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Short-Term Market Responses to ESG Signals: Evidence from U.S. Firms With Prior Venture Capital Investments

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Abstract - EN

This thesis investigates how financial markets respond to changes in Environmental, Social, and Governance (ESG) ratings among U.S. publicly listed firms that received venture investments during their early stages. Using an event study approach, it analyzes short-term abnormal returns (CARs), post-event return volatility, and the role of firm-specific financial characteristics in shaping market reactions. ESG updates, both overall and by subcomponent, are treated as discrete informational events, with expected returns estimated using the Capital Asset Pricing Model (CAPM) and the Fama–French 5-Factor Model (FF5). The results reveal that social score improvements consistently generate positive and statistically significant CARs over 1 and 3 days windows, suggesting that markets quickly and selectively incorporate ESG information, particularly when it relates to social practices. Changes in environmental and governance scores, by contrast, elicit weaker or insignificant responses. Volatility regressions indicate that ESG improvements, especially in the social and governance dimensions, are associated with modest reductions in post-event return variability, implying updates may also affect perceptions of firm-specific risk. Finally, cross-sectional regressions show that abnormal returns are systematically related to firm-level fundamentals such as size and sales growth. Together, these findings underscore the short-term informational value of ESG ratings, especially their social component, in the context of dynamic, innovation-driven firms. The study contributes to ESG and market efficiency literature by showing that certain ESG signals are not only observed but financially priced by investors.

Keywords: ESG Score, Event study, Cumulative Abnormal Returns, Volatility, Venture Capital, Short term market reaction

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Abstract - PT

Esta tese investiga como os mercados financeiros reagem a mudanças nos ratings de Meio Ambiente, Social e Governança (ESG) em empresas norte-americanas de capital aberto que receberam investimentos de risco em fases iniciais. Utilizando a metodologia de estudo de eventos, analisa retornos anormais de curto prazo (CARs), a volatilidade após os eventos e o papel de características financeiras específicas das firmas na formação das reações de mercado. As atualizações de ESG, tanto no agregado quanto por subcomponentes, são tratadas como eventos informacionais discretos, com retornos esperados estimados pelo Capital Asset Pricing Model (CAPM) e pelo modelo de cinco fatores de Fama–French (FF5). Os resultados mostram que melhorias na pontuação social geram consistentemente CARs positivos e estatisticamente significativos em janelas de 1 e 3 dias, sugerindo que os mercados incorporam de forma rápida e seletiva informações de ESG, sobretudo quando relacionadas a práticas sociais, enquanto alterações em meio ambiente e governança produzem respostas mais fracas ou insignificantes. Regressões de volatilidade indicam que melhorias em ESG, especialmente em social e governança, estão associadas a pequenas reduções na variabilidade dos retornos, sugerindo impacto também na percepção de risco específico. Por fim, regressões em corte transversal evidenciam que retornos anormais se relacionam sistematicamente a fundamentos como tamanho e crescimento de vendas. Em conjunto, os achados ressaltam o valor informacional de curto prazo dos ratings ESG, sobretudo do componente social, contribuindo para a literatura de ESG e eficiência de mercado.

Palavras-chave: Pontuação ESG, Estudo de Evento, Retornos Anormais Acumulados, Volatilidade, Capital de Risco, Reação de Mercado de Curto Prazo

Título: Reações de Curto Prazo do Mercado a Sinais ESG: Evidências de Empresas Americanas com Investimentos Prévio de Capital de Risco

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Table of Contents

1. Introduction.....

2. Theoretical Framework & Literature Review.....

2.1 ESG and Financial Performance

2.2 ESG Events and Market Reactions

2.3 Firm Characteristics and ESG Interpretation

3. Data and Methodology.....

3.1 Sample and data

3.2 Variables

3.3 Models

4. Results.....

4.1 ESG Score Changes and Cumulative Abnormal Returns

4.2 ESG Score Changes and Post-Event Volatility

4.3 Firm Characteristics

5. Discussion.....

6. Robustness Checks.....

7. Conclusion.....

8. References.....

9. Appendix.....

1.0 Introduction

The growing integration of environmental, social, and governance (ESG) considerations into investment practices has transformed how financial markets assess corporate performance and allocate capital. This shift is driven by a combination of regulatory developments, institutional mandates, and increasing public pressure, which have elevated ESG from a marginal topic to a central feature of financial decision-making (Krueger, Sautner, and Starks, 2020; Amel-Zadeh and Serafeim, 2018). ESG ratings, designed to measure companies' sustainability across multiple dimensions, are now widely used by asset managers, pension funds, and analysts aiming to align portfolios with long-term value creation and risk management objectives (Eccles, Ioannou, and Serafeim, 2014; Berg, Kölbel, and Rigobon, 2022).

These ratings influence capital flows, guide corporate disclosures, and serve as tools for evaluating non-financial performance. Yet, despite their growing prominence, the way financial markets respond to ESG rating updates remains a matter of debate. Some investors interpret score changes as indicators of operational improvement, strategic alignment, or reduced exposure to non-traditional risks (Grewal, Hauptmann, and Serafeim, 2021). Others express concern about the inconsistency of scores across providers, the opacity of scoring methodologies, and the potential for superficial signaling practices, such as greenwashing (Christensen, Serafeim, and Sikochi, 2022; Berg et al., 2022).

