714	60.435	41.63	50.03
G	69.18857	52.48571	57.165	56.83429	37.02

(b) Industrials

Quintile	1	2	3	4	5
ESG	106.9367	102.4633	82.35667	70.33333	67.555
E	106.9367	102.4633	64.75667	83.69333	73.915
S	106.9367	110.5367	74.28333	70.33333	67.555
G	102.6867	73.78667	103.26	82.35667	67.555

(c) Information Technology

| Quintile	1	2	3	4	5
ESG	87.99333	100.2667	135.055	130.6933	127.045
E	87.99333	123.2167	83.81	141.9067	127.045
S	97.78667	160.4967	93.58	118.1233	82.34
G	87.99333	118.3233	121.625	142.8833	95.105

(d) Real Estate

TABLE 4A-D. AVERAGE CDS PER SUSTAINALYTICS ESG QUINTILES WITHIN SPECIFIC SECTORS

However, these aggregated metrics might lead to overestimation of the true relationships within. Figure 1 presents the data universe in ESG/CDS space. Any relationships are almost completely obscured. Even the Information Technology provides little confidence in the relationship.
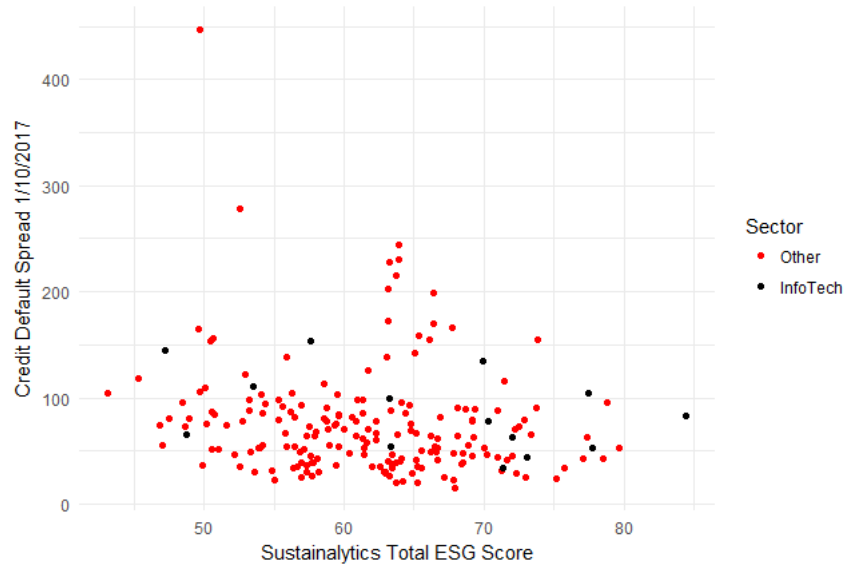
(a) Normal scale
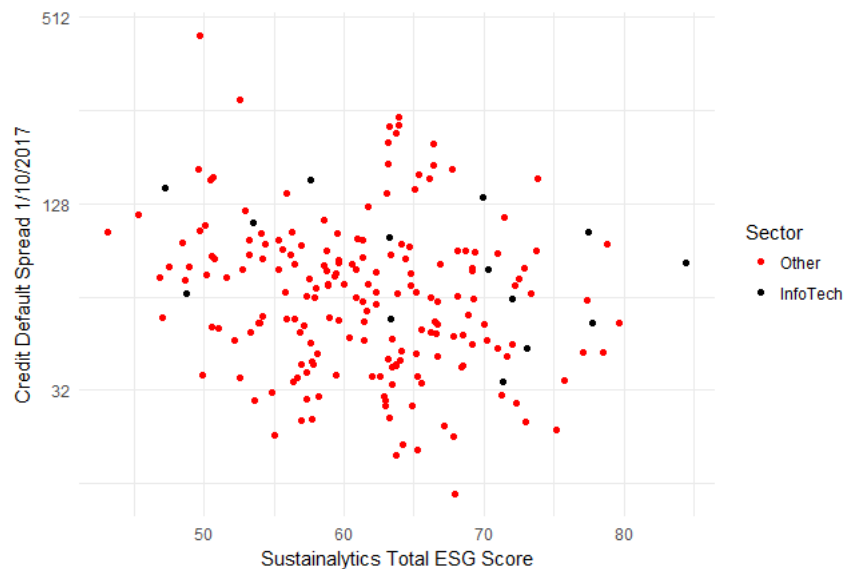
(b) Logarithmic y-scale

FIGURE 1. CDS BY SUSTAINALYTICS TOTAL ESG SCORE

PHASE II

OLS linear regression was run for the CDS on the ESG scores. Since CDS is obviously influenced much more heavily by other factors, we do not expect to see significance in these regressions. Subsequent regressions iteratively add categorical variables to control for S&P credit ratings, as well as economic sector. Of particular interest, we introduce construction variables of the products of the sectors and the E, S, and G scores, respectively, in order to examine if E, S, or G scores have a disproportionate effects in particular sectors. For example, it might be reasonable that Environmental Scores would have more

predictive strength on CDS within the Energy or Materials sectors, whereas Social Scores might have more predictive strength in the Health Care sector.

CDS Regressed Over E, S, and G, Credit Ratings, Sector, and Sector/ESG Interaction

