The Impact of Environmental Scandals on Firm Sales

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Abstract

Environmental scandals create negative information shocks about the involved firms, damage their reputation, and cause reduction in revenues. Media play a key role to spread the information and awake public attention. Using a global media coverage dataset covering firms across industries, I document the negative impact of environmental scandals on the revenues of involved firms, as well as the potential spillover effects on other firms. Each environmental controversy related to a big scandal reduces the revenues of involved firms by 2%. Big environmental scandals have negative country-related reputational spillover, although not high and significant. Specifically, German automobile manufacturers experience 1.3% reduction in their revenues compared to non-German ones, following the Volkswagen emissions scandal. However, there is no direct spillovers for competitors and other German makes after controlling for other environmental controversies about them. Finally, the impact of scandals is higher for firms operating in countries with higher environmental public awareness levels.

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1 Introduction

Scandals or controversies create negative information shocks about the involved firms and cause loss of reputation for them. Consumers care about the reputation of the companies or brands when they make a consumption decision. A survey by Ipsos Global Reputation Monitor (2018) reveals that 87% of the consumers worldwide considers the reputation of the company when purchasing a product or service. In the US, 88% of the participants of Cone Communication (2017) Corporate Social Responsibility Study told that they would stop buying products of a company if they learn about its irresponsible and deceptive business practices. Furthermore, 39% of them told that they "researched a company's business practices or support of social and environmental issues in the past 12 months". Therefore, we would expect a consumer demand response to the environmental scandals involved by firms, as a reduction in sales and revenues. Further to that, the reputation loss may not be restricted with the firms involved in scandals. There are three possible channels of externalities affecting the revenues of other firms.

Firstly, Tirole (1996) develops the theory of collective reputation as the reputation of a company is related with past behaviours of other companies in the same group. Scandals may create externalities affecting other firms in the same country-industry group. Bachmann et al. (2019) study the impact of Volkswagen emissions scandal on the sales of other German automobile manufactures in the US market as a country-related reputational spillover and find a significant decline in their revenues relative to non-German makes. Bai et al. (2019) studies the collective reputation of Chinese diary industry after a series of product quality scandals revealed about some firms within industry. They provide evidence for a large negative spillover effect on the export of the innocent firms within industry. Therefore, companies from the same origin country with a scandalized firm may experience some reputation loss and reduction in their revenues after the scandal.

Secondly, Collective reputation is formed not only within country of origin, but also within an industry. Although firms within an industry compete with each other, they also construct a reputation collectively for the goods or services they produce. Industrial collective reputation does not directly represents the reputation of companies within the industry; however, it can be directly harmed by the environmental performance of each company. For instance, there is a clear concern about the environmental impact of oil and gas industries, and these concerns blaze up with every environmental scandal about these industries like oil spills[1]. Therefore, scandals may create negative spillovers for industries as a whole.

Lastly, another channel of externalities on the competitors of a scandalized firm would be the

[1]See, for example, Roberts (2020) and Watts (2020)

substitution away from the firm involved in a scandal to its competitors. Consumers can substitute the products of a firm with its competitors after a scandal about that firm brakes out. This would create a positive spillover effect on the sales of the competitors of the scandalized firm as opposed to collective reputation spillovers. Bachmann et al. (2019) tries to quantify and differentiate this effect from the country-specific reputational spillovers using a demand model for automobile industry. I try to capture this channel using a market similarity index measuring the competition level between two firms.

Media play a key role in diffusing negative information to the public. We would expect more serious loss of reputation for firms involved in scandals that take more media attention. It allows consumers not only to be aware of the scandal but also to know about the seriousness of the consequences. Accordingly, examining the media coverage of scandals is a good way to quantify the possible reputation loss of companies. It also enables the creation of externalities on other firms by publicizing the negative information beyond the consumers of the scandalized firm and beyond the borders of a single market. Therefore, this study uses the media coverage of the environmental scandals about the firms to assess the impacts of environmental scandals on firm revenues.

Environmental change is a global problem and most of the large companies around the world try to manage their environmental reputation in the eyes of the consumers and investors. NGOs try to create pressure on the companies to disclose their environmental impact and to increase public attention to the disastrous practices of companies. CDP (2020) Non-Disclosure Campaign Report documents the spread of disclosing companies across countries and industries to build their environmental reputation. Investment advisors and financial databases collect data for environmental performance and construct scores for the companies worldwide (e.g. Refinitiv, MSCI, Sustainalytics). However, environmental scandals damage their reputation significantly. This study covers a wide range of environmental scandals involved by big companies around the world from various industries, as opposed to previous studies focusing on specific big scandals.

The aim of this study is to estimate the causal impact of environmental scandals on firm revenues, both the direct effect on the scandalized firm and possible spillovers on other firms. The advantage of using global data with various industries is to provide evidence for an average effect of environmental scandals across countries and industries. Additionally, I am able to assess the heterogeneity of the impact across countries. This study is not able to capture different consumption habits or brand loyalty in different industries; however, provide a good external validity analysis on top of the case studies in this literature.

I conduct this study in three main steps. In the first step, I attempt to estimate the net effect

of environmental scandals on the revenues of scandalized firms, using a generalized difference-in-differences setup, both specifically in automobile industry and in all industries. As a second step, I modify the models in the first step by incorporating possible spillovers effects. Lastly, I document the heterogeneity of the treatment effect across countries with different environment awareness levels.

In the first step, I start with estimating the impact of environmental scandals in the automobile manufacturing industry. Each environmental or public health controversy reduces the revenues of the involved firm by 8% on average compared to other firms within automobile industry without any controversy. Then, I generalize the model to capture all industries and estimate 1.4% decrease in firm revenues with a controversy in environmental or public health issues, which is far less than the effect in automobile industry and imprecise. Therefore, I conclude that the effect of each controversy might be heterogeneous across industries and average treatment effect is less than the one in automobile industry. These models ignore the possible externalities of environmental scandals on other companies.

In the second step, I incorporate the possible spillover effects on the competitors of the scandalized firm and on other firms from the same country of origin. There are three possible spillover channels to effect the firms other than the scandalized one: (1) positive spillover on the competitors due to the substitution away from the scandalized firm to its competitors, (2) negative spillover on the competitors due to the substitution away from the industry as a whole, (3) negative spillover on the firms from the same country of origin with scandalized firm as a country-related reputational spillover. The coefficient estimate for the spillovers on the competitors would be the combination of the first two contrary spillovers.

First, I focus on the Volkswagen emissions scandal which is the largest environmental scandal in our dataset with more than 10 controversies in a year after the scandal. The revenues of German automobile manufacturers except Volkswagen reduce 1.3% compared non-German ones for each controversy about Volkswagen. However, this reduction is due to the other controversies about the German automobile manufacturers themselves. I estimate no significant spillover effects both on the German and other automobile manufacturers. Volkswagen emissions scandal creates indirect externalities by triggering other controversies on other German automobile manufacturers and some other competitors.

Secondly, I allow spillovers for all environmental and public health controversies involved by all firms in the sample. Both the industry specific model for automobile industry and the generalized model estimate no clear spillover effects both on the competitors and on the firms from the same country of origin. These models assume homogeneous effect for each controversy, whether being related to a big scandal or a small scandal. The number of environmental controversies about a firm

in a year allows us to categorize the scandals as big or small.

Lastly, I compare the impact of a controversy related to a big scandal (more than 5 controversies in a year) versus small scandal (less than 5 controversies in a year). If a controversy is related to a big scandal, it reduces the revenues of the involved firm by 2%; however, controversies related to small scandals have no significant effect. Moreover, the spillover of controversies related to a big scandal is more negative on the firms from the same country and more positive on the competitors.

As a third step, I explain the reduction in revenues after an environmental scandal with the loss of reputation in the eyes of the consumers. This reputation loss is more severe in the countries with higher environmental public awareness level. I construct an environmental fragility index to capture the demand fragility of a firm to the environmental scandals, using the environmental awareness level in the countries each firm operate. I estimate that the impact of each environmental controversy doubles with one standard deviation increase in the environmental fragility index of a firm. This means that the consumer response would be higher for the firms operating in countries with higher environmental public awareness level.

There is a large environmental economics literature covering the relationship between environmental and economic performance at firm level, establishing a correlation without causation in general (see Dechezleprêtre and Kruse (2018) for a literature survey). A big strand of the literature studies the role of environmental disclosure strategies to create incentives for the firms to improve their environmental performance (see Dasgupta et al. (2006) for a chapter on disclosure strategies). However, studies are scarce on the negative information shocks that might destroy the environmental reputation of firms. The only other study exploiting an environmental scandal is Bachmann et al. (2019) to assess the consumer response and firm performance. To the best of my knowledge, this study is a first attempt to discover the impact of environmental scandals and environmental reputation on firm sales in a global setting across industries.

This study also contributes to the literature on individual reputation of firms by providing evidence for the reduction in revenues of firms after getting involved in environmental scandals. A strand of this literature covers the online markets and the role of reviews to construct individual reputation (see Cabral and Hortacsu (2010), Li (2010), Mayzlin et al. (2014), Fan et al. (2016), Luca (2016), Luca and Zervas (2016), Li et al. (2020)). Another strand of the literature studies the importance of firm reputation in terms of product quality as a signal for the buyers (see Banerjee and Duflo (2000), List (2006), Jin and Leslie (2009), Macchiavello (2010), Bardhan et al. (2013), Macchiavello and Morjaria (2015), Zhong (2018)). More recently, Koenig and Poncet (2019a,b) study the impact of a workforce scandal, Rana Plaza collapse in Bangladesh, on the involved firms in garment industry. They highlight

the importance of NGO activism and media slant on the consumer response to the social responsibility scandals. Che et al. (2020) studies the willingness to pay for brand reputation in case of Volkswagen emissions scandal.

Tirole (1996) starts the theoretical discussion of collective reputation, followed by other theoretical works (see Winfree and McCluskey (2005), Fleckinger (2007), Levin (2009), Fishman et al. (2017)). Zhao (2018) supports the theory for country-related collective reputation with a dynamic structural model incorporating information asymmetries for the export market of Chinese firms. This study is more related to the literature in terms of the reputational spillovers of industrial scandals. Jonsson et al. (2009) study the spillover effects of a corporate deviance scandal on the innocent firms in Swedish finance industry. Freedman et al. (2012) exploit a product quality scandal in toys industry to study the consumer response and spillover effect of the scandal on the industry as a whole in the US market. Bai et al. (2019) investigate the impact of a series of product quality scandals in Chinese diary industry on the exports of involved and innocent companies. Lastly, Bachmann et al. (2019) compare the sales of German and non-German automobile manufacturers in the US market and provide evidence for country-related reputational spillovers of Volkswagen emissions scandal. I contribute this literature in two ways. First, Volkswagen emission scandal has no significant direct spillover effect on other German automobile manufacturers. Instead, it creates spillovers by triggering other scandals about German makes. Secondly, I provide an external validity exercise exploiting the global structure of the dataset.

Lastly, I contribute to the literature of media economics by exploiting the negative media coverage on environmental and public health issues to assess reputation loss of firms and consumer response. After the seminal work of Gentzkow and Shapiro (2006), the political economy of media literature has been growing significantly, but the focus is mainly remained on politics. However, the effect of media on human behaviour is also important in terms of firm reputation and consumption decisions[2]. A recent literature studies the role of media coverage on financial markets (e.g. Kölbel and Busch (2013), Kölbel et al. (2017), Golez and Karapanda (2020))[3]. Beattie (2020) and Beattie et al. (2021) bring a new perspective by studying the relationship between advertisement and media coverage in terms of firm reputation. The results of this paper suggests that the impact of an environmental scandal on the involved firm would increase with a wider media coverage by creating more severe reputation loss for the involved firm. Koenig and Poncet (2019a,b) provide evidence for a higher impact of an industrial scandal on firms those targeted by local media and NGO activism.