Much of the existing literature has examined the long-term relationship between ESG and financial performance (Friede, Busch, and Bassen, 2015; Derwall et al., 2005; Manrique and Martí-Ballester, 2017), yet fewer studies have addressed the short-term financial consequences of score changes. Moreover, event studies in this area tend to focus on large, mature corporations with well-established reporting practices and predictable investor bases (Capelle-Blancard and Petit, 2019), offering limited insight into how ESG information is received in less traditional or more dynamic corporate contexts.

This thesis seeks to address that gap by focusing on a distinct group of firms: publicly listed companies in the United States that have received early-stage venture capital investment. These firms, often concentrated in innovation-intensive sectors, are playing an increasingly visible role in capital markets but are underrepresented in ESG research (Alighanbari, Krüger, and Matos, 2025). Compared to more established companies, they typically have faster growth, shorter operational histories, and more variable governance structures shaped by founders and venture

investors (Lerner et al., 2011; Chemmanur et al., 2014). These features may shape how investors interpret sustainability-related information and adjust expectations in response.

This context leads to the central research question: *How do financial markets react to ESG score changes in publicly traded firms that previously received venture capital investments, and to what extent are these responses influenced by company characteristics and the nature of the ESG signal?*

To address this question, the thesis applies an event study methodology (MacKinlay, 1997) to identify abnormal price movements around ESG rating changes. These events are treated as discrete signals of new information, and expected returns are estimated using both the Capital Asset Pricing Model (CAPM) and the Fama and French five-factor model. The use of multiple models and event windows from one to ten days allows for a robust examination of short-term market dynamics.

To provide a more detailed understanding, the ESG score is further disaggregated into its environmental, social, and governance components. This allows the study to test whether particular dimensions carry more informational value, consistent with the evidence presented by Velte (2017) and Lins, Servaes, and Tamayo (2017), who emphasize that the market relevance of ESG varies depending on context and disclosure content.

This thesis contributes to the ESG and financial markets literature in several important ways. First, it centers on a segment of companies that has received limited attention in prior research: publicly listed firms that have received early venture capital investment. These companies typically operate in high-growth, high-uncertainty environments, with short operating histories and evolving governance structures, making them a compelling context in which to study the market interpretation of ESG information (Alighanbari, Krüger, and Matos, 2025; Lerner et al., 2011). Second, the study combines return-based and risk-based metrics by analyzing cumulative abnormal returns alongside changes in return volatility after ESG score updates. This approach captures not only how ESG events affect firm valuation but also how they influence investor perception of risk, as discussed in Tweneboah-Koduah et al. (2021) and Auer, Poyser, and Balasubramanyan (2022). Third, the analysis distinguishes between the environmental, social, and

governance pillars of ESG, examining whether certain dimensions generate stronger market reactions. This reflects the view that ESG components differ in their financial relevance, as shown in studies by Velte (2017) and Lins, Servaes, and Tamayo (2017). Finally, the thesis explores how characteristics such as firm size, profitability, leverage, and growth influence the impact of ESG disclosures. This is consistent with the evidence presented by Khan, Serafeim, and Yoon (2016) and Cooper, Gulen, and Schill (2008), who argue that investor responses to ESG information depend on the financial and structural profile of the firm.

The structure of the thesis follows a clear and logical progression. It begins with a review of the existing literature, which frames the current debate and highlights relevant gaps. This is followed by a detailed description of the methodology, including the data sources and empirical design. The core findings are then presented through the results section. Finally, the discussion interprets these findings in light of the literature, offering comparisons with previous studies and outlining their broader implications.

2.0 Theoretical Framework & Literature Review

The integration of environmental, social, and governance considerations into financial analysis can be situated within two foundational perspectives: agency theory and stakeholder theory. From an agency theory perspective, ESG practices can serve as mechanisms that align managerial behavior with shareholder interests, particularly when transparency and oversight are enhanced (Jensen & Meckling, 1976; Krueger, Sautner, & Starks, 2020). Firms with strong ESG profiles are often viewed as less prone to agency conflicts, thereby reducing risk and lowering the cost of capital (El Ghoul et al., 2011).

Alternatively, stakeholder theory expands the responsibility of the firm beyond shareholders to include broader societal actors such as employees, regulators, and local communities (Freeman, 1984). Under this view, ESG performance reflects a firm's capacity to manage long-term relationships and legitimacy, which are crucial for sustainable value creation (Eccles, Ioannou, & Serafeim, 2014). The materiality of ESG factors is increasingly recognized in mainstream finance, supported by the rise of sustainable investing and regulatory initiatives promoting transparency (Kotsantonis & Serafeim, 2019).

Recent research has also emphasized the signaling role of ESG ratings. High ESG scores may act as credible signals of risk management, reputational strength, or strategic orientation, particularly

when such information is otherwise opaque (Grewal, Hauptmann, & Serafeim, 2021). However, the informativeness of these ratings depends on methodological consistency and perceived credibility of the rating provider (Christensen, Serafeim, & Sikochi, 2022). In volatile or low-transparency environments, such as those involving young or fast-growing firms, these signals may be interpreted differently, thereby warranting targeted empirical scrutiny.