	Dependent variable: Credit Default Swap			
	(1)	(2)	(3)	(4)
Sustainalytics Environmental Score	-0.792**	-0.568*	-0.393	0.164
Sustainalytics Social Score	-0.039	0.260	-0.125	0.316
Sustainalytics Governance Score	-0.155	-0.451	-0.102	-1.477
S&P Credit Rating: BBB-		102.992***	91.401***	107.116***
S&P Credit Rating: BBB		44.345	37.542	46.232
S&P Credit Rating: BBB+		33.454	28.413	37.309
S&P Credit Rating: A-		20.449	16.942	24.364
S&P Credit Rating: A		6.896	7.846	14.661
S&P Credit Rating: A+		2.715	7.274	25.232
S&P Credit Rating: AA-		9.546	7.702	22.936
S&P Credit Rating: AA		-3.657	7.048	47.027
S&P Credit Rating: AA+		-12.617	-36.196	-35.647
GICS Sector: Consumer Discretionary			28.236**	136.350
GICS Sector: Consumer Staples			2.835	-215.763
GICS Sector: Energy			42.704***	117.884
GICS Sector: Financials			15.120	-2.462
GICS Sector: Health Care			-4.071	-104.014
GICS Sector: Information Technology			20.064	34.590
GICS Sector: Materials			10.498	-12.310
GICS Sector: Real Estate			47.996***	-32.652
GICS Sector: Telecommunication Services			20.596	191.991
GICS Sector: Utilities			13.980	127.926
Sector and E, S, and G Interaction				*See Appendix*
Constant	137.686***	93.690**	70.726	95.689
	(32.439)	(45.114)	(49.080)	(97.579)
Adjusted R^2	0.026	0.271	0.317	0.267
Residual Std. Error	51.337 (df = 199)	44.397 (df = 190)	42.983 (df = 180)	44.520 (df = 152)

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE 5. OLS REGRESSIONS OF CDS ON E, S, AND G SCORES, S&P CREDIT RATING, AND SECTOR

NOTES: Coefficients for AAA Credit Rating and Industrial Sectors are not shown because they were chosen as the reference groups: AAA Credit Rating because its position at the end of an ordinal variable

and Industrials Sector because it contained the largest number of data points.
Some coefficients for Telecommunication Services not shown because there were only two investment
*grade Telecommunication Services companies in the S&P500 with CDS data.*

Before discussion of the regressions in Table 5, it is important to note the adjusted R^2 values. Essentially, the R^2 value represents the percentage of the variation in the output (CDS in this case) that can be reasonably explained by the particular model. It must be adjusted given that fitting over more variables necessarily increases the R^2 value regardless of whether or not the added variables actually have any predictive power, and ultimately over-fitting the data. Therefore, even for model (3), which regresses over E, S, G, the S&P Credit Rating, and Sector, is only able to explain about 31.7% of the variation exhibited by the CDS. That having been said, the models may give insight to relative importance within ESG considerations as opposed to pure predictive power.

The disappearance of the significance of the Sustainalytics Social Score after the first two models suggests that the CDS is better explained by sector level factors than aggregate company factors. The drop in decrease in adjusted R^2 value from model (3) to model (4) seems to suggest that, given the size of the data universe, no more useable information is able to be extracted by examining E, S, and G influence at a sector-specific level. Only Governance in the Consumer Staples showed any statistical interaction, with higher Governance scores explaining a slight rise in CDS.
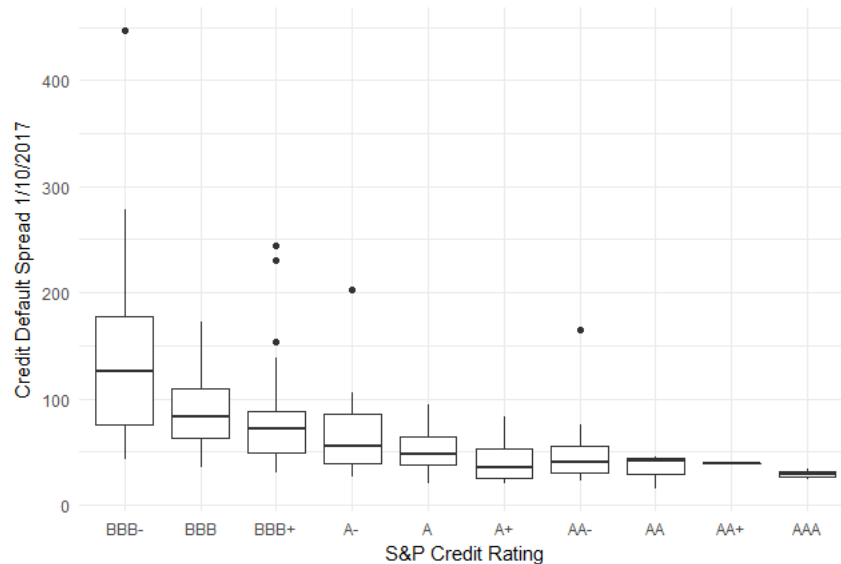
(a) Normal Scale
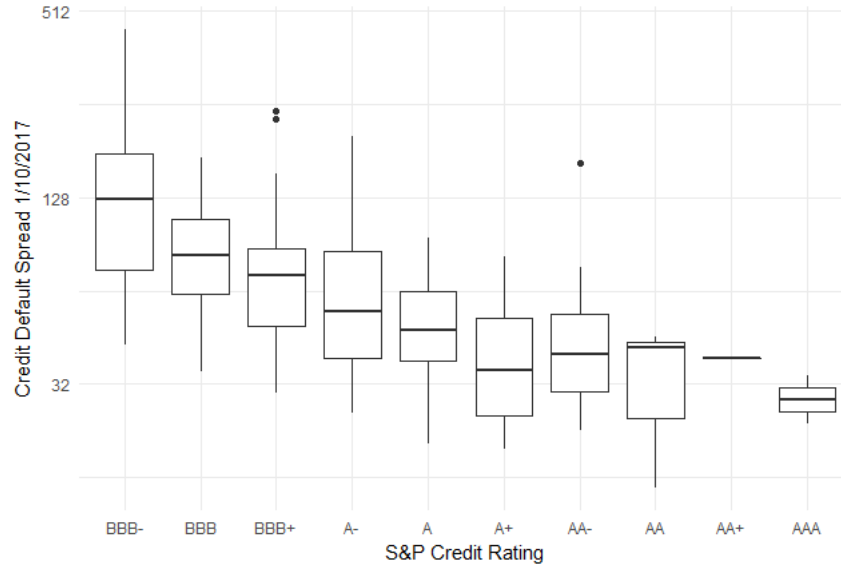
(b) Logarithmic Y-Scale

FIGURE 2. CDS OF INVESTMENT GRADE S&P500 COMPANIES ON LOGARITHMIC SCALE

Due to the lack of financial data, S&P credit ratings may be used as a proxy for a holistic view of the financial situation of each company. Figure 2 shows the expected result of decreasing, and generally less variable, CDS with higher credit ratings. This can also be seen in Table 5, albeit without statistical relevance other than the BBB- rating.