The remainder of the article is organized as follows: Section 2 describes the data used from

[2]Enikolopov and Petrova (2018) for a literature review on the influence of mass media on behaviour in different areas.
[3]See Tetlock (2015) for a survey.

different sources, explain the market similarity index used, and provide summary statistics. Section 3 documents the net effect of environmental and public health scandals on the involved firms, ignoring the spillover effects. Section 4 improves the difference-in-differences model by incorporating possible spillover effects on other firms. Section 5 discuss the possible mechanisms for the reduction in sales after environmental scandals and provide evidence for heterogeneous response across countries with different environmental awareness levels. Section 6 concludes the paper.

2 Data

2.1 ESG Performance and Controversies

Environmental, social, and corporate governance (ESG) performance of companies has gained much more importance in financial markets in the last decades. ESG performance of the listed companies has become one of the crucial factors that determine investment decisions; hence, companies that collect financial data have started to incorporate ESG performance of companies into their datasets. Refinitiv[4], a global provider of financial market data, is one of them and provides ESG data for more than 10,000 firms which capture more than 80% of global market cap. The important distinction of this dataset is that it provides ESG controversies related to companies captured from global media resources in addition to general ESG performance information reported by companies themselves. Therefore, it offers a representative and comparable global firm level dataset containing ESG controversies related to large companies which allows us to detect environmental scandals involved by firms.

Refinitiv ESG database covers listed companies which are represented within worldwide stock market indices. It starts with major stock market indices in 2002 consisting almost 1000 firms mainly in the US and Europe. The coverage expands continuously after 2008 by including other worldwide stock market indices like MSCI World and MSCI Emerging Markets. Currently, it covers more than 10,000 firms worldwide which account for more than 80% of global market cap. I restrain my sample in the main specification to the years between 2010-2018 to obtain a representative balanced panel with wide spanning both in time and unit dimensions[5].

The dataset contains negative media stories about the firms which are followed and captured from English speaking global media sources[6]. If the same story is captured by multiple sources, only one

[4]ESG dataset by Refinitiv is the successor of ASSET4 by Thomson Reuters since 2018.

[5]This reduces the number of firms in the balanced sample to 2,884 firms after excluding firms with missing outcome and control variables.

[6]A caveat of the dataset is the lack of media coverage in local languages.

of them is included in the data to avoid duplicates. However, there might be several different stories related to a single environmental scandal captured by the media. In that case, the dataset contains those several stories which reflects the severity of the scandal. For instance, an oil spill might create more than one data point if there are different stories in the media concerning the disastrous impact on the sea life, the health effect on local communities, or protests by environment activists. Moreover, there will be new data points in the following years if there are new developments covered in the media like ongoing effects of the environmental scandal/disaster, lawsuits, or fines. Therefore, we are able to track the scale and ongoing impact of scandals instead of a single data point[7].

ESG controversies are reported under categories of community, human rights, management, product responsibility, resource use, shareholders, and workforce. They further classified into 23 topics such as wage or working condition controversies, intellectual property controversies, child labor controversies. The full list of 23 topics is provided in Table A.2 in appendix. The treatment in this study will be the combination of two types of controversies: environmental controversies defined as *"controversies related to the environmental impact of the company's operations on natural resources or local communities"* and public health controversies defined as *"controversies published in the media linked to public health or industrial accidents harming the health and safety of third parties (non-employees and non-customers)"*. The total number of other types of controversies will be used as a control in the regressions to control for potential confounding effects related to be in the limelight and high media attention to the firms involved in scandals.

Each controversy (i.e. negative media story) of a firm in the data has the date, title, abstract, and URL information. A sample controversy related to the Volkswagen "Dieselgate" emissions scandal is presented in Table A.3 in the appendix. Volkswagen emissions scandal was a striking scandal broke out in September 2015. Its repercussions and consequences have continued in the following years. The news count per year for Volkswagen reflects this fact as it has zero environmental and public health controversies before 2015, three in 2015, and more than 10 each year in the following years[8].

I utilize this news count per year for each firm as the treatment variable to capture the intensity of the treatment. Table A.4 in appendix presents the distribution of controversies across years, 2-digit NAICS industries, and continents for the final balanced sample[9]. I define industries in the rest of the study at the level of 5-digit NAICS codes. This allows me to use industry-year fixed effects at disaggregated level and define spillover effects within those industries[10].

This dataset also contains ESG score which is calculated by Refinitiv to obtain relative performance

[7] See Table A.1 in appendix for an example from automobile industry.
[8] See Table A.1 in appendix.
[9] Table A.5 and A.6 presents the distribution of controversies across 3-digit and 5-digit industries.
[10] I drop indsutries with less than 10 firms due to inadequate representation and low variation within industries.

of each firm within sector using more than 450 ESG measures from publicly available information. This measure does not include information on controversies reported in the media. Refinitiv propose another combined ESG score which incorporates those controversies. Therefore, ESG score does not reflect controversies about the firms and is not affected by the scandals. I use this score to control for baseline reputation of a company in terms of environmental and social responsibility.

2.2 Revenue and Revenue Distribution

I aim to study the consumer response to the firms involved in environmental scandals. I try to measure the consumer response with the changes in firm sales. Therefore, I use the logarithm of firm revenue as the outcome variable in this study. I access the revenue data also from Refinitiv.

Refinitiv also provides the revenue distribution of each firm in the top 20 countries they operate. I utilize this information to construct a market similarity matrix for the firms in terms of the common countries they make sales. Additionally, this information is helpful to construct an environmental fragility index concerning the environmental awareness level in the markets each firm operates.

2.3 Market Similarity Index

I construct a market similarity index which measures the extent to which two firms have overlapping countries of operation using the revenue distribution information for each firm. This index is a modified version of Finger and Kreinin (1979) export similarity index which is a widely used index in international trade literature to measure the export similarity of two countries to a third country.

$$S_{ik} = \sum_{c} min\{R_i^c, R_k^c\}$$

where R_i^c is the share of country c in total sales of firm i. The market similarity index S_{ik} would be zero if there is no common market of operation for firms i and k; and it would be one if the share of each country in their revenue distribution are the same. Therefore, this index measures the level of operating in common markets or competition between to firms within an industry in a range between zero and one. A market similarity matrix which contains this index in each cell is useful to capture spillover effects of environmental scandals on competitor firms within industry.

2.4 Environmental Awareness Level

World Values Survey (WVS) and European Values Study (EVS) have conducted a joint worldwide survey during 2017-2020 with common questions. One of the common questions is about the environmental awareness level; specifically, prioritizing to protect the environment against economic growth. Participants pick one of the following statements: *"Protecting the environment should be given priority, even if it causes slower economic growth and some loss of jobs."* or *"Economic growth and creating jobs should be the top priority, even if the environment suffers to some extent."*. As these statements contain an economic decision against environmental concern, the rate of the first answer in a country would be a good estimate of the probability that a potential costumer in that country would change her consumption decision after an environmental scandal.

2.5 Summary Statistics

The final balanced sample for the period 2010-2018 consists 1,794 firms, after excluding industries with less than 10 firms and dropping firms with missing outcome and control variables in the baseline specification. There remain 60 5-digit industries, and 45 of them contain at least one environmental and public health controversy during the sample period. There are 753 environmental and public health controversies in total about 217 firms. Table A.4 in appendix presents the distribution of controversies and firms across 2-digit industries, years, and continents[11]. Number of environmental controversies makes a peak in 2016. This is not an inconsistency about the data collection process, since number of other controversies does not make such a high peak in the same year. That peak partly stems from a series of scandals in automobile industry following the Volkswagen emissions scandal[12].

Table A.7 in appendix compares the mean revenues in 2010 of firms involved in an environmental and public health scandal at least once versus never involved during the sample period, for 45 industries with at least one environmental and public health controversy during the sample period. I make the baseline comparison for 2010, the first year of the balanced sample, since the year of the first environmental controversy is different for each industry[13]. Firms with environmental controversies are larger in terms of sales in most of the industries and the difference is statistically significant for more than half of the industries. One possible explanation is that bigger firms receive more media attention. I am able control for the differential media attention across firms with the total number of other controversies.[14]

[11] See Table A.5 and A.6 for the distribution of controversies across 3-digit and 5-digit industries.

[12] See Table A.1 in appendix

[13] Some firms are already involved in environmental controversies in 2010. I ignore this for the simplicity of the baseline comparison.

[14] Firms with environmental controversies have also higher ESG scores on average in the baseline, since probably large

3 Net Effect of Environmental Scandals on Firm Sales

The goal of this study is to investigate the consumer response to the negative information shocks about the environmental reputation of companies. I attempt to estimate this using negative media coverage about the environmental and public health scandals involved by firms. This section captures that effect by comparing the change in revenues of firms with and without environmental controversies, ignoring possible spillover effects on other firms. Section 4 extends the model in this section by incorporating spillover effects.

3.1 Empirical Strategy and Identification

3.1.1 Industry Specific Model

I begin with analyzing the causal impact of environmental controversies on firm sales within *Automobile and Light Duty Motor Vehicle Manufacturing*[15]. Equation (1) is the baseline two-way fixed effects difference-in-differences setup with time-varying treatment for industry specific model, which estimates the impact of negative media coverage on environmental issues on the revenue of firms involved in environmental controversies.

$$Y_{it} = \delta T_{it} + X_{it}\beta + \alpha_i + \lambda_t + \varepsilon_{it} \tag{1}$$

The firm level treatment here is the number of controversies about firm i in year t related to the negative impact on environment and public health. Therefore, T_{it} captures the intensity of the treatment with the news count of a firm in a year, as opposed to a scandal dummy which is also reported in the results. The outcome variable Y_{it} is the natural logarithm of revenues in USD for firm i in year t. X_{it} is the set of controls varying across firms and time, which are the number of controversies per year other than environmental and public health, and yearly ESG score of each firm. The first one controls for being in the limelight and under high media attention for the big firms involved in environmental scandals. This allows us to isolate the impact of environmental and public health controversies, as there is a positive correlation between the treatment and other types of controversies. Secondly, including ESG score controls for the general reputation or cognizance level of firms in terms of environmental and social responsibility.[16]

firms invest more on environmental and social reputation.

[15]Automobile and Light Duty Motor Vehicle Manufacturing industry in our sample contains 36 firms, including Volkswagen, in a balanced panel of 9 years from 2010 to 2018. See Table A.1 in appendix for the distribution of controversies across years and firms.

[16]It is important to note here that ESG scores are not updated with the scandals. Refinitiv provides another ESG combined score which is the discounted version of the ESG score according to the controversies. Additionally, both controls

The model also includes firm and year fixed effects. Firm fixed effects control for unobservable time-invariant heterogeneity across firms, including specific firm characteristics that make some firms vulnerable to scandals or media attention. Year fixed effects control for time-varying factors that affect all firms like global demand shocks.

Identification in this type of generalized DD specifications with variation in treatment timing is not straightforward as it is in canonical 2x2 DD models. Goodman-Bacon (2018) describes this type of DD model as a weighted average of all possible 2x2 comparisons across time. In other words, there is no definite treatment and control groups, but firms are allocated to groups for each 2x2 comparison according to the treatment status in a specific year. It is even more involved in our setup as a treated firm in a year can be untreated in the following years if there is no further controversies about it. However, the basic common trends assumption of DD model is valid after accounting for the weights based on the variance in treatment variable. Therefore, the identification in our model is based on the assumption that firms would have followed parallel trends in the absence of any controversy, after accounting for the weights mentioned above.