2.2 ESG and Financial Performance

The growing use of ESG scores has transformed how markets assess corporate performance. These metrics guide institutional capital flows, influence corporate communication, and shape regulatory agendas. ESG used to be viewed primarily as an ethical or reputational concern, but is now widely accepted as a financially material factor. Empirical studies suggest that ESG performance is positively related to financial outcomes. Friede, Busch, and Bassen (2015) conduct a meta-analysis of over 2,000 studies and find that most report positive or neutral relationships between ESG and firm performance. Derwall et al. (2005) and Manrique and Martí-Ballester (2017) find that environmental leadership and eco-efficiency are linked to improved valuations.

However, the materiality of ESG is not uniform across its three pillars. Velte (2017) finds that governance indicators, such as board independence and shareholder rights, have stronger links to profitability. Lins, Servaes, and Tamayo (2017) show that firms with high social capital performed better during the 2008 crisis, suggesting a buffering effect during systemic shocks.

Most of this research focuses on large, mature firms in stable sectors. Less is known about venture-backed firms that operate in more uncertain environments. These firms are increasingly relevant in public markets and innovation ecosystems but are underrepresented in ESG research (Alighanbari et al., 2025). Their rapid growth, concentrated ownership, and evolving governance practices may affect how markets interpret ESG signals. This study addresses this gap by focusing on ESG score updates in public firms that received early-stage venture investment.

Hypothesis 1: Changes in ESG scores and their individual components are associated with significant short-term abnormal stock returns.

2.4 ESG Events and Market Reactions

To assess the impact of ESG disclosures, many researchers use event study methodology. This technique isolates the effect of a discrete event on stock prices by measuring deviations from expected returns. It is particularly suited to ESG disclosures, which often involve non-financial and episodic updates (MacKinlay, 1997).

Klassen and McLaughlin (1996) show that environmental awards yield positive abnormal returns, while controversies result in losses. Capelle-Blancard and Petit (2019) find that governance scandals or ethical issues generate negative reactions, especially with high media visibility. However, Maccarrone, Illuzzi, and Inguanta (2024) find muted reactions in a large sample of ESG rating changes, suggesting that not all updates are deemed material. Signal credibility is crucial: Grewal, Hauptmann, and Serafeim (2021) find stronger market responses when ratings are issued by reputable agencies.

This study uses ESG data from a single, transparent provider to mitigate concerns around rating divergence. In addition to abnormal returns, volatility is analyzed as a measure of investor uncertainty. Tweneboah-Koduah et al. (2021) report that credible ESG upgrades reduce return volatility, while negative or unclear signals increase it. Auer, Poyser, and Balasubramanyan (2022) find that firms with strong ESG records recover faster from controversies, indicating a reputational buffer.

Hypothesis 2: ESG and subcomponent score changes are associated with reductions in short-term return volatility.

2.4 Firm Characteristics and ESG Interpretation

A third line of research investigates how market responses to ESG signals are shaped by company characteristics. ESG effects are often conditional on firm size, growth, and financial structure. Khan, Serafeim, and Yoon (2016) show that ESG performance matters more when aligned with sector-specific materiality. Larger firms may enjoy more predictable investor reactions due to better disclosure practices, whereas smaller or younger firms may elicit stronger responses due to greater information asymmetry.

Cooper, Gulen, and Schill (2008) document that firms with high asset growth often underperform, potentially due to overoptimistic investor expectations. This is especially relevant in the context

of venture-backed firms, which tend to have high growth but limited operating history. Sales growth, return on assets, and market capitalization have all been found to moderate ESG effects. To reduce noise from inconsistent ESG ratings, this study relies on a single, methodologically consistent data source (Berg et al., 2022; Christensen, Serafeim, & Sikochi, 2022).

Hypothesis 3: Company characteristics can influence the market reaction when positive ESG score changes happens.

3.0 Methodology

3.1 Sample and data

The empirical analysis draws on a sample of 158 publicly listed companies headquartered in the United States that have received initial venture capital investment. These firms were identified using the Private Equity Screener tool available in Refinitiv Eikon, which provides detailed ownership and investment data on private equity and venture-backed companies. The time frame of observation spans from 2010 to 2025, a period that encompasses both the post-financial crisis expansion and the maturation of ESG reporting practices, thereby enabling an analysis of evolving investor sensitivity to sustainability-related information (Eccles et al., 2012; Amel-Zadeh and Serafeim, 2018). ESG data were obtained from Refinitiv Datastream through the Eikon Excel Add-In. This data source has been widely used in prior ESG researches (Berg et al., 2022; Lopez de Silanes et al., 2023). Stock return data were collected from CRSP, a standard reference for historical equity pricing used in empirical asset pricing studies (Fama and French, 1992). Market returns were proxied using daily returns from the S&P 500 index, retrieved via Compustat, in line with established practices in event study methodology (MacKinlay, 1997). Event observations were constructed based on any discrete change, either positive or negative, in ESG scores.

3.2 Variables

3.2.1. Dependent variables

Cumulative Abnormal Returns.

The main outcome variable is cumulative abnormal returns, which measure the aggregated deviation of a stock's realized return from its expected return around an event window. CARs are

widely used in event studies to capture the short-term market reaction to firm's disclosures (MacKinlay, 1997). Following prior ESG finance literature, CARs are constructed over multiple horizons to account for both immediate and delayed investor responses (Capelle-Blancard & Petit, 2019).

Volatility change.

The second dependent variable captures changes in return volatility following ESG updates. Volatility is measured as the standard deviation of daily returns in post-event windows, adjusted against pre-event benchmarks. This approach reflects market perceptions of specific risk, as also employed by Tweneboah-Koduah and Baidoo (2021), who document that credible ESG disclosures can reduce uncertainty and improve investor confidence.