The correlation between the ESG, E, S, and G scores of Sustainalytics and MSCI is examined.

	ESG	E	S	G	MSCI ESG	MSCI E	MSCI S	MSCI G
ESG	1	0.818	0.752	0.602	**0.500**	0.203	0.425	-0.042
E	0.818	1	0.349	0.324	0.372	**0.327**	0.308	-0.099
S	0.752	0.349	1	0.280	0.398	0.036	**0.395**	-0.004
G	0.602	0.324	0.280	1	0.304	0.063	0.180	**0.045**
MSCI ESG	0.500	0.372	0.398	0.304	1	0.435	0.583	0.201
MSCI E	0.203	0.327	0.036	0.063	0.435	1	0.050	-0.111
MSCI S	0.425	0.308	0.395	0.180	0.583	0.050	1	-0.076
MSCI G	-0.042	-0.099	-0.004	0.045	0.201	-0.111	-0.076	1

TABLE 6. CORRELATION BETWEEN SUSTAINALYTICS AND MSCI ESG SCORES FOR INVESTMENT GRADE UNIVERSE
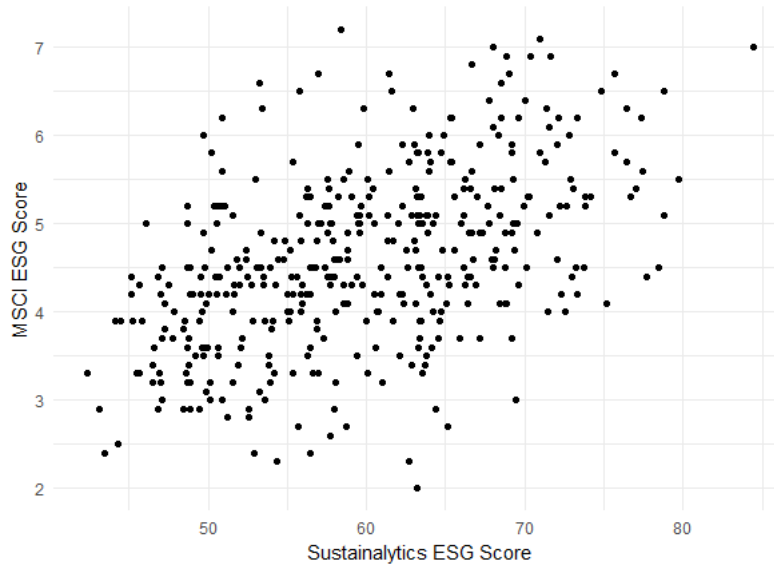
FIGURE 3. SUSTAINALYTICS AND MSCI ESG SCORES FOR S&P500

Table 6 and Figure 3 illustrate the low correlation between the respective ESG, E, S, and G scores of Sustainalytics and MSCI. Even though, the calculation methodology between these two research companies differs, one might still have expected a higher degree of correlation between their scores on the same companies. That having been said, perfect correlation between the two would eliminate the need for one or the other. The especially weak correlation in Governance scores points to a possible lack of governance related data or structure around interpretation of Governance practice.

CDS is regressed on the difference between the two scaled ESG scores as well as S&P credit ratings, and sectors. This is done because it might be plausible that severe differences in the ESG scores for a given company might signal that there is a lack of reliable information, or perhaps large differences in interpretation, about that company's activities in those areas, and thus present risk and producing upward pressure on the CDS.

CDS Regressed Over Absolute ESG Difference, Credit Ratings, and Sector

		Dependent variable:	
		Credit Default Swap	
	(1)	(2)	(3)
Absolute Difference in Scaled ESG Scores	-0.560	-0.194	-0.286
S&P Credit Rating: BBB-		115.672***	98.429***
S&P Credit Rating: BBB		59.580*	45.873
S&P Credit Rating: BBB+		46.299	34.829
S&P Credit Rating: A-		34.477	23.664
S&P Credit Rating: A		21.392	14.438
S&P Credit Rating: A+		11.713	12.532

S&P Credit Rating: AA-		21.535	11.470
S&P Credit Rating: AA		4.304	12.648
S&P Credit Rating: AA+		8.164	-31.707
GICS Sector: Consumer Discretionary			29.633**
GICS Sector: Consumer Staples			0.485
GICS Sector: Energy			44.447***
GICS Sector: Financials			17.771
GICS Sector: Health Care			-5.203
GICS Sector: Information Technology			15.905
GICS Sector: Materials			8.430
GICS Sector: Real Estate			47.272***
GICS Sector: Telecommunication Services			17.259
GICS Sector: Utilities			13.799
Constant	81.150***	32.227	28.367
	(6.029)	(32.744)	(33.083)
Adjusted R^2	0.0001	0.254	0.315
Residual Std. Error	52.009 (df = 201)	44.912 (df = 192)	43.057 (df = 182)

Note: $^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

TABLE 7. CDS REGRESSED ON DIFFERENCE IN ESG SCORING, CREDIT RATING, AND SECTOR

Table 7 exhibits no significant relationship between CDS reacting to a relative difference in Sustainalytics and MSCI ESG scoring. Arguably, the lack of significant influence of ESG scores on CDS promotes a lack of interest in the difference of such scores in the CDS market, making the difference in said scores effectively meaningless.

DISCUSSION

Previous literature has concluded that ESG scores indicate small, but positive, pressure on corporate bond performance (Clubb et al., 2016; Desclée et al., 2016). For the purposes of evaluating the investment grade companies within the S&P500, the further delineation of the sectors revealed certain sectors that seems to exhibit higher correlations between ESG scores and CDS. However, the limited width and depth of the universe precluded further granularity for examining statistically relevant E, S, and G specific relationships within given sectors. Not enough financial data was available to control for more relevant factors, and the weakness of the resulting R^2 values dampens these findings. Nevertheless, the relationships exposed by the regression, rather than its predictive use, are the relevant outcomes. It should also be noted that ordinary least squares regression relies on several assumptions, including that the residuals are normally distributed and homoskedastic, the errors are independent, and the relationships are linear. Further research could address the control over a greater number of financial variables using high-dimensional regression, as well as adjusting the linear model for robustness against heteroskedasticity.