We can justify this assumption by presenting the common trends before the scandals; however, it is also hard to visualize them in this setting with multiple treatments in different years. Although being not a direct evidence and not capturing the whole picture, Figure 1 shows the trends in the dependent variable for Volkswagen versus other automobile manufacturers which are never treated in the sample period, where red line represents the time Volkswagen emissions scandal broke out[17].[18]

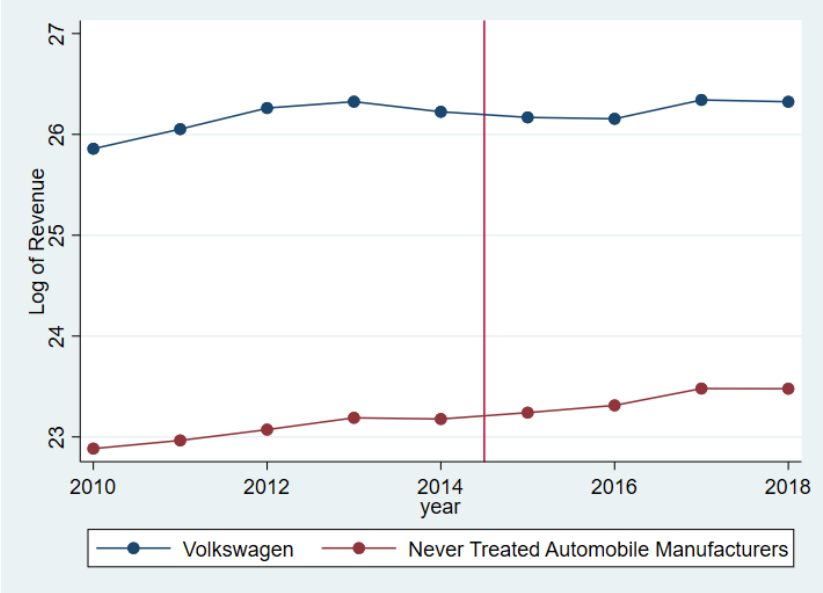


Figure 1. Trends in VW and Never Treated Firms

are checked against the possibility of multicollinearity.

[17]Volkswagen is the company with the highest number of environmental controversies in our sample.

[18]See Figure A.1 in appendix for a corresponding figure comparing treated and untreated firms in automobile industry.

A more comprehensive test of pre-trends assumption would be estimating the dynamic treatment effects, which adds leads and lags dummies to the equation (1)[19]. Figure 2 presents the coefficient estimates for leads and lags of the treatment together with the treatment effect with 95% confidence intervals[20]. Insignificant coefficients for the dummies before the scandals suggests insufficient evidence for differential pre-trends for treated and untreated firms. However, Sun and Abraham (2020) document that this kind of dynamic treatment test might be inconclusive in case of heterogeneous treatment effects across cohorts, i.e. different treatment timing groups, which might be the case if the effect of scandals are increasing with time. Nevertheless, I take this result of the test as suggestive and assume no such heterogeneity.

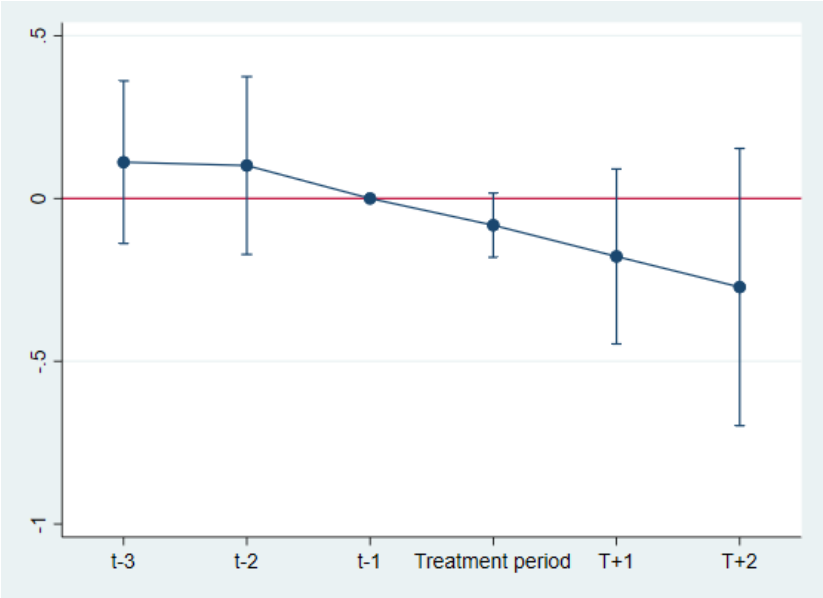


Figure 2. Dynamic Treatment Effects in Automobile Industry

3.1.2 Generalized Model

Secondly, I generalize the model in equation (1) by adding additional layer of industries.

$$Y_{ist} = \delta T_{ist} + X_{ist}\beta + \alpha_i + \phi_{st} + \varepsilon_{ist} \tag{2}$$

The preferred specification includes industry-year[21] fixed effects as they control for potential differential trends across industries, like industry specific business cycles, demand or price shocks. For instance, changes in oil prices might create an industry specific shock that affects all petroleum

[19]Dynamic regression also includes dummies for before more than 3 years and after more than 2 years from the controversies.

[20]Treatment period is not a scandal dummy and does not cover a single year. It is the estimate of the treatment variable coefficient.

[21]I define industries at 5 digit NAICS code level in the baseline specification.

companies different than other industries. However, a relaxation of the model without industry-year fixed effects is also reported. Another caveat of the generalized model is the assumption that treatment effect is homogeneous across industries.

The discussion for identification has same grounds as it is for industry specific model although the common trends assumption is more demanding for the generalized model. However, taking out all variation at industry-year level with fixed effects overcomes most of the concerns about comparing companies at different industries by controlling for differential trends at disaggregated industry level. Figure 3 documents the corresponding dynamic estimation for the generalized model.

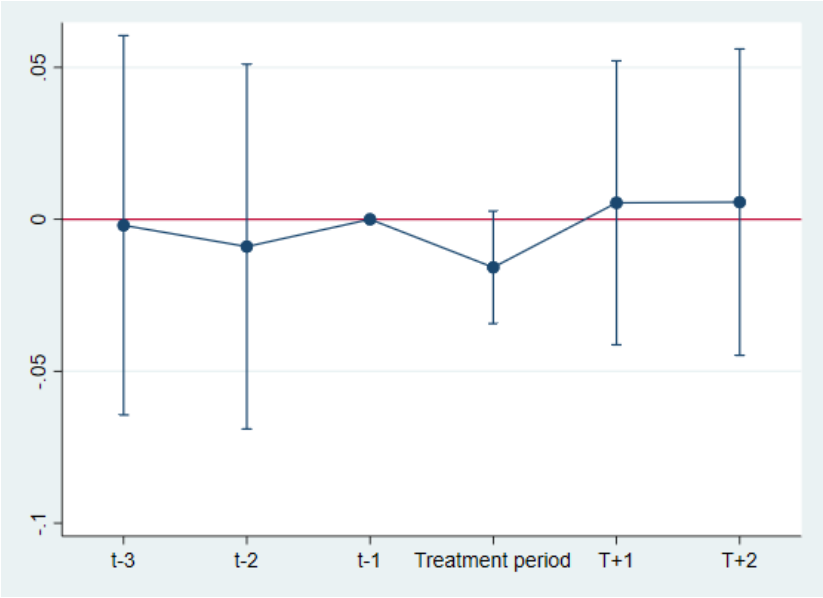


Figure 3. Dynamic Treatment Effects in Generalized Model

The control groups in both industry specific and generalized models consist the firms which are not involved in environmental controversies in a year where the treatment groups consist the ones with controversies in the same year. These models ignore the possible spillover effects across firms. Therefore, the estimated treatment effects would be net effects involving all possible spillover effects. I discuss the spillover effects in section 4 and modify the model to incorporate them.

3.2 Results

3.2.1 Automobile Industry

Table 1 presents the results of the difference-in-differences specification described for the industry specific model estimated with the balanced sample for the period 2010-2018. The treatment variable in columns (1), (3), and (5) is a time-varying dummy for having at least one controversy within year t. However, the preferred treatment variable is the number of news about a firm in a year, since it

reflects the severity of a scandal in a year by capturing the number of different controversies related to a scandal. Therefore, news count involves the intensity of the treatment as opposed to the scandal dummy.

Table 1. Net Effect of Controversies on Firm Sales - Automobile Industry

	(1)	(2)	(3)	(4)	(5)	(6)
News Count		-0.019**		-0.082*		-0.080*
		(0.007)		(0.044)		(0.043)
Scandal Dummy	-0.153***		-0.196**		-0.195**	
	(0.056)		(0.079)		(0.078)	
Other Controversies			0.006	0.017	0.006	0.017
			(0.006)	(0.011)	(0.006)	(0.011)
ESG Score					0.003	0.002
					(0.002)	(0.002)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	324	324	324	324	324	324

Notes: Robust standard errors in parentheses
Balanced Sample (2010-2018)
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Both the scandal dummy and news count estimate the negative treatment effect, although the standards errors are high after adding controls[22]. The preferred specification in column (6) estimates that firm revenues decrease 8% on average if a firm in automobile industry is involved in an environmental or public health controversy, keeping in mind that the spillover effects are ignored.

The impact of various scandals would be different according to their severity. Volkswagen scandal was one of the biggest industrial scandals in recent years and it has created crucial public attention. However, there were other small scale environmental scandals and controversies involved by automobile manufacturers in the last 10 years, which are represented by controversies in this dataset. They also affect the reputation of companies and convert to a revenue loss for them, although not as harsh as a big scandal like Volkswagen. Therefore, it is important to account for treatment intensity by using news count instead of a scandal dummy for all controversies.

3.2.2 Effects on Firm Sales Across Industries

Table 2 presents the corresponding estimates of the generalized model with alternative specifications for balanced sample[23]. Column (4) shows the WLS estimation of equation (2) which uses

[22]Standard errors are not clustered since there are only 36 firms in the automobile industry.
[23]Table A.8 in appendix presents same specifications with whole sample.

the number of firms within each industry as weights, while the others are OLS estimates. Since the OLS estimates are not too different than their WLS counterparts, I conclude that there is no much heterogeneity of treatment effects across industries with different sizes as suggested by Solon et al. (2013).

Table 2. Net Effect of Controversies on Firm Sales

	OLS			WLS
	(1)	(2)	(3)	(4)
News Count	-0.014		-0.014	-0.016
	(0.009)		(0.010)	(0.010)
Scandal Dummy		-0.001		
		(0.020)		
ESG Score	0.009***	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
Other Controversies	0.008**	0.006*	0.007**	0.007**
	(0.003)	(0.004)	(0.003)	(0.003)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes			
Industry*Year FE		Yes	Yes	Yes
N	16146	16146	16146	16146

Notes: Robust standard errors in parentheses, clustered at firm level
Balanced Sample (2010-2018)
Weighted regressions use the number of firms within industries as weights.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Scandal dummies estimate no treatment effect with a high standard error. The treatment effect is more precise when the intensity of treatment is considered. The preferred specifications with industry-year fixed effects in column (3) estimate 1.4% decrease in firm revenues with a controversy in environmental or public health issues, although it is statistically insignificant. Relaxing the model by using year fixed effects instead of industry-year fixed effects in column (1) does not change the estimated treatment effect. The estimated treatment effect is not as large as the one estimated for the automobile industry. Therefore, the effect of each controversy might be heterogeneous across industries, although not being correlated with the industry size.

Equations (1) and (2) ignore the possible spillover effects and include all non-treated firms into the control group. However, if a firm without any controversy is affected by the externalities of environmental and public health scandals relating to other firms, it would not be a good control for difference-in-differences setup. The estimates of treatment effect will be biased according to the sign of the spillover effect. Therefore, I interpret the estimated effects above as a net effect on firms involved in environmental controversies. The next sections explain possible spillover channels and attempts to

estimate them.

4 Spillover Effects of Scandals

4.1 Possible Channels of Spillover Effect

Environmental and public health scandals might create externalities that affect the firms or industries as a whole other than the firms involved in scandals. There might be different channels creating those externalities through both negative and positive spillover effects. The most obvious one relating to economics theory would be the substitution away to the competitors following the reduction in demand for the goods or services produced by the firm involved in scandals. This would create a positive spillover effect for the competitor firms in the same industry.

