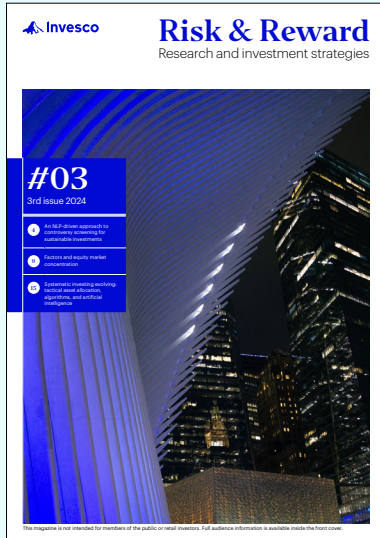


An NLP-driven approach to controversy screening for sustainable investments

By Margit Steiner, PhD, and Ananthalakshmi Ranganathan, PhD



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This ESG monitoring tool uses a dictionary-based approach to identify financially material controversies. Comparing its results with third-party assessments demonstrates the tool's efficacy in capturing controversial practices that lead to significant stock price reactions..

Today's investors give crucial consideration to environmental, social, and governance (ESG) controversies. Often tied to specific events or practices, controversies can significantly harm a company's reputation, or damage brand trust, and may lead to legal penalties and operational disruptions. But, assessing such impacts requires determining what exactly constitutes a financially material controversy.

To this end, various third-party providers have developed a broad array of systematic controversy assessments. For example, MSCI scores ESG incidents on a 0-10 scale based on severity and type across environment, human rights, labor rights, customers, and governance, while Sustainalytics uses a 1-5 severity scale. London Stock Exchange Group (LSEG)

assesses controversies across 23 topics with a market-cap bias correction and Vigeo Eiris, part of Moody's ESG Solutions assesses controversies based on severity, frequency, and responsiveness across six areas. Thus, despite their similar goals, the methodologies and criteria differ across providers, limiting comparability between assessments.

Given the importance of ESG controversies for asset allocation decisions and the challenges posed by the divergent methodologies, we have explored a novel approach to ESG controversy screening. Analyzing news flow and applying natural language processing (NLP) techniques, our aim is to supplement the common vendor assessments using a bespoke approach that can be tailored to any topic to provide



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a more targeted evaluation of financial impact and help investors make more informed decisions.

An NLP-based controversy monitoring tool

Since controversial practices or behaviors often lead to increased media coverage, our approach involves analyzing a comprehensive news corpus to identify spikes in relevant news activity.

Treating this as a standard text classification problem, identifying and categorizing news items as controversy-related or not, we begin with a rule-based dictionary screening. A dictionary is a compilation of terms and phrases used to sort underlying data into predefined categories. While more advanced methods like BERT (Bidirectional Encoder Representations from Transformers) offer deep contextual understanding, the dictionary approach is generally more transparent and easy to maintain.

For our dictionaries, we first identify the categories of interest. Given the extensive range of ESG sub-categories, we refer to the Vigeo Eiris dataset to prioritize the most prevalent controversies and organize them into distinct groups. In this article, we will confine ourselves to the social domain (S). Here, we find the most prevalent areas of controversy to be: consumer data security and privacy, discrimination, fundamental human rights, workplace health and safety standards, labor standards, modern slavery, product safety standards and stakeholder interests (table 1).

For each of these categories, we compile a list of relevant terms and phrases indicative of controversial behavior, using automated keyword extraction followed by a manual review. For example, controversies in the category consumer data security and privacy often relate to issues such as 'data breach' and 'privacy violation'. Similarly, terms like 'child labor' and 'forced labor' help pinpoint violations in labor standards and also warrant inclusion in the dictionaries. This methodology ensures a targeted and efficient approach to controversy detection, allowing us to monitor each category with a high degree of specificity and accuracy.

Abnormal news flow indicator

The next step is to construct an indicator of controversy news flows. Our premise is that major controversies initially attract heightened media attention, leading to an abnormal increase in news coverage of the companies involved.

We use news data from RavenPack, which provides approximately 5 million news headlines per month. This coverage spans 300,000 entities across more than 130 countries, encompassing over 98% of the global investable market. We focus on a sample of around 9,500 companies globally each month, starting in January 2014. For over 75% of these companies, at least one news item is published every month.

In general, larger companies are more likely than their smaller counterparts to have controversial news items reported. Hence, we standardize the controversial

Table 1
Identified categories and high-level keywords

Consumer data security and privacy Data breach Privacy violation Consumer fraud Identity theft	Labor standards Child labor Forced labor Minimum wage Working hours Union rights
Discrimination Gender discrimination Racial discrimination Age discrimination Disability discrimination Racial profiling	Modern slavery Human trafficking Debt bondage Exploitation Involuntary servitude
Fundamental human rights Freedom of speech Physical abuse Sexual abuse	Product safety standards Product defects Safety standards Regulatory compliance Hazardous materials Consumer safety
Workplace health and safety standards Workplace accidents Occupational health Safety violations Hazardous conditions	Stakeholder interests Terrorist financing Civil conflict Social conflict

Source: Invesco.