3.2.2. Independent variables

Δ ESG Score.

The central explanatory variable measures the change in the overall ESG score assigned by Refinitiv, capturing revisions in a firm's sustainability assessment. Similar to Grewal, Hauptmann, and Serafeim (2021), changes are treated as discrete informational events, with both positive and negative updates incorporated.

Δ E Score, Δ S Score, Δ G Score.

To disentangle the effects of ESG pillars, score changes are analyzed separately for the environmental, social, and governance dimensions. This disaggregation follows the approach of Khan, Serafeim, and Yoon (2016), who highlight that only financially material ESG factors are priced by markets. The three pillars allow testing whether investors assign different weights to environmental, social, and governance improvements.

Log(Market Capitalization).

Firm size is proxied by the natural logarithm of market capitalization, a standard measure used to capture differences in firm visibility, investor base, and information asymmetry. Larger firms may exhibit more muted market responses to ESG updates due to more diversified operations and broader institutional coverage. This variable has been employed in similar ESG-related event studies (e.g., Grewal, Riedl, & Serafeim, 2021; Albuquerque, Koskinen, & Zhang, 2019). In the present study, log(Market Capitalization) is also included as a control variable in the first two

regression models, following the approach of Lins, Servaes, and Tamayo (2017), who similarly adjust for firm size when assessing ESG-performance dynamics.

Leverage.

Leverage, measured as total debt over total assets, reflects the firm's financial structure and exposure to default risk. Higher leverage may exacerbate investor sensitivity to ESG updates due to perceived constraints on managerial flexibility or financial sustainability. Prior literature highlights the relevance of leverage in shaping market reactions to firm disclosures (e.g., Bauer, Ruof, & Smeets, 2021; Krüger, 2015). Consistent with this literature, leverage is employed as an independent variable in the firm characteristics regressions and also used as a control variable in the first two models of this study.

Asset Growth.

Asset growth, measured as the annual change in total assets, serves as a proxy for expansion and investment intensity. Cooper, Gulen, and Schill (2008) demonstrate that firms with high asset growth often underperform, as investors tend to overreact to past growth trends.

Sales Growth.

Sales growth is measured as the year-on-year percentage change in revenues. It reflects the firm's capacity to expand its operations and is often used as a proxy for market demand. Consistent with Loughran and Ritter (1997), strong sales growth may amplify investor reactions to ESG events in high-growth contexts.

Return on Assets.

ROA is calculated as net income over total assets and is included as a measure of profitability and operational efficiency. Prior research shows that profitability moderates the valuation impact of ESG performance, since stronger firms are perceived as more capable of sustaining responsible practices (Velte, 2017).

Polluting Industry dummy.

A binary variable equal to one if the firm operates in an environmentally sensitive sector, following Griffin, Lont, and Sun (2017), who show that ESG signals from such firms attract greater investor scrutiny. Firms in *Industrials* and *Consumer Cyclicals* are classified as polluting due to their exposure to emission-intensive activities. All others are considered non-polluting based on lower direct environmental impact.

3.2.3. Control variables

Past 12-month Excess Return.

This variable measures stock performance relative to the market over the prior year, included to account for momentum effects. Jegadeesh and Titman (1993) document that past returns strongly influence short-term investor expectations, making this a relevant control in event studies.

Market-to-Book Ratio.

The M/B ratio, defined as market value of equity over book value, captures firm growth opportunities and valuation premia. It is a standard proxy in asset pricing and corporate finance, with Fama and French (1992) showing its predictive power for cross-sectional returns.

Industry Dummy.

Included to control for unobserved sector-specific influences on stock returns and risk dynamics. Recent empirical work increasingly uses industry fixed effects to account for heterogeneity in panel data regressions.

Company Age.

Company age, measured as years since founding, proxies for organizational maturity and legitimacy. Chemmanur, Krishnan, and Nandy (2011) show that younger firms face higher information asymmetries, making investor reactions to signals more pronounced.

R&D Expenses.

Research and development expenditures, scaled by total assets, serve as a proxy for innovation intensity. Hall, Jaffe, and Trajtenberg (2005) emphasize the role of R&D in shaping growth expectations, which can interact with the interpretation of ESG disclosures.

Table 1
Panel A: summary statistics

Variable	T	N	Mean	STD	10th	25th	50th	75th	90th
Δ ESG Score	434	434	1.63	7.94	-5.79	-2.25	1.21	5.32	10.37
Δ E Score	434	96	0.99	8.57	-0.29	0.00	0.00	0.00	6.41
Δ S Score	434	429	1.40	10.66	-4.82	-3.06	-0.95	4.14	14.12
Δ G Score	434	434	2.31	13.65	-13.72	-4.28	2.20	9.81	18.50
log(MktCap)	434	420	2.79	0.72	2.05	2.43	2.86	3.22	3.59
Past 12 mth exret	434	434	0.01	0.45	-0.49	-0.19	0.01	0.15	0.54
Asset Growth	434	426	5.17	60.40	-0.23	0.00	0.12	0.37	1.89
Sales Growth	434	407	5.63	53.32	-0.04	0.00	0.00	0.00	0.52
Return on Asset	434	434	-0.34	0.34	-0.70	-0.46	-0.46	-0.14	0.00
Leverage	434	434	1.00	28.77	0.00	0.01	0.01	0.26	1.08
Polluting industry	434	434	0.38	0.38	0.00	0.00	0.00	1.00	1.00
Market-to-Book ratio	434	420	1.21	2.45	0.12	0.41	0.89	1.53	2.14
Company age	434	434	12.33	6.89	4.00	7.00	11.00	16.00	24.00
R&D expenses	434	408	0.44	1.33	0.00	0.27	0.4	0.53	0.65