On the other hand, there might be another spillover effect working inversely for the firms in the same industry due to the increasing attention to that specific industry after an environmental and public health scandal. Production processes for a product or environmental unfriendly structure of an industry may be revealed and increase public attention after an environmental scandal. This case would create an overall awareness and shrink demand for that industry as a whole. This spillover effect might be more intensive on the competitors operating in the same market; whereas, the consumers in a country in which scandalized firm is not operating might not be aware that much. In other words, there might be a negative spillover effect for the industry with scandal as a whole; however, this effect can be stronger for the competitors of the scandalized firm within industry. Bai et al. (2019) provide evidence for this kind of spillover effect for Chinese dairy industry. They document that the innocent firms in diary industry have also been affected significantly after a series of scandals involved by some Chinese diary production firms.

However, increasing attention to the diary industry might not be the only channel creating that negative spillover effect. Bai et al. (2019) highlight that there is a collective reputation issue that captures Chinese diary industry as a whole in its export market. This reputation does not cover only the industry but also covers the Chinese tag as a country. Therefore, country-related reputational spillover is another possible channel that might create negative externalities for the firms from the same country of origin with the firm involved in an environmental scandal. Bachmann et al. (2019) studies the spillover effect of VW emissions scandal on other German car manufacturers. Their sales in the US market reduce after the scandal compared to the non-German car brands due to the loss of collective reputation in German automobile brands.

4.2 Volkswagen Emissions Scandal

Firstly, I focus on the spillover effects of Volkswagen emissions scandal on other automobile manufacturers[24]. Equation (3) adds the externalities on competitors of Volkswagen and other German automobile manufacturers on top of the specification in equation (1).

$$Y_{it} = \gamma_1 T_{vt} C_{iv} + \gamma_2 T_{vt} S_{iv} + \delta T_{it} + X_{it}\beta + \alpha_i + \lambda_t + \varepsilon_{it} \tag{3}$$

T_{vt} represents the number of controversies about Volkswagen in year t. C_{iv} is a dummy for German automobile manufacturers. S_{iv} is the market similarity index, discussed in section 2.3, which measures the extent to which a company shares common markets with Volkswagen. The other variables are the same as explained for equation (1). Volkswagen is excluded from the sample. The identification assumption for a causal estimate of the spillover effect of Volkswagen scandal on the other German automobile manufacturers is that non-German and German ones except Volkswagen would have followed the same trend in the absence of the Volkswagen emissions scandal.

The first term estimates the spillover effect of Volkswagen scandal on other German auto manufacturers. Bachmann et al. (2019) estimate a significant negative spillover effect on sales of other German manufacturers compared to non-German ones within US market. There are two important distinctions in my specification. First, I control for the number of negative media coverage on environmental controversies for other firms. Secondly, the treatment variable for spillover, T_{vt}, captures the intensity of the spillover with the number of different controversies related to the emissions scandal, such as different lawsuits in different countries.

The second term estimates the spillover effect of the news about Volkswagen on its competitors where the competition level is captured by the market similarity index. This interaction term assumes zero externality on an automobile manufacturer which has no common country of operation with Volkswagen, and the intensity of the spillover effect increases with a higher common share of markets in their revenues. In other words, an automobile manufacturer which has some countries of operation in which Volkswagen has no sales will be less affected compared to another firm operating in exactly same markets with Volkswagen. The estimate of γ_2 would include two possible contrary spillover channels; substitution away to the competitors versus substitution away from the industry as a whole in countries where Volkswagen is operating. Therefore, that estimate will be the net spillover effect of Volkswagen scandal on its competitors.

Table 3 provides the estimation of spillover effects in equation (3) with and without controlling

[24]Volkswagen emissions scandal is the biggest scandal in our sample since the only firm with more than 10 controversy in a year is Volkswagen. Refer to Bachmann et al. (2019) for a background of the Volkswagen scandal.

for the controversies about other automobile manufacturers. Column (1) is the baseline specification without spillover effects. Columns (2)-(6) use T_{vt}, number of controversies on Volkswagen, for spillover treatment interacted with market similarity index or a dummy for being a German company. Table A.9 in appendix use D_{vt}, post scandal dummy for Volkswagen, instead of T_{vt} and provides interpretively same results.

Table 3. Spillover Effects of Volkswagen Scandal

	Eqn (1)	Spillover of News Count for VW					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
News Count	-0.080*		-0.051**		-0.053*		-0.054**
	(0.043)		(0.024)		(0.029)		(0.027)
Same Country ($T_{vt}C_{iv}$)		-0.013**	-0.003			-0.006	0.002
		(0.007)	(0.005)			(0.010)	(0.009)
Competitors ($T_{vt}S_{iv}$)				-0.020	-0.007	-0.015	-0.008
				(0.019)	(0.021)	(0.024)	(0.025)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	324	315	315	279	279	279	279

Notes: Robust standard errors in parentheses
Controls are ESG score and other controversies.
Balanced Sample (2010-2018) for Automobile and Light Duty Motor Vehicle Manufacturing Industry
Volkswagen is excluded in spillover regressions.
4 firms have missing similarity index since they do not have revenue distribution data.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Column (2) compares the changes in revenue of German and non-German automobile manufacturers after Volkswagen scandal, as Bachmann et al. (2019) have done for the US market with a similar setup, and estimate 1.3% decrease in revenues of German companies for each controversy about Volkswagen. The corresponding regression with a scandal dummy in Table A.9 estimates 15% decrease in revenues of German automobile manufacturers compared to other non-German ones after Volkswagen scandal. These results are in line with Bachmann et al. (2019). However, this effect fades out after controlling for the spillover effects on competitors and other controversies about firms in the control group. Spillover effect on competitors is also getting closer to zero when we control for news count of all firms. Therefore, negative spillover effects are concentrated on the firms which have environmental controversies and negative media coverage about themselves.

Volkswagen emissions scandal has sparked a series of other emission scandals related to some other automobile manufacturers, mainly the German ones, although they have not drawn public

attention as much as Volkswagen[25]. Volkswagen has more than 10 controversies in each year after the scandal, whereas other German automobile manufacturers Daimler[26] and BMW are the other most controversial companies with 4 environmental controversies per year on average in the following years, including emission cheating like Volkswagen. Therefore, the country-related reputational spillover may not be high in case of Volkswagen scandal; however, it increases attention to the industry and triggers other small scale scandals. Controlling for news count allows us to capture those controversies and isolate the country-related reputational spillover effect.

Consequently, there is no evidence of a significant direct spillover effect of Volkswagen scandal both as a country-related reputational spillover and as externalities on competitors. However, the spillovers are working indirectly by triggering other controversies on other German automobile manufacturers and some competitors. That is the case although Volkswagen emissions scandal was a striking and influential industrial scandal which creates a remarkable loss of reputation and revenues for Volkswagen itself. Therefore, we should expect no spillover effect for other environmental controversies in automobile industry. Nevertheless, I expand the model in the next section by allowing spillover effects for all other controversies in automobile industry as a step forward to the generalized model including all industries.

4.3 Automobile Industry

In this section, I modify the spillover terms to incorporate spillover effects for all controversies within automobile manufacturing industry.

$$Y_{it} = \gamma_1 \sum_k T_{kt} C_{ik} + \gamma_2 \sum_k T_{kt} S_{ik} + \delta T_{it} + X_{it}\beta + \alpha_i + \lambda_t + \varepsilon_{it} \tag{4}$$

where k represents each controversial firm in automobile industry. T_{kt} is the number of controversies about firm k at year t, C_{ik} is a dummy for being from the same country for firm i with controversial firm k, S_{ik} is the market similarity index of firm i with controversial firm k.

First term in equation (4) captures total number of controversies about the firms from the same country with firm i. Second term sums over all controversial firms those might create potential externalities as a competitor. Table 4 presents the estimation of equation (4). There is no evidence for significant spillover effects as expected, although the spillover effect for being from the same country with a controversial firm is slightly positive which is counter intuitive in terms of country-related

[25]See Table A.1 in appendix for the number of controversies per year related to German and non-German automobile manufacturers.

[26]The parent company of Mercedes-Benz and Smart

reputational spillover.

Table 4. Spillover Effects within Automobile Industry

	(1)	(2)	(3)	(4)
News Count	-0.080*	-0.098*	-0.082*	-0.100*
	(0.043)	(0.053)	(0.043)	(0.051)
Same Country		0.016		0.016
		(0.012)		(0.011)
Competitors			0.005	-0.001
			(0.013)	(0.012)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	324	324	288	288

Notes: Robust standard errors in parentheses
Controls are ESG score and other controversies.
Balanced Sample (2010-2018)
Industry: Automobile and Light Duty Motor Vehicle Manufacturing
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.4 Generalized Model

Lastly, I generalize the equation (4) to the whole sample of industries.

$$Y_{ist} = \gamma_1 \sum_k T_{kst} C_{ik} + \gamma_2 \sum_k T_{kst} S_{ik} + \delta T_{ist} + X_{ist}\beta + \alpha_i + \phi_{st} + \varepsilon_{ist} \tag{5}$$

Interpretation of equation (5) is similar to equation (4), noting that the externalities are assumed to operate only within industries. Table 5 documents the estimation results with alternative specifications. OLS estimates with baseline specification find no evidence for significant spillover effects. As opposed to the models which assume no externalities, spillover effect estimations are sensitive to weighting and relaxing industry-year fixed effects.

WLS estimation use the number of firms within industries as weights. The discrepancy between OLS and WLS estimates indicates that there is heterogeneity of spillover effects across industries with different sizes, where spillover effect of an environmental scandal is more negative on competitors and more positive on firms from the same country, on average, in larger industries.[27] As discussed in section 4.1, spillover effect on competitors combines two contrary externalities. If the substitution away to competitors channel dominates, we would expect a positive sign for this estimate. On the

[27]Refer to Solon et al. (2013) and Lee and Solon (2011) for a discussion about the role of weights.

Table 5. Spillover Effects in Generalized Model

	OLS				WLS	OLS
	(1)	(2)	(3)	(4)	(5)	(6)
News Count	-0.014	-0.016	-0.023*	-0.021	-0.025*	-0.019
	(0.010)	(0.011)	(0.013)	(0.013)	(0.014)	(0.012)
Same Country		-0.004		-0.008	0.012	-0.006
		(0.009)		(0.018)	(0.012)	(0.017)
Competitors			0.001	0.004	-0.015	0.025**
			(0.011)	(0.015)	(0.015)	(0.011)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry*Year FE	Yes	Yes	Yes	Yes	Yes	3-digit
N	16146	16029	11322	11322	11322	11322

Notes: Robust standard errors in parentheses, clustered at firm level

Controls are ESG score and other controversies.

Balanced Sample (2010-2018)

Weighted regressions use the number of firms within industries as weights.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

other hand, if there is a strong substitution away from that industry specifically in countries where scandalized firm operates, the sign of estimate for competitors may turn to negative. The stronger negative spillover effect in large industries might be a sign of stronger substitution away not only from scandalized firm but also from the industry as a whole in those markets.

It is important to note here again that, industry-year fixed effects remove potential effect of a scandal on an industry as a whole. However, since the data of this study is a global one, the markets in which firms operate may not overlap. Therefore, negative externality of a scandal on the industry as a whole may not affect firms operating in different countries. The spillover effect on competitors discussed above accounts for the the extent to which a company shares markets with scandalized firm. There might still be some negative externality affecting all firms in an industry with scandal whether or not they share common markets, specifically when a scandal receives global attention. For instance, an oil spill might create global impact on oil industry independently from the spilling company. Industry-year fixed effects remove this negative impact on an industry as a whole. If that effect is large in negative sign, models with relaxed industry-year fixed effects will underestimate spillover effects on competitors by not taking out the reduction in revenues of all firms in industry with scandal. However, spillover effect on competitors turns to positive after relaxing industry-year fixed effects to 3-digit level instead of 5-digit. Therefore, either negative spillover effect on an industry as a whole is negligible or industry-year fixed effects removes important level of variation in revenues at industry-year level. Table A.10 in appendix presents the effect of total number of controversies in an

industry on the aggregate revenues of untreated firms, where the effect seems negative but small and imprecise. Therefore, we can conclude that the spillover effects on an industry as a whole might be negative but not significant.

