— Online Appendix —

Attention or Sentiment: How Social Media React to ESG?

Appendix I. The value of CSR and ESG

The value of CSR and ESG is widely investigated in a variety of domains such as marketing, strategy, finance, accounting, and also IS. CSR and ESG are found to affect customers, investors, and firms, etc.

According to a report by Allianz, consumers expect to obtain more than just products and services from their providers (Allianz 2018). More specifically, they increasingly demand firms to engage in ESG activities. As a result, most consumers believe that firms paying more attention to ESG issues have better long-term prospects. Thus, CSR can impact the way consumers evaluate a company's products or services, confirming that doing good can help firms do well (Chernev and Blair 2015). Furthermore, some factors are found to have influence on the relationship between CSR and consumers' responses, e.g., brand concepts (Torelli et al. 2012). Besides, Sen and Bhattacharya (2001) investigate the conditions, circumstances and population under which specific CSR activities will have positive impact, and they find that under certain circumstances, CSR initiatives can reduce consumers' purchase intentions.

Shareholders are also sensitive to firm's CSR or ESG activities. Flammer (2013) finds that firms that act responsibly towards the environment experience a significant increase in stock price, while those that act irresponsibly encounter a significant decrease. When experiencing negative events, firms' CSR activities can mitigate the decrease in shareholder value (Godfrey et al. 2009). Ioannou and Serafeim (2015) investigate the influence of CSR ratings on sell-side analysts' predictions about firms' future financial performance and find that analysts initially produce pessimistic recommendations, perceiving CSR as a cost; but gradually they become more optimistically on these firms over time. During the 2008-2009 financial crisis, companies with high CSR ratings achieved higher stock returns than those with low CSR performance, further

supporting the argument that CSR has a positive impact on firm value (Lins et al. 2017). CSR strategies can influence firms' access to capital markets by reducing capital constraints for companies with superior CSR performance (Cheng et al. 2014). Homburg et al. (2013) confirm the helpfulness of supplier firms' CSR engagement in generating positive customer outcomes, such as customers' trust and loyalty, in organizational business relationships. Du et al. (2011) find that CSR can be a competitive weapon for challengers against market leaders. Specifically, challengers who engage in CSR activities can achieve more positive attitudes and behaviors from consumers. Ramchander et al. (2012) find that stakeholder-related CSR announcements produce a positive stock market response for focal firms and a negative feedback for their rival firms. CSR activities can be divided into internal and external ones, and Hawn and Ioannou (2016) find that they jointly have a significantly positive association with firm market value. Flammer (2015) utilize a regression discontinuity approach to confirm the causal impact of CSR on a company's financial performance and discover that the implementation of comprehensive CSR strategies leads to a significant increase in firm value.

CSR can impact firm value, but the relationship holds only under certain conditions. Servaes and Tamayo (2013) discover that for companies with high customer awareness, the relationship between CSR and firm value is positive, but for firms with low customer awareness insignificant or even negative. Luo et al. (2015) posits that analyst recommendations serve as a mediator between CSR and firm financial performance. Furthermore, it is found that customer satisfaction also acts as a mediator between CSR and firm market value (Luo and Bhattacharya 2006). Mishra and Modi (2016) investigate the supplementary role of marketing capability in the relationship between CSR and shareholder wealth, and find its significant interaction effect with firms' CSR efforts. Another study by Luo and Bhattacharya (2009) demonstrates that CSR can reduce firms' idiosyncratic risk, with even greater risk reduction observed for companies with more advertising investment; however, simultaneous investment in advertising and R&D with the attendance of CSR results in higher idiosyncratic risk.

Table A1 summarizes the related works in comparison with our own.

Table A1. Summary of Related Literature

Study	Corporate governance [a]	Focus	Method	Data source [b]	Key findings
Flammer (2013)	N	Shareholder	Event study	Corporate announcement news	It echoes the perspective of considering the environment as a resource and posits that its worth is contingent upon both internal and external moderators.
Chernev and Blair (2015)	N	Consumer	ANOVA	Experiments	A firm's socially responsible behavior can change consumers' perception of the firm.
Torelli et al. (2012)	N	Consumer	ANOVA	Experiments	Brand concepts affect consumers' responses to firms' CSR activities.
Homburg et al. (2013)	N	Consumer	Structural equation model (SEM)	Survey	It confirms the helpfulness of supplier firms' CSR engagement in generating positive customer outcomes in organizational business relationships.
Luo and Bhattacharya (2006)	N	Consumer	Structural equation model (SEM)	Fortune America's Most Admired Corporations (FAMA)	In the context of CSR and firm market value, customer satisfaction plays a partial mediating role; corporate abilities serve as a moderating factor that impacts the financial returns generated by CSR initiatives; customer satisfaction mediates the moderated relationship.
Mishra and Modi (2016)	N	Shareholder	Seemingly unrelated	KLD	It finds that the relationship between CSR and