Table 2

Mean average abnormal returns in times of controversy, based on abnormal news activity (446 in total)

Event window	Mean average abnormal return (%) (daily)		Mean average abnormal return (%) (cumulative)	
		t-stat		t-stat
-5	-0.15	-1.50	-0.15	-1.50
-4	-0.15	-1.26	-0.30	-2.12
-3	-0.13	-1.26	-0.43***	-2.67
-2	-0.10	-0.97	-0.53***	-3.05
-1	-0.25***	-2.58	-0.78***	-3.81
0	-0.31***	-2.74	-1.09***	-4.43
1	-0.01	-0.05	-1.10***	-4.29
2	0.06	0.62	-1.04***	-3.88
3	0.14	1.31	-0.90***	-3.38
4	0.06	0.59	-0.84***	-2.98
5	0.10	0.78	-0.74**	-2.33

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.
Source: Invesco.

Table 3

Mean average abnormal returns in times of controversy, events identified as critical and either reactive or non-responsive by Vigeo Eiris (175 in total)

Event window	Mean average abnormal return (%) (daily)		Mean average abnormal return (%) (cumulative)	
		t-stat		t-stat
-5	-0.48*	-1.82	-0.48*	-1.82
-4	0.01	0.03	-0.47	-0.97
-3	-0.14	-0.65	-0.61	-1.16
-2	0.02	0.10	-0.58	-1.04
-1	0.22	0.92	-0.36	-0.59
0	-0.79	-1.28	-1.15	-1.36
1	-0.52	-1.60	-1.67*	-1.73
2	-0.15	-0.67	-1.82*	-1.82
3	-0.34	-0.97	-2.16*	-1.95
4	0.07	0.38	-1.61	-1.50
5	-0.28	-1.31	-1.89*	-1.73

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.
Source: Invesco.

news volume per company using a one-year lookback window:

$$A_{it} = \frac{C_{it} - \bar{C}_{i(t-1, t-365)}}{s.d(C_{i(t-1, t-365)})}$$

where C_{it} is the total number of controversies identified for company i on day t , $\bar{C}_{i(t-1, t-365)}$ is the mean number of controversies during the previous year for company i , and $s.d(C_{i(t-1, t-365)})$ is the associated standard deviation during the previous year for company i .

Dictionary-based vs. vendor-identified controversial events

To find whether controversies surrounding a company's behavior are financially material, we document price reactions on the day of the highest media coverage of controversies as indicated by the abnormal news flow indicator. To capture

the most severe controversial events, we focus on the top percentiles. Using a 252-day estimation window, a baseline is established for typical price behavior, with an event window spanning from five days before to five days after the coverage peak. In total, we identified 446 events with our approach.

As shown in table 2 and figure 1 (chart A), controversial events have a significant negative impact on stock prices. The cumulative mean average return declines substantially, particularly around the event date. This reflects the financial materiality of these controversies and the efficacy of our approach.

For comparison, we now look at controversies identified by Vigeo Eiris. Vigeo Eiris assesses each detected controversy qualitatively, distinguishing four levels of



Controversial events have a significant negative impact on stock prices.

Table 4
Mean average abnormal returns in times of controversy, events identified as critical and non-responsive by Vigeo Eiris (43 in total)

Event window	Mean average abnormal return (%) (daily)		Mean average abnormal return (%) (cumulative)	
		t-stat		t-stat
-5	-0.06	-0.24	-0.06	-0.24
-4	0.09	0.21	0.04	0.08
-3	-0.91*	-1.71	-0.87	-1.06
-2	0.45	1.15	-0.42	-0.60
-1	0.15	0.35	-0.27	-0.30
0	-3.02*	-2.16	-3.29**	-2.48
1	-2.03*	-2.36	-5.32***	-2.80
2	-0.01	-0.04	-5.34***	-2.80
3	-1.10	-0.96	-6.44**	-2.43
4	0.14	0.46	-4.41**	-2.36
5	0.28	1.40	-4.13**	-2.22

*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.
 Source: Invesco.