4.5 Big vs. Small Scandals

The models above assume the same effect of each controversy, whether it is the only controversy of a firm or it is a part of a series of controversies like Volkswagen case. However, a single environmental controversy about a firm may not create the same effect with a controversy as a part of a big scandal. Similarly, we should not expect a large and significant spillover effect for each and every controversy, since creating a widespread public attention affecting other firms requires a striking scandal. In other words, the effect of an environmental scandal both on the firm itself and on other firms may not be increasing linearly with the number of controversies. In order to test this, I classify the controversies into two groups. If there are less than 5 controversies in a firm-year, those controversies are assigned to the small scandal group. If there are 5 and more controversies in a year, I assign them to the big scandal group, which means they are related to a big environmental scandal[28]. They still account for the intensity of the scandal within each group since I use news count instead of small and big scandal dummy. Equation (6) extends the model in equation (5) to compare the effects of small and big scandals.

$$\begin{aligned} Y_{ist} =& \gamma_1^{big} \sum_k D_{kst}^{big} T_{kst} C_{ik} + \gamma_1^{small} \sum_\ell D_{\ell st}^{small} T_{\ell st} C_{i\ell} \\ &+ \gamma_2^{big} \sum_k D_{kst}^{big} T_{kst} S_{ik} + \gamma_2^{small} \sum_\ell D_{\ell st}^{small} T_{\ell st} S_{i\ell} \\ &+ \delta^{big} T_{ist} D_{ist}^{big} + \delta^{small} T_{ist} D_{ist}^{small} + X_{ist}\beta + \alpha_i + \phi_{st} + \varepsilon_{ist} \end{aligned} \tag{6}$$

where k and ℓ represent firms with big and small scandals respectively. Number of controversies in direct treatment and spillover treatment terms are multiplied by dummies for being belong to big or small scandal groups to differentiate the effects of controversies in two groups.

Table 6 presents OLS estimation of equation (6). Column (1) reveals that involving in an environmental controversy decreases the revenues of a firm by 2.1% if there are more than five controversies about that firm in a year, but there is no such effect if the number of controversies are less than 5. This effect is higher and more precise compared to its counterpart in Table 5 where the effect is assumed to be the same for every controversy. It is also robust to controlling for the spillover effects. Column (2)

[28]There are 14 firms (25 firm-year observations) within big scandal group and 217 firms (410 firm-year observations) within small scandal group.

adds the spillover terms on the firms from the same country for big and small scandals. There is no significant country-related reputational spillover effect for both groups; however, the estimated effect for controversies related to big scandals is more negative, and gets bigger and more prices in column (4) when spillovers on competitors are also controlled.

Table 6. Spillover Effects in Generalized Model: Big vs. Small Scandals

	(1)	(2)	(3)	(4)
News Count (Big)	-0.021*	-0.025*	-0.028*	-0.023
	(0.012)	(0.014)	(0.016)	(0.017)
News Count (Small)	-0.004	-0.003	-0.034*	-0.027*
	(0.011)	(0.012)	(0.018)	(0.015)
Same Country (Big)		-0.009		-0.045
		(0.014)		(0.033)
Same Country (Small)		0.000		0.022*
		(0.008)		(0.011)
Competitors (Big)			0.027	0.047*
			(0.018)	(0.028)
Competitors (Small)			-0.050	-0.065**
			(0.030)	(0.031)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry*Year FE	Yes	Yes	Yes	Yes
N	16146	16002	11007	11007

Notes: Robust standard errors in parentheses, clustered at firm level
Balanced Sample (2010-2018)
Controls are ESG score and other controversies.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Spillover effects on competitors have opposite signs for big and small scandals. Firms are affected positively from controversies related to big scandals involved by their competitors; whereas they are affected negatively from small scandals involved by their competitors. There are three possible explanations for these results. First, substitution away from scandalized firms to the competitors might be stronger than substitution away from the competitors in the industry for big scandals. Corresponding interpretation for negative spillover effect of small scandals would be a stronger substitution away from the competitors of firms involved in small scandals, which is not much intuitive. Secondly, spillover effects on competitors might be heterogeneous across industries, and two groups might reflect the effects of two contrary spillover effects on competitors in different industries. This might be the case if big scandals are concentrated in industries in which spillover channel of substitution away from competitors is stronger; whereas, small scandals are concentrated in industries in which the other channel is stronger. However, the estimated spillover effects on competitors are larger in size compared

to the direct effects of controversies on involved firms. This is also counter-intuitive. Therefore, those spillover terms might be creating noisy results due to some problems with the similarity index.

Firstly, models with spillover effects on competitors exclude approximately 30% of the firms from the sample. Those firms have missing similarity index due to missing revenue distribution data and we are unable to observe the spillovers on them. Secondly, the sums in spillover regressions miss out the spillover effects created by controversial firms with missing similarity index. Lastly, it is a symmetric measure of similarity. However, the spillovers might not work the same way in both directions between two firms. For instance, if firm A operates in a single market (or in a few markets) where a global firm B also operates, the spillover effect of firm B on firm A might be higher than the spillover effect of firm A on firm B. The similarity index used in this study does not capture this difference. Consequently, the models with the spillover effects on competitors may produce biased estimates.

5 Mechanisms and Discussion

Environmental and public health scandals generate negative information shocks for the involved companies. Media coverage about those scandals distributes the information and creates public attention. Companies' irresponsible practices and destructive consequences on environment damage their reputation in the eyes of the consumers. Consequently, some consumers would avoid to buy products or services from those companies and their sales would go down. The previous section reveals that the impact of each environmental controversy is stronger in case of big scandals. An environmental controversy related to a big scandal would create higher public attention and more severe reputation loss for involved firms.

It is obvious that not every consumer would avoid buying from scandalized firms. Firms experience a shrinkage in demand due to scandals; however, most of the consumers do not change their consumption decisions. What are the factors determining the extent to which firms experience a reduction in demand for their goods and services? This should be related with the severity of reputation loss of the company, as the comparison of small and big scandals suggests.

The prevalence of the information about the scandal among the consumers and public would determine the extent of the reputation loss. The number of environmental controversies in each year about a company captures this to some extent. However, the comparison of controversies related to small and big scandals reveals that the impact of a scandal is not increasing linearly with the number of controversies. A controversy which is a part of a big scandal damages the reputation of the company and reduces its revenues stronger than a controversy related with a small scandal. Therefore,

the number of controversies does not reflect the real reputation loss of the companies. Section 2.1 explains how the controversy data are collected. They are the negative environmental and public health stories covered in the media about the firms; however, they do not include each and every news in the media. Different news covering the same story are excluded to avoid duplicates; hence, the number of controversies does not correspond to the number of news. We should expect wider media coverage of bigger scandals, beyond the number of controversies. This could be one of the factors explaining more severe reputation loss and wider revenue loss with controversies related to big scandals.

Conventional media is not the only source of publicizing the information in today's world. Social media could be more powerful to distribute the information and damage the reputation of companies. Therefore, twitter sentiments could play an important role to worsen the reputation damage for companies, beyond the conventional media coverage. Additionally, social media opens a way around the media censorship in some countries. Media censorship can differentiate the impact of scandals on consumer response in different countries by restricting the distribution of negative knowledge about some firms.[29]

Another factor determining the extent of the reduction in demand could be the environmental awareness level of the customers of the company. Assuming that every customer receives the same information, they would change their consumption decision depending on prioritizing the environmental protection against other concerns or consumption habits. In the US, 88% of the participants of Cone Communication (2017) CSR Study told that they would stop buying products of a company if they learn about its irresponsible and deceptive business practices. Furthermore, 39% of them told that they "researched a company's business practices or support of social and environmental issues in the past 12 months". However, these percentages would be different in other countries regarding the environmental issues depending on the environmental public awareness level. The next section attempts to capture the heterogeneity of the consumer response across different countries with heterogeneous environmental public awareness level.

5.1 Environmental Fragility in Demand

Firms operating in countries in which environmental public awareness level is higher would be more fragile to environmental scandals. I construct an environmental fragility index using the environmental awareness level in countries in which each firm operate.

$$F_i = \sum_c R_i^c P^c$$

[29] A report by Reuters states that Refinitiv filters negative news about China (Stecklow, 2019).

where R_i^c is the share of country c in total sales of country i, and P^c is the environmental awareness level in country c.

P^c corresponds the share of people who prioritize to protect environment against the economic growth in each country according to a joint survey by EVS and VWS. Specifically, it is the proportion of participants closer to the statement *"Protecting the environment should be given priority, even if it causes slower economic growth and some loss of jobs."* against the statement *"Economic growth and creating jobs should be the top priority, even if the environment suffers to some extent."*. Environmental fragility index calculates this proportion for the potential customers of each company by multiplying P^c with the revenue shares in each country and summing over countries. In other words, this index is the probability that a customer of the company prioritises protecting environment against economic growth.

Environmental fragility index is a good measure to capture the probability that a customer of a company would change her consumption decision after the company involved in an environmental scandal, since it reflects the environmental concern against the economic concerns. Equation (7) adds the interaction of the treatment and the standardized environmental fragility index to the model in equation (2), to capture the heterogeneity of treatment effects across firms operating in different markets with heterogeneous environmental public awareness levels.[30]

$$Y_{ist} = \delta_1 T_{ist} + \delta_2 T_{ist} F_i^z + X_{ist}\beta + \alpha_i + \phi_{st} + \varepsilon_{ist} \tag{7}$$

Table 7 presents the OLS and WLS estimation of equation (7) with and without industry-year fixed effects[31]. Column (1) estimates that the revenues of a firm with mean environmental fragility index would decrease 1.5% with each environmental controversy involved, and it would decrease 4.4% for firms with environmental fragility index one standard deviation above the average. Including industry-year fixed effects in column (2) does not change the treatment effect significantly for average fragility index (1.8%), but increases the standard errors. The treatment effect increases 1.8 percentage points in negative sign with one standard deviation increase in the environmental fragility index, although being not precise due to high standard errors. Columns (3) uses the number of firms within each industry to weight the regressions and estimates stronger and more precise treatment effects.

The results in Table 7 provides evidence that the consumer response to the environmental scandals is not homogeneous across countries. Firms which have higher share of revenues in countries with higher environmental public awareness level experience more reduction in their sales after involving

[30] The term F_i^z is omitted due to firm fixed effects.
[31] F_i is standardized to make interpretation easier.

Table 7. Heterogeneity - Environmental Fragility Index

	OLS		WLS
	(1)	(2)	(3)
News Count	-0.015**	-0.018	-0.023**
	(0.008)	(0.012)	(0.010)
News Count*Fragility Index	-0.029***	-0.018	-0.026**
	(0.009)	(0.013)	(0.013)
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes		
Industry*Year FE		Yes	Yes
N	11133	11133	11133

Notes: Robust standard errors in parentheses, clustered at firm level
Controls are ESG score and other controversies.
Fragility indicies are standardized.
Balanced Sample (2010-2018)
WLS use the number of firms within industries as weights.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

environmental scandals. One possible explanation is that the reputation loss due to environmental scandals would be more severe in countries with higher environmental public awareness level. However, we should note that this does not have to be a causal relationship. There could be many other factors correlated with the environmental awareness level and affecting the consumer response to the environmental scandals. The most obvious one is the average income level. The correlation between the proportion of people who prioritize to protect environment against the economic growth in each country in EVS/VWS and the GDP level is 0.47. Higher per capita income could partially explain more elastic demand structure in some countries.

6 Conclusion

This study reveals the importance of firms' environmental reputation in the eyes of consumers. Firms try to build a good reputation in terms of environmental and social responsibility to attract investment and receive customers. However, getting involved in environmental scandals damages their reputation significantly. Media play a key role to spread the information and create public attention against the scandalized firms. Using a global media coverage database, I document that negative media coverage in environmental and public health issues creates a consumer response and reduces the sales of involved firms. These scandals create some externalities on other firms within the same industry in three different channels: country-related collective reputation loss for firms from the

same country of origin, collective reputation loss for the industry as a whole, and substitution away from the scandalized firm to its competitors.