As the relative ESG scores of Sustainalytics and MSCI were found to be very weakly correlated, a regression of CDS on the difference between the scaled ESG scores, S&P credit ratings, and economic sector produced little inference between scaled ESG scores predicting a reduction in CDS. This points to the need for standardization in ESG reporting and the policy space around corporate disclosure of sustainability measures.

PHASE III

In Phase III, three cases in the sectors with positive correlations between ESG scores and the CDS spreads were selected based on the results of Phase I. The Industrial, Material and Technology sectors showed positive correlations between the ESG scores and the CDS spreads. Then, we matched the ESG scores with the controversy report.

CASE 1: GENERAL ELECTRIC COMPANY (GE)

ABOUT COMPANY

GE is a $ 125 billion revenue high-tech global industrial company, one that is leading the digital transformation sector. General Electrics is one of the most widely known and respected brand in the world and the fourth largest company in the world. A conglomerate which operates through the following segments : Aviation, Current, Digital, Energy Connections, Global Research, Healthcare, Lighting, Oil and Gas, Power, Renewable Energy, Transportation, Capital which cater to the needs of Financial services, Medical devices, Life Sciences, Pharmaceutical, Automotive, Software Development and Engineering industries. Recently GE announced that the headquarters will be transferred to Boston a city known for excellent universities and ground breaking innovations.

FINANCIALS

GE has a revenue of $122B, profit of $1.68B, margin of 1.39%, stock share of $28.8 and market Cap of $285.6B. The Sustainalytics ESG score in Q4 2016 was 67.67 and the CDS 47.30 BP, in Q1 2017 the Sustainalytics ESG score is 70.16 and the CDS Spread of 37.86 BP. "Even though credit default swaps (CDS) are basically insurance policies against the default of a bond issuer, many investors had used these securities to take a view on a particular credit event" (Brown, 2014). In this particular case, an improvement in the ESG score could indicate a correlation with the drop in CDS spread.

Quintile	1	2	3	4	5
ESG	71.13143	62.53429	52.145	37.77286	50.28833
E	80.68714	55.95143	40.83333	46.91286	47.46833
S	56.25714	66.66714	60.435	41.63	50.03
G	69.18857	52.48571	57.165	56.83429	37.02

CONTROVERSY SCORES WITH ESG

We wanted to see if there is a relationship between the ESG scores and the Controversy scores to see if the ESG scores can show signals before any controversy or incident occurs. In order to see the relationship, we tracked the changes of ESG scores and matched them with controversy cases. Unfortunately, the given controversy scores were the recent 3~5 years data while the ESG scores started from 2008. With the purpose of delivering clear visualization, the controversy scores indicate the severeness of controversies, and the score 10 means "Very Severe" while the lower score indicates "Minor", as following:

Controversy Score	
10	Very Severe
9	
8	Severe
7	
6	
5	Moderate
4	
3	
2	Minor
1	
0	None

Table 8. Controversy Score

GE had quite steady ESG scores over times in the range of 55 to 78, but recently, the Social score and the Environment score went down while the Governance score stayed high. Most controversies in GE were related to Social issues including labor management, health & safety, product liability, and impact on local communities. When the Social score in ESG started to reduce, a severe controversy related to labor management occurred. On November 10th, 2015, there was a severe social controversy that many labor unions filed a class action lawsuit against GE because the company terminate medicare plans and drug benefits for retired salaried workers, affecting approximately 130,000 retirees and their spouses. Likewise, right after Environment score decreased in late 2011, a severe controversy related to toxic emissions and waste occurred. On the General Electric Company 2011 annual report, GE reported that the cleanup of the Hudson River, the river polluted by dispensing polychlorinated biphenyls from GE, may take longer time than estimated because the contamination was severe in wider areas. With the chart with GE's ESG scores and Controversy scores, we could see some relationships between ESG scores with very severe controversies.
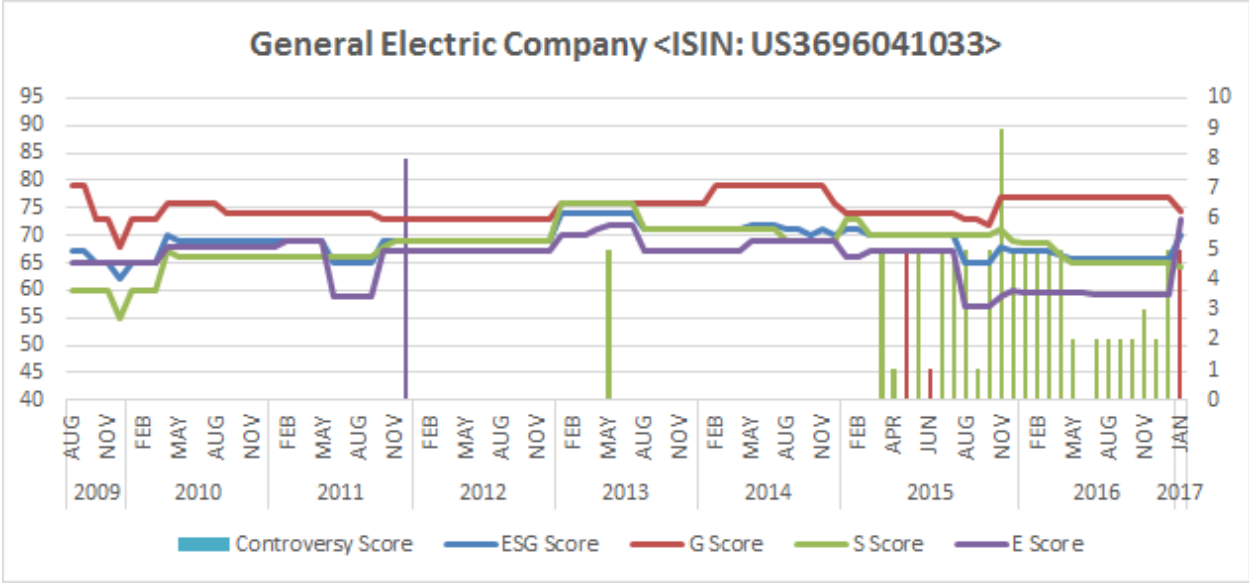
Figure 4. ESG Scores and Controversy Scores for General Electric Company

CASE 2: APPLE INC.