			regression (SUR)		shareholder wealth is complemented by the role of marketing capability.
Sen and Bhattacharya (2001)	N	Consumer	ANOVA	Experiments	Consumer purchase intention can be decreased by CSR initiatives under certain circumstances.
Du et al. (2011)	N	Firm	Qualitative study, quasi-experiment	Transcripts, survey	CSR can serve as a competitive weapon for challengers against market leaders.
Flammer (2015)	N	Shareholder	Regression Discontinuity	RiskMetrics and SharkRepellent	The implementation of CSR initiatives leads to a significant enhancement in the company's value.
Servaes and Tamayo (2013)	N	Consumer	OLS regression	KLD	Among firms with high customer awareness, there is a positive correlation between CSR and firm value. However, for firms with low customer awareness, the relationship between CSR and firm value is either negative or insignificant.
Cheng et al. (2014)	Y	Firm	Econometric models	Thomson Reuters (ASSET4)	CSR strategies can affect firms' ability in accessing finance in capital markets in that firms with superior CSR performance encounter fewer capital constraints.
Godfrey et al. (2009)	Y	Shareholder	Event study	KLD	When experiencing negative events, firms' CSR activities can mitigate the decrease in shareholder value.
Hawn and Ioannou	Y	Shareholder	Econometric models	ASSET4	Internal and external CSR activities jointly exhibit a

(2016)					significantly positive correlation with firm value.
Ioannou and Serafeim (2015)	Y	Stock analyst	Panel regression	KLD	Sell-side analysts make pessimistic recommendations with perceiving CSR as an agency cost in the early stage, then gradually become more optimistically over time.
Luo et al. (2015)	Y	Stock analyst	Two-stage least squares (2SLS)	KLD	The relationship between corporate social performance and firm financial performance is mediated by stock analyst recommendations.
Ramchander et al. (2012)	Y	Shareholder	Event study	KLD	The announcement of stakeholder-related CSR initiatives results in a positive stock price reaction for the focal firms and a negative stock price reaction for their competitors, and the opposite response is observed for CSR announcements deletion.
Lins et al. (2017)	Y	Shareholder	Econometric models	MSCI (formerly known as KLD)	During the 2008-2009 global financial crisis, high-CSR firms achieved higher stock returns compared to those with low CSR performance, thereby confirming the positive impact of CSR on firm value.
Luo and Bhattacharya (2009)	N	Firm	Econometric models	Fortune’s MAC	CSR can mitigate firms' idiosyncratic risk, particularly for those with

					higher advertising investment; however, the simultaneous enhancement of advertising and R&D resources in conjunction with corporate social performance may result in increased risk.
D'Arcy et al. (2020)	Y	Firm	Panel regression	KLD	A positive CSR performance record which is peripheral to a firm's core activities causes an elevated possibility of data breach, but firms with poor CSR records do not have a higher possibility to experience data breach.
This study	Y	Individual investor	Panel regression; Event study; Instrumental variable regression	Sustainalytics; Refinitiv; RepRisk	A firm's ESG performance increase is associated with its subsequent investor attention increase; The effect of ESG on investor attention holds for both ESG downgrade and upgrade events; The positive association between ESG performance and investor attention is driven by environmental and social factors.

Notes. [a]: N means that the study does not consider corporate governance factor, and Y otherwise; [b]: the data source is summarized just for CSR or ESG data source.

Appendix II. Data Collection

(1) Investor-generated content from Seeking Alpha

For our study, we use the S&P 500 firms as our research sample and acquire

investor-generated content data from Seeking Alpha, which is one of the most popular OICs all over the world. As postings published on Seeking Alpha are long articles reviewed by editors of the platform, so it takes authors substantial effort to compose an article. Consequently, compared with authors on platforms allowing users to publish short postings such as StockTwits, authors on Seeking Alpha publish much fewer articles. Therefore, there are not too many articles related to a firm or stock, especially for small-cap ones. At the same time, ESG is considerably more visible and accurately measured for big firms. Hence, we choose investor-generated articles about S&P 500 firms for our study.