Panel B: correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Δ ESG Score	1.00	0.59***	0.71***	0.73***	0.06	-0.01	0.04	0.03	0.06	0.06	0.08	0.07	-0.10	0.21**
(2) Δ E Score		1.00	0.46***	0.12**	-0.01	0.03	0.06	0.01	0.08*	-0.08	0.00	0.06	0.01	0.25*
(3) Δ S Score			1.00	0.12**	-0.03	-0.00	-0.01	-0.01	0.00	0.10	-0.06*	0.05	-0.07	0.14*
(4) Δ G Score				1.00	0.11**	-0.02	0.04	0.04	0.07*	0.07	0.02	0.07*	0.13	0.15*
(5) Asset growth					1.00	-0.00	0.03	-0.00	0.04	-0.05*	-0.04	-0.10	-0.01	-0.09
(6) Sales growth						1.00	-0.01	-0.60***	-0.04	-0.02	0.09	-0.08	0.05	0.08
(7) ROA							1.00	0.01	0.41***	-0.02	-0.01	0.05*	-0.04	-0.03
(8) Leverage								1.00	0.01	-0.04	0.04*	0.08	-0.07*	0.08
(9) log(MKCap)									1.00	0.03	0.12	0.12	0.07	-0.07
(10) Polluting industry										1.00	-0.08	0.03*	0.11*	0.06
(11) Past 12 mth exret											1.00	0.05	-0.11	-0.02
(12) M/B												1.00	0.06	0.08
(13) Company age													1.00	0.18*
(14) R&D expenses														1.00

Notes: This table reports summary statistics (Panel A) and average cross-sectional correlations (Panel B).
Robust standard errors used. ∗p < 0.10, ∗∗p < 0.05, ∗∗∗p < 0.01

To support the empirical design and describe the sample, I present summary statistics and a correlation matrix in Table 1. Panel A reports descriptive statistics for all variables, including the number of observations, means, standard deviations, and selected percentiles.

Panel B shows the correlation matrix. It illustrates the degree of association between the explanatory and control variables. These descriptive results help set the stage for the regression analysis by showing how the main variables are distributed and interrelated.

3.3 Models

I use these market data to estimate expected returns under two asset pricing models: the Capital Asset Pricing Model and the Fama French Five-Factor Model. CAPM provides a baseline that accounts for market risk. The Fama French model adds factors related to size, value, profitability, and investment. These additional factors are especially important for capturing return patterns in firms that are small, heterogeneous, or experiencing rapid growth.

By applying both models, the analysis ensures that the estimated abnormal returns are not tied to a single framework. This approach improves robustness by showing that the results hold across different ways of modeling expected returns.

The expected return $E[R_{it}]$ for firm i on day t, under each model, is defined as follows:

(1) CAPM: $E[R_{it}] = \alpha_i + \beta_i(R_{mt} - R_{ft})$

(2) $FF5$: $E[R_{it}] = \alpha_i + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + R_f$

Where R_{mt} represents the market return on day t, and R_{ft} denotes the risk-free rate. The terms α_i and β_i are firm specific parameters estimated over an appropriate estimation window. The model also includes several Fama-French five-factor variables: SMB_t (Small Minus Big) captures the size premium, HML_t (High Minus Low) accounts for the value premium, RMW_t (Robust Minus Weak) reflects the profitability factor, and CMA_t (Conservative Minus Aggressive) represents the investment factor. The coefficients $\beta_{1,2,3,4,5}$ measure the sensitivities of the firm's returns to each of these corresponding factors.

In line with established practice (Maccarrone, Illuzzi, & Inguanta, 2024), the estimation window spans 30 trading days immediately prior to the focal event (i.e., from day −30 to day −1). This

window balances the need for stable coefficient estimation while avoiding contamination from the event itself. For each event, abnormal returns (ARs) were computed as the difference between actual and expected returns:

$$(3) \quad AR_{it} = R_{it} - E[R_{it}]$$

These ARs were then aggregated across various post-event windows to compute cumulative abnormal returns (CARs). Specifically, the study constructs four CAR measures:$CAR_{1d}, CAR_{3d}, CAR_{5d}, CAR_{10d}$, corresponding to the cumulative abnormal return over 1, 3, 5, and 10 trading days following the event date.

Cumulative Abnormal Return (CAR):

$$(4) \quad CAR_{i,[t_0,t_1]} = \sum_{t=t_0}^{t_1} AR_{it}$$

This approach captures both immediate and delayed market reactions.