ABOUT COMPANY

Apple Inc found by Steve Jobs and Roland Wayne is one of the largest technology company in the world. Apple is $233 billion revenue company with one of the most widely known and respected brand. Apple has been voted by different sources as the world's most valuable brand and with a large brand valuation. However, Apple Inc. receives significant criticism regarding the labor practices of its contractors and its environmental and business practices, including the origins of source materials.

FINANCIALS

Apple Inc. has a revenue of $233B, profit of $53.7B, margin of 23%, Stock share of $153 and market Cap of $586B. The Sustainalytics ESG score in Q4 2016 was 67.36 and the CDS 47.30 BP, in Q1 2017 the Sustainalytics ESG score is 68.28 and the CDS Spread 37.86 BP. As mentioned above credit default swaps (CDS) is comparable to an insurance policies against a unreliable a bond issuer. In this particular case, an improvement in the ESG score could indicate a correlation with the drop in CDS spread.

Quintile	1	2	3	4	5
ESG	106.9367	102.4633	82.35667	70.33333	67.555
E	106.9367	102.4633	64.75667	83.69333	73.915
S	106.9367	110.5367	74.28333	70.33333	67.555
G	102.6867	73.78667	103.26	82.35667	67.555

14

CONTROVERSY SCORES WITH ESG

Apple Inc.'s ESG score shows its divergent approach to Environment,Social, and Governance strategy. The company's Environment score is quite high in between 65 to 80 while the Social score is between 35 to 55. Although it is hard to find the direct relationship that ESG scores help to predict controversies specifically, the number of controversies is reflected by the ranges of E, S, and G scores. With the given controversy scores, only two out of 25 controversies were related to environment while 15 of them were social controversies. A severe environmental controversy was about environmental impacts of Apple suppliers in China. The Institute of Public and Environmental Affairs (IPE), a Chinese environmental NGO, reported the several years' information about Apple suppliers' pollution impacts including toxic wastewater, hazardous chemicals in China in 2011. The Apple's bad supply chain management affected not only the environmental impacts but also social impacts. Apple's social controversies brought notorious issues regarding its labor management relations, child labors, and supply chain labor standards, and ruined the company's image significantly. Several reports showed that Apple's supply chain such as Foxconn and Pegatron in China hired workers under the Chinese labor laws' minimum working age of 16, with the same number of working hours and under the same intense working conditions as the adult workers. In addition, some new reports broadcasted the workers in its supply chain in China who were committed suicide or diagnosed with leukemia due to the poor working conditions and the exposure to chemicals in early 2010s. The low Social scores in ESG system connected to the frequent controversies related to social issues.
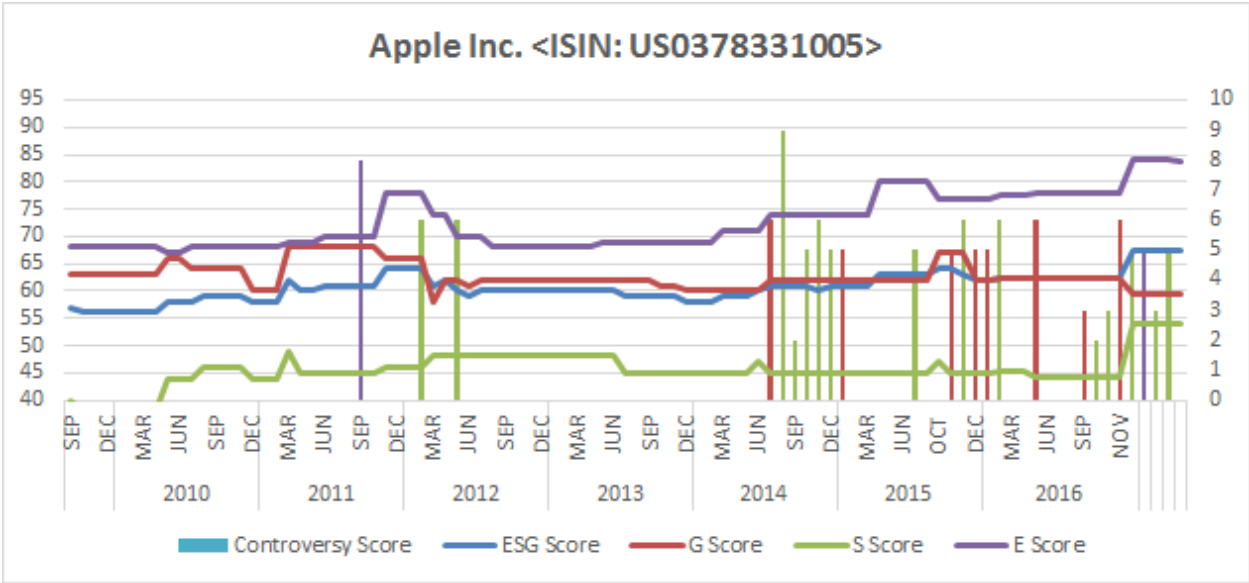
Figure 5. ESG Scores and Controversy Scores for Apple Inc.