(2) Financial data from Compustat

The financial data for each firm is retrieved from Compustat, a repository of financial information for publicly traded companies worldwide. It is worth noting that, as total assets and other financial indicators of firms used for our study are released on a quarterly basis instead of a monthly basis, following the data-matching scheme in line with Luo (2009), we postulate that the monthly financial indicators of a company are equivalent to the quarterly values for the months encompassed within the quarterly reporting period. At last, quarterly reported total assets, operating income, intangible assets, and long-term debt are obtained from Compustat.

(3) Stock market data from CRSP

In order to calculate *Beta*, *Momentum*, and *Volatility* of a stock, we need to obtain its historical return data. These data are obtained from the CRSP database, which is a database for stock trading information for listed companies around the world.

(4) ESG rating scores from Sustainalytics

We obtain ESG performance scores for each company from Sustainalytics, which is a global leader in providing ESG performance data (Sustainalytics 2020). In addition to an overall ESG score, there are also three sub-dimensional scores for each firm in each month: environmental, social, and governance scores. For the purpose of this research, we primarily consider the overall ESG scores in our main analysis, whereas investigate the three sub-dimensional scores in the

additional analyses. We obtain the ESG scores and the average ESG scores for its industry for each company monthly for the period from January 2014 (some firms started later because of data missing) to December 2019.

After we delete firms which have never been discussed in Seeking Alpha and those whose ESG scores, financial data, or stock return data are missing, 429 firm are eventually included in our study.

Appendix III. Variables and Measurement

Table A2. Variable Descriptions

Type	Variable	Description
Dependent variable	$Attention_{it}$	The logarithm of the total number of articles published about Firm *i* published in Month *t*.
	$Sentiment_{it}$	The average sentiment of articles about Firm *i* published in Month *t*.
Independent variable	$ESG_{i,t-1}$	Measured by the ESG score for Firm *i* in Month *t-1*, which is obtained from Sustainalytics.
Control variables	$Firm\_size_{i,t-1}$	The logarithm of the total assets of Firm *i* in Month *t-1*.
	$ROA_{i,t-1}$	Measured as the ratio of operating income to total assets for Firm *i* in Month *t-1*.
	$Intangible\_assets_{i,t-1}$	The ratio between intangible assets value and total assets value for Firm *i* in Month *t-1*.
	$Financial\_leverage_{i,t-1}$	The ratio between long-term debt to total assets for Firm *i* in Month *t-1*.
	$Beta_{i,t-1}$	The market beta estimated using monthly returns from 60 months prior to the focal month (*t-60*) to one month prior to the focal month (*t-1*).
	$Momentum_{i,t-1}$	Estimated using the cumulative returns from 24 months prior to the focal month (*t-24*) to one month prior to the focal month (*t-1*).
	$Volatility_{i,t-1}$	The monthly standard deviation of daily returns, calculated based on data from the 12 months prior to the focal month (*t-12*) through one month prior to the focal month (*t-1*).
	Industry FE	The fixed effects of industry a firm belongs to.
	Month FE	The fixed effects of month when an article is published.

Appendix IV. Results for Robustness Checks

Table A3. Relationship Between ESG and *Social Media Attention* for Different Time Windows

Variable	Model 1 (*t+1*)	Model 2 (*t+2*)	Model 3 (*t+3*)
$ESG_{i,t-1}$	**0.006(0.001)*****	**0.006(0.001)*****	**0.006(0.001)*****
$Firm\_size_{i,t-1}$	0.337(0.013)***	0.337(0.013)***	0.336(0.013)***
$ROA_{i,t-1}$	4.097(0.521)***	4.281(0.516)***	4.136(0.534)***
$Intangible\_assets_{i,t-1}$	-0.493(0.049)***	-0.490(0.049)***	-0.491(0.049)***
$Financial\_leverage_{i,t-1}$	-0.181(0.038)***	-0.179(0.038)***	-0.161(0.039)***
$Beta_{i,t-1}$	-0.149(0.020)***	-0.146(0.020)***	-0.147(0.020)***
$Momentum_{i,t-1}$	0.076(0.023)***	0.080(0.022)***	0.097(0.022)***
$Volatility_{i,t-1}$	15.137(2.160)***	14.785(2.175)***	14.276(2.183)***
Intercept	-2.993(0.136)***	-2.994(0.135)***	-2.977(0.136)***
Industry FE	YES	YES	YES
Month FE	YES	YES	YES
Cluster SE	*Industry-Month*	*Industry-Month*	*Industry-Month*
Obs.	26,281	25,819	25,369
R^2	0.4020	0.4027	0.4023

Notes. Robust standard errors clustered at industry-month level are reported in parentheses; *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.005$.