I start by showing the negative impact of each environmental and public health controversy on the firm sales for automobile industry and for all industries. Then, I investigate the spillover effects of Volkswagen emissions scandal specifically. The revenues of other German automobile manufacturers also decrease; however, there is no direct spillovers for competitors and other German makes after controlling for other environmental controversies about them. Using a comparable controversy data across industries, I am able to estimate an average impact of environmental scandals on firms across industries. The average direct impact of each controversy related to a big scandal is negative (2%) but not as high as it is in automobile industry (5-8%). Big scandals have more negative country-related reputational spillovers on average across industries, but not high and significant. Finally, the impact of scandals is higher for firms operating in countries with higher environmental public awareness levels.

The results of this study suggest that media coverage is important to spread the reputation loss. This phenomenon opens more questions about the media coverage and forms of environmental scandals. Does the tone of the media language determine the attention and response of the consumers? Does the news reflect the severity of a scandal in a correct manner? If it does, do consumers' demand responses change accordingly? Does the type of the environmental scandal matter? Some environmental scandals have local impact while the others are global. Do people care about remote environmental scandals when the effect is local? Is it different when they have global impacts? How are the global sales of firms affected from the environmental scandals with local vs. global impacts? All these questions are open to be answered in future studies.

References

Bachmann, Ruediger, Gabriel Ehrlich, Ying Fan, and Dimitrije Ruzic (2019) "Firms and Collective Reputation: a Study of the Volkswagen Emissions Scandal," Working Paper 26117, National Bureau of Economic Research, 10.3386/w26117.

Bai, Jie, Ludovica Gazze, and Yukun Wang (2019) "Collective Reputation in Trade: Evidence from the Chinese Dairy Industry," Working Paper 26283, National Bureau of Economic Research, 10.3386/w26283.

Banerjee, Abhijit V. and Esther Duflo (2000) "Reputation Effects and the Limits of Contracting: A Study of the Indian Software Industry," *The Quarterly Journal of Economics*, 115 (3), 989–1017, 10.1162/003355300554962.

Bardhan, Pranab, Dilip Mookherjee, and Masatoshi Tsumagari (2013) "Middlemen Margins and Globalization," *American Economic Journal: Microeconomics*, 5 (4), 81–119, 10.1257/mic.5.4.81.

Beattie, Graham (2020) "Advertising and media capture: The case of climate change," *Journal of Public Economics*, 188, 104219, https://doi.org/10.1016/j.jpubeco.2020.104219.

Beattie, Graham, Ruben Durante, Brian Knight, and Ananya Sen (2021) "Advertising Spending and Media Bias: Evidence from News Coverage of Car Safety Recalls," *Management Science*, 67 (2), 698–719, 10.1287/mnsc.2019.3567.

Cabral, Luis and Ali Hortacsu (2010) "THE DYNAMICS OF SELLER REPUTATION: EVIDENCE FROM EBAY," *The Journal of Industrial Economics*, 58 (1), 54–78, https://doi.org/10.1111/j.1467-6451.2010.00405.x.

CDP (2020) "Non-Disclosure Campaign Report," https://www.cdp.net/en/investor/engage-with-companies/non-disclosure-campaign, accessed on 14th March, 2021.

Che, X., H. Katayama, and P. Lee (2020) "Willingness to Pay for Brand Reputation: Lessons from the Volkswagen Diesel Emissions Scandal," Discussion Paper 20/02, City, University of London, London, UK, https://openaccess.city.ac.uk/id/eprint/23486/, © The Authors.

Cone Communication (2017) "CSR Study," https://www.conecomm.com/2017-cone-communications-csr-study-pd, accessed on 14th March, 2021.

Dasgupta, Susmita, Hua Wang, and David Wheeler (2006) "Disclosure Strategies for Pollution Control," in Tietenberg, Tom and Henk Folmer eds. *The International Yearbook of Environmental and Resource Economics 2006/2007*, Chap. 3, 93–119, Northampton: Edward Elgar.

Dechezleprêtre, Antoine and Tobias Kruse (2018) "A review of the empirical literature combining economic and environmental performance data at the micro-level," (1514), https://doi.org/10.1787/45d269b2-en.

Enikolopov, Ruben and Maria Petrova (2018) "Mass media and its influence on behaviour."

Fan, Ying, Jiandong Ju, and Mo Xiao (2016) "Reputation premium and reputation management: Evidence from the largest e-commerce platform in China," *International Journal of Industrial Organization*, 46, 63–76, https://doi.org/10.1016/j.ijindorg.2016.01.004.

Finger, J. M. and M. E. Kreinin (1979) "A Measure of 'Export Similarity' and Its Possible Uses," *The Economic Journal*, 89 (356), 905–912, 10.2307/2231506.

Fishman, Arthur, Israel Finkelshtain, Avi Simhon, and Nira Yacouel (2017) "Collective Brands,"Technical report, https://economics.hse.ru/data/2017/11/03/1158469673/collective%20nov%2017.pdf.

Fleckinger, Pierre (2007) "Collective Reputation and Market Structure: Regulating the Quality vs Quantity Trade-of,"Technical report.

Freedman, Seth, Melissa Kearney, and Mara Lederman (2012) "Product Recalls, Imperfect Information, and Spillover Effects: Lessons from the Consumer Response to the 2007 Toy Recalls," *The Review of Economics and Statistics*, 94 (2), 499–516.

Gentzkow, Matthew and Jesse M. Shapiro (2006) "Media Bias and Reputation," *Journal of Political Economy*, 114 (2), 280–316, 10.1086/499414.

Golez, Benjamin and R. Karapanda (2020) "Home-Country Media Slant and Equity Prices," *Econometric Modeling: Capital Markets - Asset Pricing eJournal*.

Goodman-Bacon, Andrew (2018) "Difference-in-Differences with Variation in Treatment Timing," Working Paper 25018, National Bureau of Economic Research, 10.3386/w25018.

Ipsos Global Reputation Monitor (2018) "Non-Disclosure Campaign Report," https://reputation.ipsos-mori.com/how-reputation-and-trust-affect-purchase-decisions-and-marketing-efficiency/, accessed on 14th March, 2021.

Jin, Ginger Zhe and Phillip Leslie (2009) "Reputational Incentives for Restaurant Hygiene," *American Economic Journal: Microeconomics*, 1 (1), 237–67, 10.1257/mic.1.1.237.

Jonsson, Stefan, Henrich R. Greve, and Takako Fujiwara-Greve (2009) "Undeserved Loss: The Spread of Legitimacy Loss to Innocent Organizations in Response to Reported Corporate Deviance," *Administrative Science Quarterly*, 54 (2), 195–228, 10.2189/asqu.2009.54.2.195.

Koenig, Pamina and Sandra Poncet (2019a) "Social responsibility scandals and trade," *World Development*, 124, 104640, https://doi.org/10.1016/j.worlddev.2019.104640.

——— (2019b) "Reputation and (un)fair trade: Effects on French importers from the Rana Plaza collapse," PSE Working Papers halshs-02418274, HAL, https://ideas.repec.org/p/hal/psewpa/halshs-02418274.html.

Kölbel, Julian F. and T. Busch (2013) "The effect of bad news on credit risk: a media based view of the pricing of corporate social responsibility."

Kölbel, Julian F., Timo Busch, and Leonhardt M. Jancso (2017) "How Media Coverage of Corporate Social Irresponsibility Increases Financial Risk," *Strategic Management Journal*, 38 (11), 2266–2284, https://doi.org/10.1002/smj.2647.

Lee, Jin Young and Gary Solon (2011) "The Fragility of Estimated Effects of Unilateral Divorce Laws on Divorce Rates," Working Paper 16773, National Bureau of Economic Research, 10.3386/w16773.

Levin, Jonathan (2009) "The Dynamics of Collective Reputation," *The B.E. Journal of Theoretical Economics*, 9 (1), 1–25, https://ideas.repec.org/a/bpj/bejtec/v9y2009i1n27.html.

Li, Lingfang (Ivy) (2010) "Reputation, Trust, and Rebates: How Online Auction Markets Can Improve Their Feedback Mechanisms," *Journal of Economics & Management Strategy*, 19 (2), 303–331, https://doi.org/10.1111/j.1530-9134.2010.00253.x.

Li, Lingfang (Ivy), Steven Tadelis, and Xiaolan Zhou (2020) "Buying reputation as a signal of quality: Evidence from an online marketplace," *The RAND Journal of Economics*, 51 (4), 965–988, https://doi.org/10.1111/1756-2171.12346.

List, John A. (2006) "The Behavioralist Meets the Market: Measuring Social Preferences and Reputation Effects in Actual Transactions," *Journal of Political Economy*, 114 (1), 1–37, 10.1086/498587.

Luca, M. (2016) "Reviews, Reputation, and Revenue: The Case of Yelp.Com."

Luca, M. and G. Zervas (2016) "Fake It Till You Make It: Reputation, Competition, and Yelp Review Fraud," *Manag. Sci.*, 62, 3412–3427.

Macchiavello, Rocco (2010) "Development Uncorked: Reputation Acquisition in the New Market for Chilean Wines in the UK," CEPR Discussion Papers 7698, C.E.P.R. Discussion Papers, https://ideas.repec.org/p/cpr/ceprdp/7698.html.

Macchiavello, Rocco and Ameet Morjaria (2015) "The Value of Relationships: Evidence from a Supply Shock to Kenyan Rose Exports," *American Economic Review*, 105 (9), 2911–45, 10.1257/aer.20120141.

Mayzlin, Dina, Yaniv Dover, and Judith Chevalier (2014) "Promotional Reviews: An Empirical Investigation of Online Review Manipulation," *American Economic Review*, 104 (8), 2421–55, 10.1257/aer.104.8.2421.

Roberts, David (2020) "On climate change, oil and gas companies have a long way to go," https://www.vox.com/energy-and-environment/2020/9/25/21452055/climate-change-exxon-bp-shell-total-chevron-oil-gas, accessed on 14th March, 2021.

Solon, Gary, Steven J Haider, and Jeffrey Wooldridge (2013) "What Are We Weighting For?" Working Paper 18859, National Bureau of Economic Research, 10.3386/w18859.

Stecklow, Steve (2019) "Refinitiv deployed filter to block Reuters reports as Hong Kong protests raged," https://www.reuters.com/investigates/special-report/hongkong-protests-media/, accessed on 14th March, 2021.

Sun, Liyang and Sarah Abraham (2020) "Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects."

Tetlock, Paul C. (2015) "Chapter 18 - The Role of Media in Finance," in Anderson, Simon P., Joel Waldfogel, and David Strömberg eds. *Handbook of Media Economics*, 1 of Handbook of Media Economics, 701–721: North-Holland, https://doi.org/10.1016/B978-0-444-63685-0.00018-8.

Tirole, Jean (1996) "A Theory of Collective Reputations (with applications to the persistence of corruption and to firm quality)," *The Review of Economic Studies*, 63 (1), 1–22, 10.2307/2298112.

Watts, Jonathan (2020) "Oil and gas firms 'have had far worse climate impact than thought'," https://www.theguardian.com/environment/2020/feb/19/oil-gas-industry-far-worse-climate-impact-than-thought-fossil-fuels-methane, accessed on 14th March, 2021.