With the given data about controversy scores, the event which was repeated several times over different periods was counted as one controversy. In order to show the continuity and severity of controversies, we added a chart per each case with the repeated controversies, counting separately. The following chart is the Apple's case as an example, and the other cases' charts will be found in the **Appendix D**.
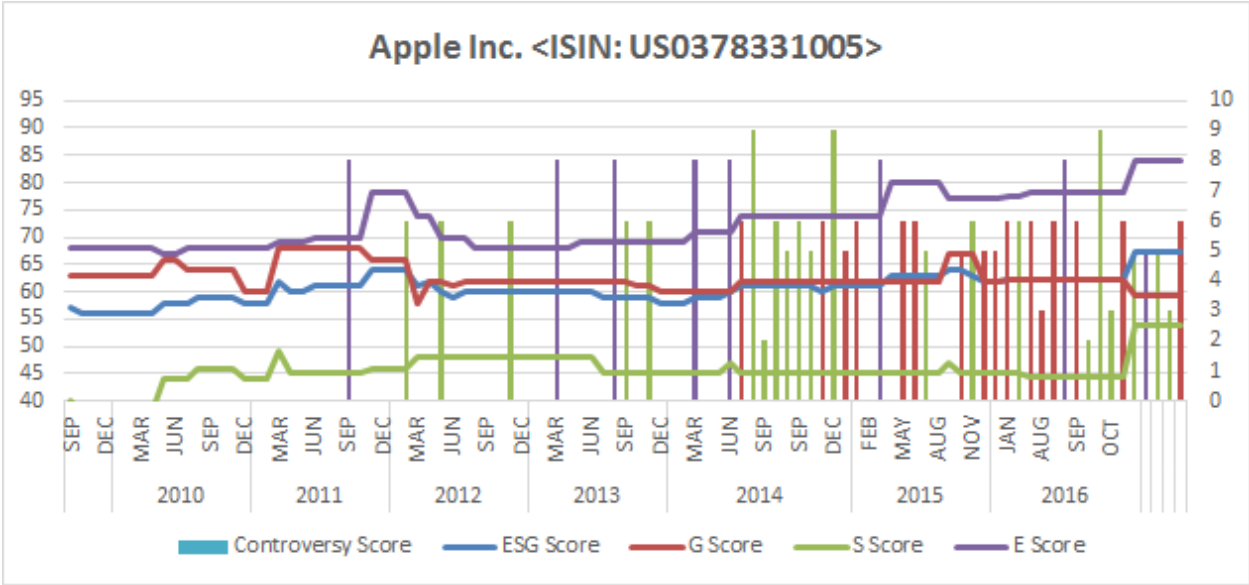
Figure 6. ESG Scores and Controversy Scores for Apple Inc. - Counting Repeated Controversies

CASE 3: E. I. DU PONT DE NEMOURS AND COMPANY

ABOUT COMPANY

DuPont de Nemours is a $ 27.93 billion revenue company for the diversified chemical industry. DuPont was the world's fourth largest chemical company in the world. "E.I. du Pont de Nemours & Co. provides science-based products and services. It operates through six segments; Agriculture, Electronics & Communications, Industrial Biosciences, Nutrition & Health, Performance Materials, Safety and Protection" (Forbes, 2016).

FINANCIALS

E.I. Du Pont has a revenue of $57.9B, profit of $1.95B, margin of 3.36%, stock share of $79.9 and market Cap of $57.5. The Sustainalytics ESG score in Q4 2016 was 58.55 and the CDS 55.10 BP, in Q1 2017 the Sustainalytics ESG score is 59.57 and the CDS Spread 53.03 BP. In this particular case, an improvement in the ESG score could indicate a possible correlation with the drop in CDS spread.

Quintile	1	2	3	4	5
ESG	74.91	76.96	72.99	83.19	52.57
E	64.62667	87.24333	93.5	50.59	64.66
S	74.91	73.81	76.14	77.04667	58.71333
G	83.5	72.86333	58.87333	77.48333	67.9

CONTROVERSY SCORES WITH ESG

While the DuPont's total ESG scores over the periods didn't change much, the Social scores increased and the Environment scores decreased. The latest Social and Environment scores dramatically changed: the Social score on January, 2017 went up to 70.29 while the Environment score in the same period dropped to 47.67. On the other hand, the Governance score stayed stable above 65. As the Environment scores and Social scores are relatively low, there are more controversies related to environmental issues and social issues. Since DuPont is a chemical company, many environmental controversies were related to toxic emissions and waste and its impacts on local communities, biodiversity, and land use. The most severe environmental controversy showed that many local and international communities and NGOs have criticized that the DuPont's continued development of genetically modified ("GM") crops damaged the biodiversity and their contamination harmed other local crops since 2012. In addition, in 2016, the company faced many lawsuits regarding the groundwater contamination by the leakage of perfluorooctanoate acid which can cause "kidney cancer, testicular cancer, ulcerative colitis, thyroid disease, hypercholesterolemia (high cholesterol), and pregnancy-induced hypertension" (Perfluorooctanoic acid, 2017). DuPont also had a very severe social issue that four workers were killed in gas leak in Texas plant, so the U.S. Occupational Safety and Health Administration charged DuPont with penalties for the serious and repeat violations against its employees' health and safety. The low Environment and Social score in ESG brought more controversies in environmental and social issues.
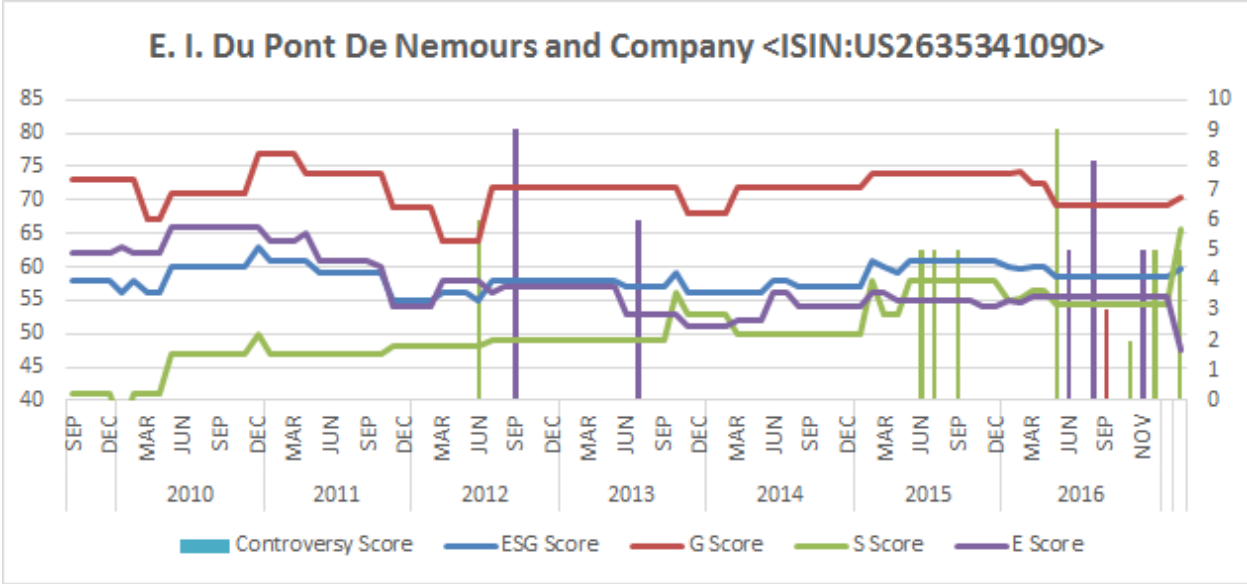
Figure 7. ESG Scores and Controversy Scores for E. I. Du Pont De Nemours and Company