Table A4. Relationship Between ESG and *Social Media Sentiment* for Different Time Windows

Variable	Model 1 (*t+1*)	Model 2 (*t+2*)	Model 3 (*t+3*)
$ESG_{i,t-1}$	-0.001(0.001)	-0.001(0.001)	-0.001(0.001)
$Firm\_size_{i,t-1}$	-0.066(0.006)***	-0.066(0.006)***	-0.064(0.006)***
$ROA_{i,t-1}$	0.931(0.266)***	1.073(0.263)***	1.365(0.271)***
$Intangible\_assets_{i,t-1}$	0.232(0.037)***	0.227(0.037)***	0.232(0.037)***
$Financial\_leverage_{i,t-1}$	-0.078(0.033)*	-0.081(0.034)*	-0.088(0.035)*
$Beta_{i,t-1}$	0.041(0.017)*	0.033(0.017)	0.031(0.017)
$Momentum_{i,t-1}$	0.196(0.020)***	0.163(0.020)***	0.137(0.020)***
$Volatility_{i,t-1}$	-19.595(1.338)***	-18.572(1.399)***	-16.870(1.410)***
Intercept	-0.922(0.088)***	-0.928(0.091)***	-0.976(0.092)***
Industry FE	YES	YES	YES

Month FE	YES	YES	YES
Cluster SE	*Industry-Month*	*Industry-Month*	*Industry-Month*
Obs.	13,868	13,649	13,429
R^2	0.1213	0.1188	0.1151

Notes. Robust standard errors clustered at industry-month level are reported in parentheses; *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.005$; To make ESG's coefficients more interpretable, the dependent variable is magnified 100 times.

Table A5. Relationship Between ESG and *Social Media Sentiment* (Filling Missing Values)

Variable	Filling Method 1	Filling Method 2	Filling Method 3
$ESG_{i,t-1}$	-0.0001(0.0004)	-0.0003(0.0004)	-0.0009(0.0006)
$Firm\_size_{i,t-1}$	-0.032(0.004)***	-0.028(0.004)***	-0.051(0.005)***
$ROA_{i,t-1}$	0.394(0.141)**	0.526(0.147)***	0.408(0.191)*
$Intangible\_assets_{i,t-1}$	0.084(0.018)***	0.103(0.018)***	0.166(0.026)***
$Financial\_leverage_{i,t-1}$	-0.094(0.016)***	-0.079(0.016)***	-0.087(0.018)***
$Beta_{i,t-1}$	0.033(0.010)***	0.021(0.009)*	0.031(0.013)*
$Momentum_{i,t-1}$	0.158(0.012)***	0.124(0.012)***	0.135(0.012)***
$Volatility_{i,t-1}$	-12.959(0.878)***	-10.180(0.856)***	-15.331(0.885)***
Intercept	-1.251(0.054)***	-1.291(0.054)***	-1.042(0.059)***
Industry FE	YES	YES	YES
Month FE	YES	YES	YES
Cluster SE	*Industry-Month*	*Industry-Month*	*Industry-Month*
Obs.	26,281	26,281	26,281
R^2	0.0783	0.0668	0.1316

Notes. Robust standard errors clustered at industry-month level are reported in parentheses; *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.005$; To make ESG's coefficient more interpretable, sentiment is magnified 100 times.