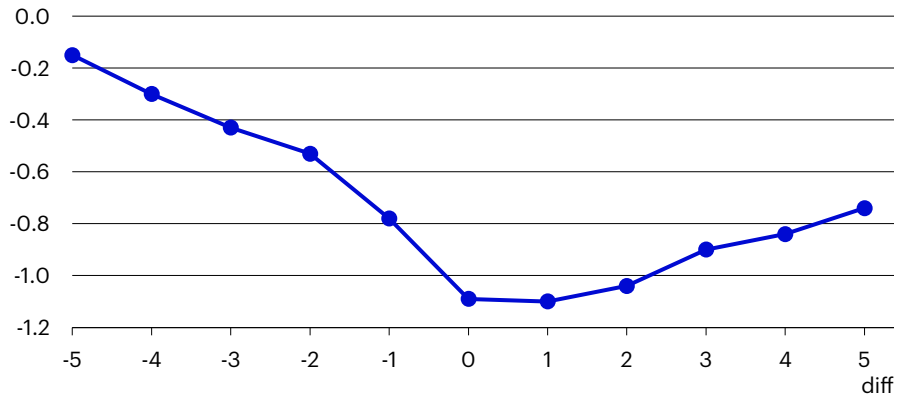
severity (Minor, Significant, High, Critical) and responsiveness (Proactive, Remediative, Reactive, Non-Communicative). Since we anticipate a material impact when a company is involved in severe controversies, we consider controversies that are both critical and either reactive or non-responsive (table 3 and figure 1, chart B). Furthermore,

we perform a specific analysis of those critical controversies which are non-responsive to map the consequences of inaction (table 4).

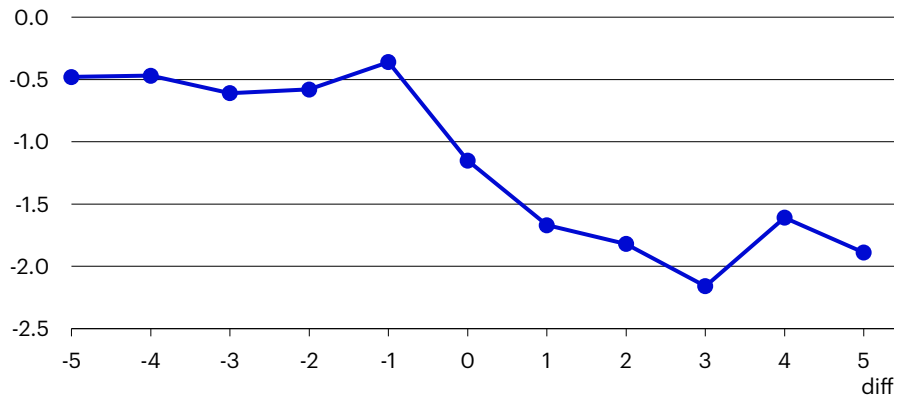
We can see from table 3 and figure 1 (chart B) that there is no statistically significant drop in returns for events

Figure 1
Mean cumulative average abnormal return, based on abnormal news activity (chart A) and Vigeo Eiris (critical and either reactive or non-responsive, chart B)

(Chart A) meanCAR

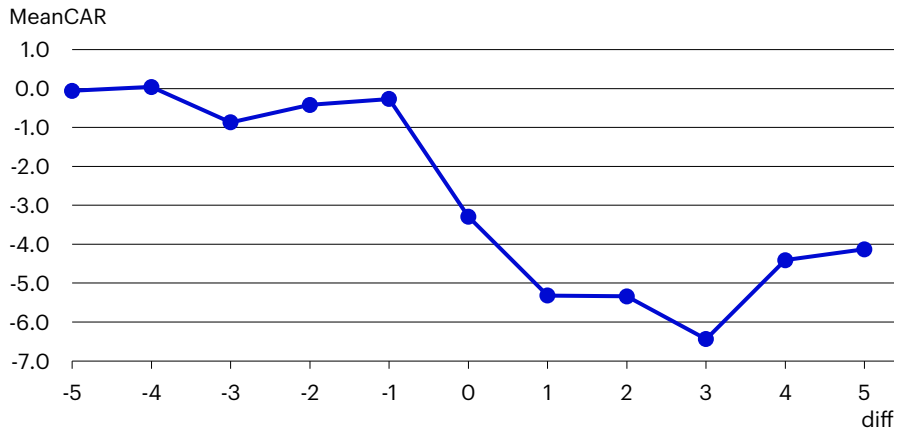


(Chart B) meanCAR



Source: Invesco.

Figure 2
Mean cumulative average abnormal return, based on controversies identified as critical and non-responsive by Vigeo Eiris



Source: Invesco.

identified by Vigeo Eiris as critical and either reactive or non-responsive, with Average Abnormal Returns (AAR) showing no statistical significance. In contrast, Table 4 and figure 2, which focuses on critical and non-responsive controversies, reveal significant negative Cumulative Average Abnormal Returns (CAAR) from the event day onwards. This suggests that both quantitative measures (such as abnormal news activity) and qualitative assessments (like those by Vigeo Eiris) can identify financially relevant controversies, however, underscoring the importance of understanding the nuances in external vendor classifications.

Conclusion

Our controversy monitoring tool, utilizing dictionary-based approaches, effectively identifies financially material controversies via the abnormal news flow indicator, which captures controversial practices that lead to significant stock price reactions. Hence, this may serve as a complementary screening and alert system, capable of addressing bespoke topics outside standard classifications, additionally ensuring timely and comprehensive identification of financially material controversies.



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