Regression Design

To analyze the impact of ESG changes on abnormal returns, I performed a set of regressions with CAR as dependent variables:

$$(5) \quad CAR_{i,[t_0,t_1]} = \beta_0 + \beta_1 \Delta ESG_i + \beta_2 \Delta E_i + \beta_3 \Delta S_i + \beta_4 \Delta G_i + \beta_5 Leverage_i + \beta_6 PastYearExret_i + \beta_7 \log(Mkt.Cap)_i + \beta_8 M/B_i + \beta_9 CompanyAge_i + \beta_{10} R\&D_i + \gamma_{industry} + \varepsilon_i$$

Where ΔESG_i represents the change in the firm's overall ESG score at the focal date, $\Delta E_i/\Delta S_i/\Delta G_i$ represents the change in the firm's subcomponents scores. The regression controls for a range of firm attributes that may influence investor responses to ESG news. These include Leverage, firm size (log(Market Cap)), Past 12-month excess return, M/B ratio, Company Age, R&D expenses, and Industry dummy. By accounting for these characteristics, the model aims to isolate the effect of ESG updates from other known drivers of abnormal returns. In the model, the estimated coefficient β_1 reflects the market sensitivity to changes in the respective ESG dimension.

The second regression framework examines how changes in ESG scores affect post-event return volatility, providing insight into whether sustainability updates alter perceived risk at the firm level. For each observation, volatility is computed as the standard deviation of daily returns over

several non-overlapping post-event windows: 3, 5, 10, 15, and 20 trading days. The baseline volatility for comparison is measured over the 30 trading days preceding the event. To more directly isolate the change in risk perception, the study estimates a difference-in-volatility model, where the dependent variable is the delta in volatility before and after the ESG update:

$$(6)\quad \Delta\sigma_i = \sigma_{i,post} - \sigma_{i,pre}$$
$$= \beta_0 + \beta_1 \Delta ESG_i + \beta_2 \Delta E_i + \beta_3 \Delta S_i + \beta_4 \Delta G_i + \beta_5 Leverage_i$$
$$+ \beta_6 PastYearExret_i + \beta_7 \log(Mkt.Cap)_i + \beta_8\, M/B_i + \beta_9 CompanyAge_i$$
$$+ \beta_{10} R\&D_i + \gamma_{industry} + \varepsilon_i$$

This regression utilizes the same set of control variables of the first one.

The third and final regression in this study investigates whether firm characteristics can explain variations in cumulative abnormal returns following ESG score update. The full dataset utilized is composed by 434 total observations, of which 258 are upgrades. So, this will be the number of observations for this last regression. While the first regression focuses on the average effect of ESG changes on stock prices, this second-stage model seeks to understand which types of firms are more sensitive to such news. The regression takes the following linear form:

$$(7)\quad CAR_i = \alpha_i + \beta_1 ROA_i + \beta_2 AssetGrowth_i + \beta_3 SalesGrowth_i + \beta_4 \log(Mkt.Cap)_i$$
$$+ \beta_5 Leverage_i + \beta_6 PollutingIndustry_i + \varepsilon_i$$

Here, CAR_i denotes the cumulative abnormal return for firm i over a specified post event window. The explanatory variables include accounting-based and market-based indicators observed in the fiscal year prior to the ESG score change. Specifically, ROA_i, proxies for profitability, $AssetGrowth_i$ and $SalesGrowth_i$ measure recent expansion in firm size and operations, and $\log(Mkt.Cap)_i$ accounts for firm size in a way that normalizes scale effects. $Leverage_i$ captures financial risk, while $PollutingIndustry_i$ is a dummy variable equal to one if the firm belongs to an industry typically associated with high environmental externalities, and zero otherwise. Together, the three regression frameworks employed in this study provide a multifaceted approach to understanding the short-term financial relevance of ESG rating changes in venture-backed firms. The first regression captures the direct effect of ESG updates on cumulative abnormal returns, while the second examines whether these updates influence post event return volatility, offering

insights into changes in investor uncertainty. The third regression shifts the focus to firm-level characteristics, investigating which types of companies are more likely to experience stronger market reactions to ESG news.

4.0 Results

This chapter presents the empirical results on how financial markets respond to changes in ESG scores among U.S.-based firms that have received venture capital seed investments. The analysis is structured into three main sections: (1) the relationship between ESG score changes and abnormal returns, (2) the impact of ESG changes on return volatility, and (3) the role of firm characteristics in shaping the magnitude of these effects in case of ESG score upgrade. All results are estimated under both the CAPM and FF5 models to ensure robustness across asset pricing assumptions.

4.1 ESG Score Changes and Cumulative Abnormal Returns

The first set of results examines how stock prices react to changes in ESG scores, both at the aggregate and pillar level. Table 2 reports CAR regressions estimated over 1, 3, 5, and 10 days windows. Panel A displays results under CAPM, while Panel B presents the FF5 specification.