Appendix V. Tree Diagrams for Drivers of ESG Upgrades/Downgrades

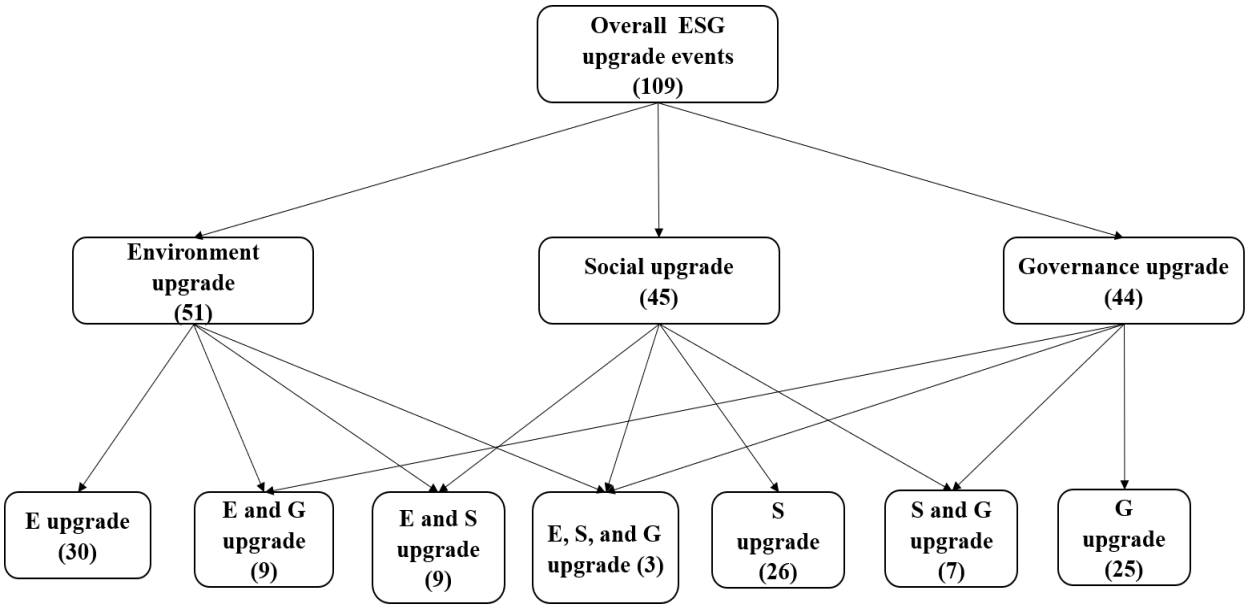

Figure A1. Tree Diagrams for Drivers of ESG Upgrades

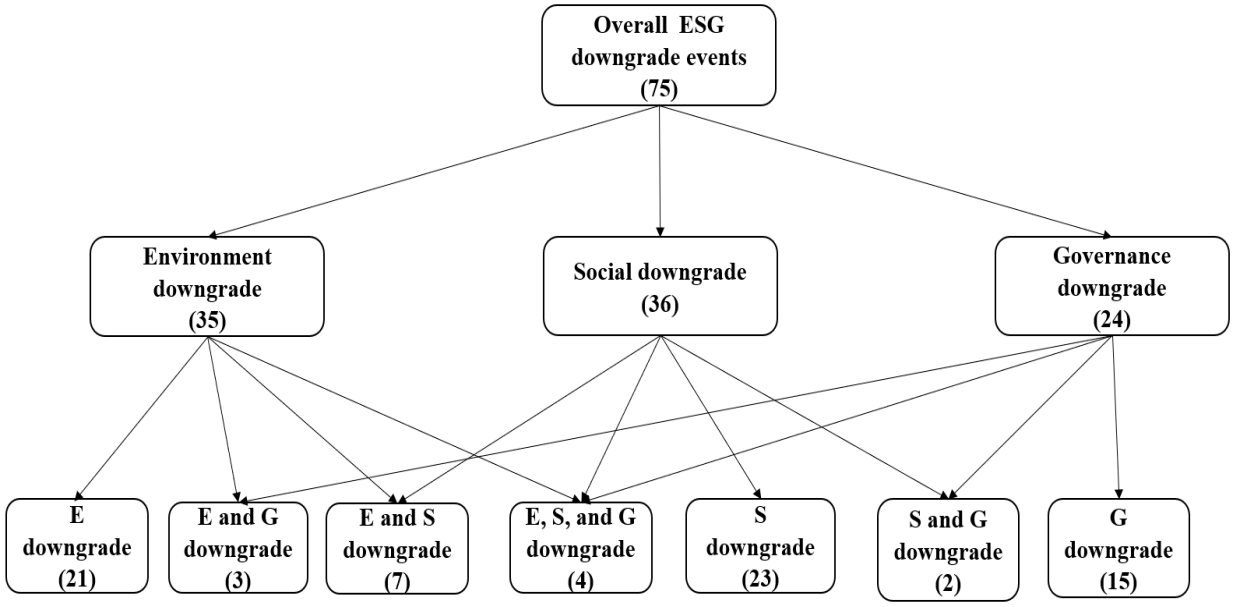

Figure A2. Tree Diagrams for Drivers of ESG Downgrades

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