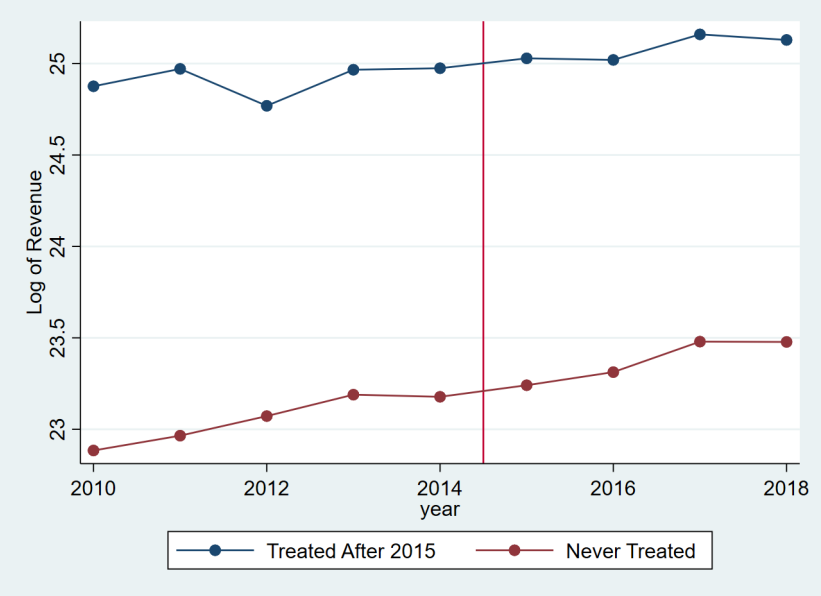
Winfree, Jason A. and Jill J. McCluskey (2005) "Collective Reputation and Quality," *American Journal of Agricultural Economics*, 87 (1), 206–213, https://doi.org/10.1111/j.0002-9092.2005.00712.x.

Zhao, Y. (2018) "Your (Country's) Reputation Precedes You : Information Asymmetry , Externalities and the Quality of Exports."

Zhong, Jiatong (2018) "Reputation of Quality in International Trade: Evidence from Consumer Product Recalls."

A Appendix

Figure A.1. Trends in Treated vs. Untreated Automobile Manufactures



Note: Some firms have controversies right after 2015, some others have in later years.

Table A.1. Distribution of Environmental Controversies by Year - Automobile Industry

	German			Non-German
year	Volkswagen	BMW	Daimler	33 companies
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	3	0	0	2
2016	16	0	2	15
2017	10	2	3	7
2018	13	6	7	7

Table A.2. The full list of 23 ESG controversy topics

Category	Name (N)	Label (L)	Description (D)
Community	TR.ControvAntiCompetition	Anti-competition controversy	Number of controversies published in the media linked to anti-competitive behavior (e.g., anti-trust and monopoly), price-fixing or kickbacks.
Community	TR.ControvBusinessEthics	Business ethics controversies	Number of controversies published in the media linked to business ethics in general, political contributions or bribery and corruption.
Community	TR.ControvCopyrights	Intellectual property controversies	Number of controversies published in the media linked to patents and intellectual property infringements.
Community	TR.ControvCriticalCountries	Critical countries controversies	Number of controversies published in the media linked to activities in critical, undemocratic countries that do not respect fundamental human rights principles.
Community	TR.ControvPublicHealth	Public health controversies	Number of controversies published in the media linked to public health or industrial accidents harming the health and safety of third parties (non-employees and non-customers).
Community	TR.ControvTaxFraud	Tax fraud controversies	Number of controversies published in the media linked to tax fraud, parallel imports or money laundering.
Human rights	TR.ControvChildLabor	Child labor controversies	Number of controversies published in the media linked to use of child labor issues.
Human rights	TR.ControvHumanRights	Human rights controversies	Number of controversies published in the media linked to human rights issues.
Management	TR.ControvMgtComp	Mgt compensation controversies count	Number of controversies published in the media linked to high executive or board compensation.
Product responsibility	TR.ControvConsumer	Consumer controversies	Number of controversies published in the media linked to consumer complaints or dissatisfaction directly linked to the company's products or services.
Product responsibility	TR.ControvCustomerHS	Controversies customer health and safety	Number of controversies published in the media linked to customer health and safety.
Product responsibility	TR.ControvPrivacy	Controversies privacy	Number of controversies published in the media linked to employee or customer privacy and integrity.
Product responsibility	TR.ControvProductAccess	Controversies product access	Number of controversies published in the media linked to product access.
Product responsibility	TR.ControvRespMarketing	Controversies responsible marketing	Number of controversies published in the media linked to the company's marketing practices, such as over-marketing of unhealthy food to vulnerable consumers.
Product responsibility	TR.ControvResponsibleRD	Controversies responsible R&D	Number of controversies published in the media linked to responsible research and development (R&D).
Resource use	TR.ControvEnv	Environmental controversies	Number of controversies related to the environmental impact of the company's operations on natural resources or local communities.
Shareholders	TR.ControvAccounting	Accounting controversies count	Number of controversies published in the media linked to aggressive or non-transparent accounting issues.
Shareholders	TR.ControvInsiderDealings	Insider dealings controversies count	Number of controversies published in the media linked to insider dealings and other share price manipulations.
Shareholders	TR.ControvShareholders	Shareholder rights controversies count	Number of controversies published in the media linked to shareholder rights infringements.
Workforce	TR.ControvDiversityOpportunity	Diversity and opportunity controversies	Number of controversies published in the media linked to workforce diversity and opportunity (e.g., wages, promotion, discrimination and harassment).
Workforce	TR.ControvEmployeesHS	Employee health & safety controversies	Number of controversies published in the media linked to workforce health and safety.
Workforce	TR.ControvWorkingCondition	Wages or working condition controversies count	Number of controversies published in the media linked to the company's relations with employees or relating to wages or wage disputes.
Workforce	TR.Strikes	Strikes	Has there has been a strike or an industrial dispute that led to lost working days?

Source: https://www.refinitiv.com/en/sustainable-finance/esg-scores

Table A.3. A sample controversy

Date	19/07/2016
Title	Volkswagen seeks Canadian "Dieselgate" settlement -Handelsblatt - Reuters News
URL	http://www.reuters.com/article/us-volkswagen-emissions-canada-idUSKCN0ZY2ID
Abstract	Volkswagen is seeking a settlement with Canadian diesel vehicle owners similar to the one reached in the United States, German newspaper Handelsblatt reported on Monday, citing a spokesperson for the carmaker. Volkswagen last month agreed to pay as much as $15.3 billion after admitting it cheated on U.S. diesel emissions tests for years, to buy back vehicles from consumers and provide funding that could benefit makers of cleaner technologies. The carmaker will set aside $10.033 billion to cover buybacks or fixes for diesel cars and sport utility vehicles that used illegal software to defeat government emissions tests. Volkswagen would be on the hook for up to $2 billion if it reached a similar settlement in Canada, Handelsblatt reported, without saying what the source of that information was. A spokesman at Volkswagen's headquarters in Wolfsburg declined to comment. "We are not commenting on speculation in the media. VW is in talks with the Canadian authorities but there are no decisions yet," the spokesman said.

Table A.4. Distribution of Controversies

Industries (2 digit NAICS)	Environmental & Public Health Controversies	Other Controversies	Firms with Env. & P.H. C. out of Total	Env. and P.H. Controversies per Firm	Other Controversies per Firm
Mining, Quar. & Oil/Gas Extr.	212	771	67 / 250	0.85	3.08
Utilities	156	410	43 / 141	1.11	2.91
Construction	7	148	7 / 115	0.06	1.29
Manufacturing	326	4590	71 / 579	0.56	7.93
Wholesale Trade	6	49	3 / 11	0.55	4.45
Retail Trade	7	415	3 / 84	0.08	4.94
Transport. and Warehousing	18	530	9 / 66	0.27	8.03
Information	6	1399	6 / 167	0.04	8.38
Finance and Insurance	4	447	2 / 154	0.03	2.90
Real Estate, Rental & Leasing	2	32	2 / 121	0.02	0.26
Prof., Sci., and Tech. Services	9	275	4 / 80	0.11	3.44
Accom. and Food Services	0	88	0 / 26	0	3.38
Year					
2010	75	1399	55 / 1794	0.04	0.78
2011	57	981	39 / 1794	0.03	0.55
2012	45	897	37 / 1794	0.03	0.50
2013	84	1167	55 / 1794	0.05	0.65
2014	55	1147	38 / 1794	0.03	0.64
2015	60	372	32 / 1794	0.03	0.21
2016	198	1203	93 / 1794	0.11	0.67
2017	63	919	34 / 1794	0.04	0.51
2018	116	1069	52 / 1794	0.06	0.60
Continent					
Africa	5	146	3 / 36	0.14	4.06
Asia	80	1865	36 / 564	0.14	3.31
Europe	251	2717	56 / 405	0.62	6.71
North America	340	4047	103 / 620	0.55	6.53
Oceania	39	222	10 / 112	0.35	1.98
South America	38	157	9 / 57	0.67	2.75
Total:	**753**	**9154**	**217 / 1794**		

Note: Balanced Sample (2010-2018)

Table A.5. Distribution of Controversies - 3 digit Industries

Industries (3 digit NAICS)		Environmental & Public Health Controversies	Other Controversies	Number of Firms	Env. and P.H. Controversies per Firm
211	Oil and Gas Extraction	66	193	87	0.76
212	Mining (except Oil and Gas)	141	481	128	1.10
213	Support Activities for Mining	5	97	35	0.14
221	Utilities	156	410	141	1.11
236	Construction of Buildings	4	111	97	0.04
237	Heavy and Civil Engineering Construction	3	37	18	0.17
312	Beverage and Tobacco Product Manufacturing	8	179	32	0.25
324	Petroleum and Coal Products Manufacturing	135	443	31	4.35
325	Chemical Manufacturing	48	1173	130	0.37
327	Nonmetallic Mineral Product Manufacturing	4	47	25	0.16
331	Primary Metal Manufacturing	19	203	37	0.51
333	Machinery Manufacturing	1	83	35	0.03
334	Computer and Electronic Product Manufacturing	9	1082	188	0.05
335	Electrical Equip., Appliance, Component Manuf.	0	30	15	0.00
336	Transportation Equipment Manufacturing	102	1283	68	1.50
339	Miscellaneous Manufacturing	0	67	18	0.00
424	Merchant Wholesalers, Nondurable Goods	6	49	11	0.55
445	Food and Beverage Stores	4	219	26	0.15
448	Clothing and Clothing Accessories Stores	0	77	23	0.00
452	General Merchandise Stores	3	119	35	0.09
481	Air Transportation	1	360	26	0.04
482	Rail Transportation	15	80	14	1.07
483	Water Transportation	2	90	26	0.08
511	Publishing Industries (except Internet)	1	215	31	0.03
515	Broadcasting (except Internet)	0	102	25	0.00
517	Telecommunications	4	769	91	0.04
519	Other Information Services	1	313	20	0.05
522	Credit Intermediation and Related Activities	0	3	12	0.00
523	Securities, Comm. Cont., Other Fin. Inv. & Rel. Act.	0	72	43	0.00
524	Insurance Carriers and Related Activities	4	372	99	0.04
531	Real Estate	2	32	121	0.02
541	Professional, Scientific, and Technical Services	9	275	80	0.11
721	Accommodation	0	88	26	0.00