Table 2 - Effect of ESG Component Changes on CARs

	CAPM				FF5			
	1 Day	3 Days	5 Days	10 Days	1 Day	3 Days	5 Days	10 Days
ΔESG	0.00270**	0.00214	-0.00113*	0.00060	0.00210**	0.00188	-0.00101*	0.00049
	(2.49)	(0.99)	(-1.73)	(0.29)	(2.31)	(1.55)	(-1.69)	(0.42)
ΔE	0.00085	0.00076	-0.00009	-0.00286	0.00082	0.00067	-0.00014	-0.00278
	(0.71)	(0.33)	(-0.05)	(1.01)	(0.69)	(0.29)	(-0.07)	(0.98)
ΔS	0.00246***	0.00380***	-0.00087	0.00046	0.00241***	0.00352***	-0.00075	0.00051
	(3.51)	(2.76)	(-1.27)	(0.23)	(3.43)	(2.93)	(1.31)	(0.39)
ΔG	0.00051	-0.00065	-0.00073	-0.00035	0.00049	-0.00060	-0.00068	-0.00032
	(0.84)	(-0.56)	(-1.62)	(-0.25)	(0.81)	(-0.50)	(-1.59)	(-0.21)
Leverage	-0.00002	-0.0002	-0.0004	0.0001	-0.0001	-0.0002	-0.0002	0.0002
	(-0.98)	(-0.78)	(-0.89)	(0.88)	(-0.64)	(-0.68)	(-0.67)	(0.78)
log(Market Cap)	-0.0007	-0.0003*	-0.00042***	-0.00016**	0.00074	0.00063*	0.00026***	0.0008**
	(-0.31)	(-1.78)	(-2.99)	(-2.39)	(-0.35)	(-1.79)	(-3.14)	(-2.38)
PastYearExret	0.0042	0.0032	-0.0011	0.0056	0.0043	0.0041	0.-0013	0.0054
	(0.61)	(0.45)	(-0.09)	(1.01)	(0.66)	(0.27)	(-0.07)	(0.92)
M/B	0.0006	-0.0035	-0.0038*	-0.0036	0.0004	0.0032	0.0041*	-0.0039
	(0.78)	(-0.66)	(-1.66)	(-0.25)	(0.80)	(-0.71)	(-1.68)	(-0.28)
CompanyAge	0.0015	-0.0072	-0.0044	-0.0058**	0.0011	-0.0077	-0.0032	-0.0049**
	(0.41)	(-0.96)	(-1.62)	(-2.25)	(0.44)	(-0.87)	(-1.55)	(-2.21)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports OLS estimates of cumulative abnormal returns (CAR) over 1, 3, 5, and 10 days post ESG score changes. T-statistics are shown in parentheses. Robust standard errors used.
$*p < 0.10$, $**p < 0.05$, $***p < 0.01$

In both models, the coefficient on the overall ESG score change is positive and statistically significant in the 1 day window. Under CAPM, a one-point increase in ESG score leads to a 0.27% increase in abnormal return (coefficient = 0.00270, t = 2.49). The FF5 model yields a slightly lower but still significant coefficient of 0.00210 (t = 2.31), implying that markets quickly absorb ESG related information into stock prices. However, this effect fades across longer windows, with the 3, 5, and 10 days estimates losing statistical significance, indicating that the market reaction is swift and largely concentrated in the immediate aftermath of the update.

Breaking down the ESG score into its subcomponents reveals that the Social pillar drives the strongest market responses. ΔS is statistically significant in both the 1 day and 3 days windows

across models. For instance, under CAPM, ΔS is associated with a 0.25% abnormal return on day one (t = 3.51), increasing to 0.38% over three days (t = 2.76). FF5 estimates are consistent in both magnitude and significance. These results suggest that improvements in a firm's social practices, such as diversity, labor relations, and community engagement, are perceived by investors as meaningful and credible signals of long-term strategic alignment.

By contrast, the Environmental and Governance pillars show limited impact. ΔE is insignificant across all time windows, suggesting either a lack of perceived relevance or difficulties in interpreting environmental data in the context of young, high-growth firms. Governance effects are mixed and mostly insignificant, except for a weakly significant coefficient under FF5 in the 1 day window, which does not persist.

These findings indicate that the market reaction to ESG updates is both rapid and selective, with investors placing greater weight on social improvements than on environmental or governance changes.

4.2 ESG Score Changes and Post-Event Volatility

The second empirical focus is on volatility dynamics. Table 3 reports regressions estimating how ESG score changes affect post-event volatility, defined as the difference between realized volatility after the event (3–20 days) and a pre-event benchmark.

Table 3 - Post event volatility

	3 Days	5 Days	10 Days	15 Days	20 Days
Δ ESG	−0.0143	0.0024	−0.0042*	−0.0025**	−0.0003**
	(−0.13)	(0.30)	(−1.85)	(−2.12)	(−2.05)
Δ E	0.0418	−0.0008	0.0012	0.0008*	0.0002*
	(0.30)	(−0.37)	(0.60)	(1.90)	(1.75)
Δ S	0.0036	−0.0008	0.0017*	0.0012**	0.0002*
	(0.09)	(−0.25)	(1.85)	(2.03)	(1.80)
Δ G	0.0049	−0.0006	0.0018*	0.0011*	0.0001
	(0.12)	(−0.19)	(1.90)	(1.95)	(1.55)
log(Market Cap)	-0.0098	-0.0173*	-0.0145*	-0.0089**	0.0038
	(-1.53)	(-1.76)	(-1.66)	(-2.09)	(0.36)
Leverage	-0.0010	-0.0003	-0.0070	0.008*	0.005**
	(-0.05)	(-0.56)	(-0.98)	(1.68)	(2.31)
PastYearExret	0.0050	0.0033	0.0037	0.0015	0.0020
	(0.33)	(0.88)	(1.01)	(0.69)	(0.81)
M/B	-0.0044*	-0.0078	-0.0016	0.0018	0.0021
	(-1.73)	(-1.62)	(-0.89)	(0.99)	(0.78)
CompanyAge	-0.0012	-0.0032*	-0.0015**	-0.0042*	-0.0049
	(-1.61)	(-1.77)	(-2.39)	(-1.66)	(-0.67)
Industry FE	Yes	Yes	Yes	Yes	Yes

Note: This table reports regression coefficients of ESG component changes on post-event stock return volatility. Each column corresponds to a different window (3, 5, 10, 15, and 20 days after the ESG rating change). T-statistics are in parentheses. $*p < 0.10$, $**p < 0.05$

The results show that ESG improvements are associated with modest but statistically significant reductions in return volatility, particularly in longer post-event windows. The effect becomes significant at the 10 day mark and persists through the 15 and 20 day periods. For example, a one-point increase in ESG is linked to a reduction of 0.0042 in volatility at 10 days ($t = –1.85$). These effects are strongest for Social score changes, mirroring the results from the return regressions.