The three cases with GE, Apple, and DuPont shows that the number of controversies is affected by ESG scores. If the company has the higher Environment score, there are the fewer number of controversies related to environmental issues. However, it was hard to find the direct relationship between a ESG score and a controversy score. Therefore, we can't predict specific controversies by certain ESG scores, but we can assume that the higher ESG scores can bring fewer negative controversies.

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APPENDIX

Appendix A: Quintile Tables

Note: Quintile 5 represents the set of companies with the highest ESG, E, S, and G scores, respectively.

Green: Lower CDS | Red: Higher CDS

Sustainalytics | Investment Grade

All Sectors

Quintile	1	2	3	4	5
ESG	95.57146	65.69244	78.7355	76.71439	64.628
E	95.94659	79.6739	75.742	61.29878	68.707
S	91.09976	69.91659	74.58	71.04951	74.84375
G	76.0439	84.53195	80.188	71.85244	68.86425

Consumer Discretionary: 27 (number of companies)

Quintile	1	2	3	4	5
ESG	162.91	47.108	75.83333	80.464	126.51
E	162.91	47.384	96.67667	75.904	105.782
S	136.875	58.454	95.18167	127.51	76.142
G	102.45	53.34	114.435	142.338	84.634

Consumer Staples: 19

Quintile	1	2	3	4	5
ESG	53.2475	54.4525	80.65	49.745	47.48
E	102.0675	51.615	44.505	40.7725	46.32667
S	59.2575	48.4425	96.09	34.305	47.48
G	44.375	41.4975	47.3775	54.0475	115.21

Energy: 17

Quintile	1	2	3	4	5
ESG	149.275	89.05667	98.61	107.8367	96.16667
E	103.065	152.4633	97.265	107.8367	96.16667
S	144.53	105.9033	91.575	91.31333	111.55
G	82.6025	159.35	97.1325	128.4667	96.11

Financials: 24

Quintile	1	2	3	4	5

ESG	83.944	65.526	78.25	61.022	66.1675
E	69.102	77.2	86.924	45.952	78.1225
S	81.14	45.168	98.022	56.356	76.2375
G	73.568	88.772	65.546	71.41	52.975

Healthcare: 21

Quintile	1	2	3	4	5
ESG	71.02	46.1325	45.6925	54.7475	23.2925
E	60.6	56.1275	38.03	42.4025	46.33
S	58.212	57.6875	63.365	41.53	23.2925
G	67.58	58.685	51.8975	30.4425	33.14

Industrials: 33

Quintile	1	2	3	4	5
ESG	71.13143	62.53429	52.145	37.77286	50.28833
E	80.68714	55.95143	40.83333	46.91286	47.46833
S	56.25714	66.66714	60.435	41.63	50.03
G	69.18857	52.48571	57.165	56.83429	37.02

Information Technology: 14

Quintile	1	2	3	4	5
ESG	106.9367	102.4633	82.35667	70.33333	67.555
E	106.9367	102.4633	64.75667	83.69333	73.915
S	106.9367	110.5367	74.28333	70.33333	67.555
G	102.6867	73.78667	103.26	82.35667	67.555

Materials: 15

Quintile	1	2	3	4	5
ESG	74.91	76.96	72.99	83.19	52.57
E	64.62667	87.24333	93.5	50.59	64.66
S	74.91	73.81	76.14	77.04667	58.71333
G	83.5	72.86333	58.87333	77.48333	67.9

Real Estate: 13

Quintile	1	2	3	4	5
ESG	87.99333	100.2667	135.055	130.6933	127.045
E	87.99333	123.2167	83.81	141.9067	127.045

S	97.78667	160.4967	93.58	118.1233	82.34
G	87.99333	118.3233	121.625	142.8833	95.105

Utilities: 18

Quintile	1	2	3	4	5
ESG	66.4625	83.31	109.5233	54.045	61.06
E	57.9725	58.415	160.62	49.1075	61.06
S	59.9775	89.8675	63.83667	92.425	55.47667
G	54.72	94.865	40.57333	112.185	52.74

Appendix B: CDS Regressed Over E, S, and G, Credit Ratings, Sector, and Sector/ESG Interaction

	Dependent variable:			
	Credit Default Swap			
	(1)	(2)	(3)	(4)
Sustainalytics Environmental Score	-0.792**	-0.568*	-0.393	0.164
	(0.322)	(0.291)	(0.335)	(1.009)
Sustainalytics Social Score	-0.039	0.260	-0.125	0.316
	(0.395)	(0.349)	(0.423)	(1.107)
Sustainalytics Governance Score	-0.155	-0.451	-0.102	-1.477
	(0.459)	(0.405)	(0.520)	(1.345)
S&P Credit Rating: BBB-		102.992***	91.401***	107.116***
		(33.628)	(33.010)	(37.512)
S&P Credit Rating: BBB		44.345	37.542	46.232
		(32.998)	(32.565)	(36.244)
S&P Credit Rating: BBB+		33.454	28.413	37.309
		(32.733)	(32.341)	(36.081)
S&P Credit Rating: A-		20.449	16.942	24.364
		(33.129)	(32.754)	(36.663)
S&P Credit Rating: A		6.896	7.846	14.661
		(32.990)	(32.649)	(36.616)
S&P Credit Rating: A+		2.715	7.274	25.232
		(35.114)	(34.482)	(37.744)
S&P Credit Rating: AA-		9.546	7.702	22.936
		(34.565)	(34.291)	(38.116)
S&P Credit Rating: AA		-3.657	7.048	47.027
		(40.771)	(40.116)	(45.809)
S&P Credit Rating: AA+		-12.617	-36.196	-35.647
		(55.120)	(54.687)	(60.958)
GICS Sector: Consumer Discretionary			28.236**	136.350