Table A.6. Distribution of Controversies - 5 digit Industries

Industries (5 digit NAICS)		Environmental & Public Health Controversies	Other Controversies	Number of Firms	Env. and P.H. Controversies per Firm
21111	Oil and Gas Extraction	66	193	87	0.76
21211	Coal Mining	19	81	21	0.90
21221	Iron Ore Mining	72	209	21	3.43
21222	Gold Ore and Silver Ore Mining	29	105	52	0.56
21223	Copper, Nickel, Lead, and Zinc Mining	14	34	21	0.67
21229	Other Metal Ore Mining	7	52	13	0.54
21311	Support Activities for Mining	5	97	35	0.14
22111	Electric Power Generation	103	200	80	1.29
22112	Electric Power Transmission, Control, and Distribution	31	110	42	0.74
22121	Natural Gas Distribution	22	100	19	1.16
23611	Residential Building Construction	2	58	74	0.03
23622	Commercial and Institutional Building Construction	2	53	23	0.09
23731	Highway, Street, and Bridge Construction	3	37	18	0.17
31211	Soft Drink and Ice Manufacturing	8	137	21	0.38
31212	Breweries	0	42	11	0.00
32411	Petroleum Refineries	135	443	31	4.35
32511	Petrochemical Manufacturing	4	29	12	0.33
32518	Other Basic Inorganic Chemical Manuf.	5	9	13	0.38
32521	Resin and Synthetic Rubber Manuf.	15	33	20	0.75
32541	Pharmaceutical and Medicine Manuf.	19	997	68	0.28
32562	Toilet Preparation Manufacturing	5	105	17	0.29
32731	Cement Manufacturing	4	47	25	0.16
33111	Iron and Steel Mills and Ferroalloy Manuf.	19	203	37	0.51
33313	Mining and Oil and Gas Field Machinery Manuf.	0	20	11	0.00
33329	Other Industrial Machinery Manufacturing	0	8	13	0.00
33361	Engine, Turbine, & Power Transmission Eq. Manuf.	1	55	11	0.09
33411	Computer and Peripheral Equipment Manuf.	1	114	27	0.04
33422	Radio and TV Broad. & Wireless Comm. Eq. Manuf.	2	520	12	0.17
33441	Semiconductor and Other Electronic Comp. Manuf.	1	218	89	0.01
33451	Nav., Measur., Electromedical, & Cont. Inst. Manuf.	5	230	60	0.08
33531	Electrical Equipment Manufacturing	0	30	15	0.00
33611	Automobile and Light Duty Motor Vehicle Manuf.	93	973	36	2.58
33641	Aerospace Product and Parts Manufacturing	9	292	21	0.43
33661	Ship and Boat Building	0	18	11	0.00
33911	Medical Equipment and Supplies Manufacturing	0	67	18	0.00
42421	Drugs and Druggists' Sundries Merc. Wholesalers	6	49	11	0.55
44511	Supermarkets and Other Grocery Stores	4	219	26	0.15
44812	Women's Clothing Stores	0	20	12	0.00
44814	Family Clothing Stores	0	57	11	0.00
45211	Department Stores	3	119	35	0.09
48111	Scheduled Air Transportation	1	360	26	0.04
48211	Rail Transportation	15	80	14	1.07
48311	Deep Sea, Coastal, and Great Lakes Water Trans.	2	90	26	0.08
51121	Software Publishers	1	215	31	0.03
51512	Television Broadcasting	0	102	25	0.00
51711	Wired Telecommunications Carriers	1	199	34	0.03
51721	Wireless Telecommunications Carriers	3	570	57	0.05
51913	Internet Publ. and Broad. and Web Search Portals	1	313	20	0.05
52229	Other Nondepository Credit Intermediation	0	3	12	0.00
52321	Securities and Commodity Exchanges	0	37	11	0.00
52392	Portfolio Management	0	35	32	0.00
52411	Direct Life, Health, and Medical Insurance Carriers	0	217	48	0.00
52412	Direct Insurance Carriers	4	155	51	0.08
53111	Lessors of Residential Buildings and Dwellings	1	7	21	0.05
53112	Lessors of Nonresidential Buildings	1	25	100	0.01
54133	Engineering Services	4	38	16	0.25
54151	Computer Systems Design and Related Services	2	189	51	0.04
54171	R&D in the Physical, Engineering, and Life Sci.	3	48	13	0.23
72111	Hotels (except Casino Hotels) and Motels	0	47	15	0.00
72112	Casino Hotels	0	41	11	0.00

Table A.7. Baseline comparison of firms with and without environmental and public health controversy

	Firms with Controversy		Firms without Controversy			
Industries (5 digit NAICS)	**Count**	**Mean Revenue**	**Count**	**Mean Revenue**	**Difference**	**p-value**
Oil and Gas Extraction	28	15.246	59	4.204	11.042	0.001
		(18.104)		(12.5)	(3.331)	
Coal Mining	8	26.306	13	1.668	24.639	0.078
		(48.461)		(1.418)	(13.228)	
Iron Ore Mining	6	49.009	15	2.811	46.199	0.000
		(10.479)		(3.897)	(3.058)	
Gold Ore and Silver Ore Mining	11	5.093	41	0.546	4.548	0.000
		(5.89)		(0.665)	(0.917)	
Copper, Nickel, Lead, and Zinc Mining	8	3.825	13	2.177	1.648	0.262
		(2.815)		(3.365)	(1.426)	
Other Metal Ore Mining	4	2.36	9	0.789	1.571	0.200
		(3.212)		(1.092)	(1.153)	
Support Activities for Mining	2	12.961	33	2.811	10.15	0.012
		(7.088)		(5.197)	(3.833)	
Electric Power Generation	23	22.813	57	6.628	16.186	0.001
		(29.605)		(12.164)	(4.644)	
Electric Power Transmission, Control, and Distribution	13	14.69	29	12.425	2.265	0.761
		(17.496)		(23.838)	(7.385)	
Natural Gas Distribution	7	39.46	12	12.276	27.184	0.123
		(57.495)		(10.907)	(16.772)	
Residential Building Construction	2	1.642	72	2.904	-1.262	0.621
		(1.14)		(3.571)	(2.544)	
Commercial and Institutional Building Construction	2	8.74	21	7.958	0.782	0.896
		(8.014)		(7.996)	(5.918)	
Highway, Street, and Bridge Construction	3	34.323	15	14.785	19.538	0.129
		(12.736)		(20.039)	(12.192)	
Soft Drink and Ice Manufacturing	3	62.375	18	3.992	58.383	0.000
		(29.785)		(3.208)	(6.316)	
Petroleum Refineries	13	155.716	18	30.134	125.582	0.000
		(129.456)		(31.101)	(31.525)	
Petrochemical Manufacturing	3	22.113	9	17.377	4.736	0.570
		(16.718)		(10.609)	(8.054)	
Other Basic Inorganic Chemical Manuf.	3	8.294	10	8.116	0.178	0.980
		(6.994)		(11.106)	(6.898)	
Resin and Synthetic Rubber Manuf.	3	32.97	17	4.409	28.561	0.008
		(45.454)		(3.018)	(9.654)	
Pharmaceutical and Medicine Manuf.	9	35.803	59	5.733	30.071	0.000
		(26.12)		(10.295)	(4.745)	
Toilet Preparation Manufacturing	3	30.914	14	7.488	23.425	0.047
		(26.215)		(15.135)	(10.837)	
Cement Manufacturing	3	17.867	22	3.419	14.448	0.000
		(4.753)		(4.838)	(2.973)	
Iron and Steel Mills and Ferroalloy Manuf.	8	25.233	29	10.982	14.251	0.023
		(24.617)		(11.335)	(5.977)	
Engine, Turbine, & Power Transmission Eq. Manuf.	1	13.226	10	17.872	-4.646	0.880
				(28.496)	(29.887)	
Computer and Peripheral Equipment Manuf.	1	4.688	26	15.988	-11.3	0.656
				(24.579)	(25.047)	
Radio and TV Broad. & Wireless Comm. Eq. Manuf.	1	65.225	11	24.136	41.089	0.336
				(38.95)	(40.682)	
Semiconductor and Other Electronic Comp. Manuf.	1	16.018	88	6.317	9.7	0.509
				(14.557)	(14.64)	
Nav., Measur., Electromedical, & Cont. Inst. Manuf.	2	28.238	58	4.561	23.677	0.000
		(2.228)		(7.029)	(5.016)	
Automobile and Light Duty Motor Vehicle Manuf.	13	79.378	23	28.395	50.983	0.007
		(50.163)		(51.295)	(17.661)	
Aerospace Product and Parts Manufacturing	4	63.801	17	19.728	44.074	0.016
		(58.619)		(20.571)	(16.661)	
Drugs and Druggists' Sundries Merc. Wholesalers	3	96.121	8	12.226	83.895	0.000
		(17.277)		(12.308)	(9.187)	
Supermarkets and Other Grocery Stores	1	421.849	25	22.415	399.434	0.000
				(25.636)	(26.143)	
Department Stores	2	46.197	33	6.475	39.722	0.000
		(29.972)		(6.57)	(6.052)	
Scheduled Air Transportation	1	31.755	25	9.522	22.233	0.013
				(8.083)	(8.243)	
Rail Transportation	6	7.7	8	10.207	-2.507	0.591
		(5.265)		(10.067)	(4.54)	
Deep Sea, Coastal, and Great Lakes Water Trans.	2	14.469	24	7.927	6.542	0.460
		(0)		(12.102)	(8.72)	
Software Publishers	1	62.484	30	4.074	58.41	0.000
				(7.396)	(7.518)	
Wired Telecommunications Carriers	1	37.937	33	10.423	27.514	0.051
				(13.38)	(13.582)	
Wireless Telecommunications Carriers	3	104.782	54	16.1	88.682	0.000
		(20.448)		(24.384)	(14.386)	
Internet Publ. and Broad. and Web Search Portals	1	29.321	19	1.726	27.595	0.000
				(1.487)	(1.526)	
Direct Insurance Carriers	2	80.649	49	12.422	68.227	0.000
		(78.54)		(16.863)	(14.508)	
Lessors of Residential Buildings and Dwellings	1	13.623	20	1.532	12.091	0.000
				(2.777)	(2.845)	
Lessors of Nonresidential Buildings	1	0.688	99	1.148	-0.46	0.844
				(2.318)	(2.329)	
Engineering Services	2	12.241	14	4.282	7.96	0.020
		(12.173)		(2.411)	(3.022)	
Computer Systems Design and Related Services	1	32.184	50	9.672	22.512	0.317
				(22.066)	(22.286)	
R&D in the Physical, Engineering, and Life Sci.	1	10.099	12	2.581	7.518	0.140
				(4.54)	(4.725)	

Notes: Industries are 5 digit industries in the sample with at least 10 firms and at least 1 environmental and public health controversy during sample period. Counts are the number of firms involved in an environmental and public health scandal at least once vs. never involved during the sample period. Mean revenues (in billion USD) are the average across firms within each group in 2010, initial year of the balanced sample. Standard deviations are in parenthesis below each mean value. Differences are obtained regressing firm revenues on a dummy for being ever treated, for each industry. Corresponding standard errors are reported within parenthesis. Last column reports corresponding p-values.

Table A.8. Net Effect of Controversies on Firm Sales - Whole Sample

	OLS			WLS
	(1)	(2)	(3)	(4)
News Count	-0.017*		-0.019*	-0.025*
	(0.009)		(0.010)	(0.014)
Scandal Dummy		-0.026		
		(0.019)		
ESG Score	0.007***	0.006***	0.006***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
Other Controversies	0.014***	0.010***	0.011***	0.009***
	(0.003)	(0.002)	(0.002)	(0.003)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes			
Industry*Year FE		Yes	Yes	Yes
N	54967	54742	54742	54742

Notes: Robust standard errors in parentheses, clustered at firm level

Whole Sample (2001-2020)

Weighted regressions use the number of firms within industries as weights.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.9. Spillover Effects of Volkswagen Scandal (with scandal dummy)

	(1)	(2)	(3)	(4)	(5)	(6)
News Count		-0.051**		-0.056**		-0.056**
		(0.025)		(0.028)		(0.027)
Same Country ($D_{vt}C_{iv}$)	-0.150**	-0.040			-0.110	-0.014
	(0.074)	(0.057)			(0.128)	(0.109)
Competitors ($D_{vt}S_{iv}$)			-0.139	0.004	-0.055	0.013
			(0.217)	(0.244)	(0.291)	(0.302)
ESG Score	0.003	0.003	0.005	0.006	0.006	0.006
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Other Controversies	0.025	0.027*	0.025	0.026*	0.025	0.026*
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	315	315	279	279	279	279

Notes: Robust standard errors in parentheses

Balanced Sample (2010-2018) for Automobile and Light Duty Motor Vehicle Manufacturing Industry

Volkswagen is excluded in spillover regressions.

4 firms have missing similarity index since they do not have revenue distribution data.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.10. Effect of controversies at industry level

	WLS		OLS	
	(1)	(2)	(3)	(4)
News Count	-0.004	-0.003	-0.003	-0.003
	(0.004)	(0.003)	(0.004)	(0.003)
Other Controversies	0.001	0.001	0.001*	0.001
	(0.001)	(0.000)	(0.001)	(0.000)
Average ESG Score		0.031***		0.031***
		(0.006)		(0.007)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	540	540	540	540

Notes: Robust standard errors in parentheses, clustered at industry level

Balanced Sample (2010-2018)

Revenues are aggregated after excluding firms involved in scandals.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$