	(11.602)	(146.415)
GICS Sector: Consumer Staples	2.835	-215.763
	(12.951)	(136.725)
GICS Sector: Energy	42.704***	117.884
	(14.726)	(181.781)
GICS Sector: Financials	15.120	-2.462
	(13.730)	(148.782)
GICS Sector: Health Care	-4.071	-104.014
	(12.950)	(134.752)
GICS Sector: Information Technology	20.064	34.590
	(14.719)	(181.025)
GICS Sector: Materials	10.498	-12.310
	(14.155)	(148.146)
GICS Sector: Real Estate	47.996***	-32.652
	(14.750)	(158.117)
GICS Sector: Telecommunication Services	20.596	191.991
	(32.134)	(363.760)
GICS Sector: Utilities	13.980	127.926
	(14.548)	(202.009)
Environmental Score: GICS Sector: Consumer Discretionary		-1.759
		(1.377)
Environmental Score | GICS Sector: Consumer Staples		-2.375
		(1.634)
Environmental Score | GICS Sector: Energy		0.854
		(3.012)
Environmental Score | GICS Sector: Financials		-0.437
		(1.300)
Environmental Score | GICS Sector: Health Care		-0.302
		(1.509)
Environmental Score | GICS Sector: Information Technology		0.934
		(1.855)
Environmental Score | GICS Sector: Materials		-1.105
		(1.758)
Environmental Score | GICS Sector: Real Estate		0.454
		(2.313)
Environmental Score | GICS Sector: Telecommunication Services		-2.349
		(5.048)
Environmental Score | GICS Sector: Utilities		-0.085
		(1.511)

Social Score | GICS Sector: Consumer Discretionary				-1.571
				(1.706)
Social Score | GICS Sector: Consumer Staples				1.483
				(1.880)
Social Score | GICS Sector: Energy				-1.564
				(2.400)
Social Score | GICS Sector: Financials				-0.255
				(2.260)
Social Score | GICS Sector: Health Care				-1.722
				(1.886)
Social Score | GICS Sector: Information Technology				-2.283
				(2.316)
Social Score | GICS Sector: Materials				-0.122
				(1.940)
Social Score | GICS Sector: Real Estate				-0.235
				(1.690)
Social Score | GICS Sector: Telecommunication Services				
Social Score | GICS Sector: Utilities				0.690
				(1.964)
Governance Score | GICS Sector: Consumer Discretionary				1.222
				(2.028)
Governance Score | GICS Sector: Consumer Staples				4.055[*]
				(2.102)
Governance Score | GICS Sector: Energy				-0.445
				(3.101)
Governance Score | GICS Sector: Financials				0.781
				(2.107)
Governance Score | GICS Sector: Health Care				3.109
				(2.133)
Governance Score | GICS Sector: Information Technology				0.826
				(2.985)
Governance Score | GICS Sector: Materials				1.418
				(2.189)
Governance Score | GICS Sector: Real Estate				0.909
				(3.321)
Governance Score | GICS Sector: Telecommunication Services				
Governance Score | GICS Sector: Utilities				-1.910
				(2.971)
Constant	137.686[***]	93.690[**]	70.726	95.689

	(32.439)	(45.114)	(49.080)	(97.579)
Adjusted R^2	0.026	0.271	0.317	0.267
Residual Std. Error	51.337 (df = 199)	44.397 (df = 190)	42.983 (df = 180)	44.520 (df = 152)

Note: *p<0.1; **p<0.05; ***p<0.01

Appendix C: CDS Regressed Over Absolute ESG Difference, Credit Ratings, and Sector

	Dependent variable:		
	Credit Default Swap		
	(1)	(2)	(3)
Absolute Difference in Scaled ESG Scores	-0.560	-0.194	-0.286
	(0.556)	(0.492)	(0.484)
S&P Credit Rating: BBB-		115.672***	98.429***
		(33.575)	(32.862)
S&P Credit Rating: BBB		59.580*	45.873
		(32.676)	(32.209)
S&P Credit Rating: BBB+		46.299	34.829
		(32.687)	(32.246)
S&P Credit Rating: A-		34.477	23.664
		(32.994)	(32.583)
S&P Credit Rating: A		21.392	14.438
		(32.830)	(32.432)
S&P Credit Rating: A+		11.713	12.532
		(35.220)	(34.355)
S&P Credit Rating: AA-		21.535	11.470
		(34.817)	(34.204)
S&P Credit Rating: AA		4.304	12.648
		(41.034)	(39.981)
S&P Credit Rating: AA+		8.164	-31.707
		(55.163)	(54.646)
GICS Sector: Consumer Discretionary			29.633**
			(11.589)
GICS Sector: Consumer Staples			0.485
			(12.730)
GICS Sector: Energy			44.447***
			(13.654)
GICS Sector: Financials			17.771
			(11.773)
GICS Sector: Health Care			-5.203

			(12.558)
GICS Sector: Information Technology			15.905
			(14.286)
GICS Sector: Materials			8.430
			(13.800)
GICS Sector: Real Estate			47.272***
			(14.448)
GICS Sector: Telecommunication Services			17.259
			(32.057)
GICS Sector: Utilities			13.799
			(13.172)
Constant	81.150***	32.227	28.367
	(6.029)	(32.744)	(33.083)
Adjusted R^2	0.0001	0.254	0.315
Residual Std. Error	52.009 (df = 201)	44.912 (df = 192)	43.057 (df = 182)

Note: *p<0.1; **p<0.05; ***p<0.01

Appendix D: Controversy Scores and ESG Scores of GE and DuPont – Counting repeated controversies

E. I. Du Pont De Nemours and Company <ISIN:US2635341090>

Controversy Score — ESG Score — G Score — S Score — E Score