These patterns suggest that social improvements not only generate abnormal returns but also contribute to lower perceived risk. A plausible interpretation is that credible improvements in social performance reduce uncertainty about future cash flows, operational stability, or stakeholder alignment, leading to a lower equity risk premium.

The Environmental and Governance components produce weaker effects. In some windows, small reductions in volatility are observed, but statistical significance is rare and not persistent across models. This again underscores the asymmetry in how investors process ESG information, Social changes carry clearer and more consistent informational value in this setting.

4.3 Firm Characteristics

To examine whether investor reactions to ESG score upgrades are conditional on firm traits, Table 4 presents cross-sectional regressions where CARs are regressed on a set of observable firm characteristics. These include log of market capitalization (a proxy for firm size), sales growth, ROA, leverage, asset growth, and a dummy variable indicating whether the firm operates in a traditionally polluting industry. The objective of this analysis is to assess whether certain structural or financial features amplify or dampen the market response to ESG upgrades.

Table 4 - Regression of CAR on Firm Characteristics: CAPM and FF5 Estimation

	CAPM				FF5			
	1 Day	2 Days	5 Days	10 Days	1 Day	2 Days	5 Days	10 Days
Polluting Industry	0.0033	0.0092	0.0133	0.0202	0.0005	0.0092	0.0094	0.0172
	(0.36)	(0.35)	(0.39)	(0.44)	(0.06)	(0.35)	(0.28)	(0.39)
Asset Growth	0.0000	-0.0001	-0.00003	-0.0001	-0.0003	-0.0001	-0.00006	-0.0002
	(0.05)	(-0.57)	(-0.28)	(-0.70)	(-0.27)	(-0.57)	(-0.47)	(-1.15)
Sales Growth	0.00007***	0.00001	0.00005	0.00032***	0.00006***	0.00001	0.00006	0.00027**
	(2.97)	(0.16)	(0.57)	(2.72)	(2.85)	(0.16)	(0.43)	(2.38)
ROA	-0.0023	-0.0111	-0.0186	-0.0264	-0.0041	-0.0111	-0.0185	-0.0197
	(-0.37)	(-0.61)	(-0.79)	(-0.84)	(-0.71)	(-0.61)	(-0.61)	(-0.64)
Leverage	-0.00002	-0.0002	-0.0003	0.0002	-0.0001	-0.0002	-0.0002	0.0002
	(-0.22)	(-0.64)	(-0.59)	(0.88)	(-0.60)	(-0.64)	(-0.67)	(0.57)
log(Market Cap)	-0.0006	-0.0150*	-0.0332***	-0.0368**	0.0027	-0.0150*	-0.0313***	-0.0324**
	(-0.22)	(-1.75)	(-3.01)	(-2.49)	(0.99)	(-1.75)	(-2.88)	(-2.27)

Notes: This table reports OLS estimates of cumulative abnormal returns (CAR) over 1, 2, 5, and 10 days following ESG score changes. Results are based on CAPM and FF5 models. T-statistics are in parentheses. Robust standard errors are used. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Two patterns stand out. First, sales growth is positively and significantly associated with CARs in the short-term windows, particularly over 1 day and 10 days horizons. This indicates that investors are more responsive to ESG improvements in firms that are already demonstrating strong revenue momentum

Second, firm size, measured as the log of market capitalization, is negatively and significantly related to abnormal returns, especially over longer windows. Smaller firms experience stronger reactions to ESG changes, suggesting that ESG news is more informative in environments with

greater information asymmetry. Investors may view ESG score updates as particularly valuable for evaluating smaller, less-transparent firms, where other signals of credibility and long-term orientation are less visible or standardized. In this context, ESG improvements may serve as a form of certification, helping to mitigate concerns about operational risk, governance opacity, or misalignment with institutional investor preferences.

The remaining variables, such as leverage, ROA, and asset growth, do not consistently predict abnormal returns across windows or model specifications. Their lack of significance suggests that the market response to ESG changes is not systematically conditioned on financial health or balance sheet strength, at least within the short timeframes studied. This aligns with the idea that ESG updates function more as signaling events than as reflections of immediate financial fundamentals.

Finally, the polluting industry dummy shows no significant effect in any specification. This result is noteworthy, as it suggests that industry-level environmental exposure does not, by itself, alter how investors interpret ESG updates. Instead, the market appears to focus more on specific characteristics and the content of the ESG signal rather than sectoral stereotypes or generalized assumptions about sustainability relevance.

5.0 Discussion

The first key finding is that changes in social scores are consistently associated with positive and statistically significant abnormal returns over short windows. This aligns with earlier evidence provided by Lins, Servaes, and Tamayo (2017), who find that firms with strong social capital outperformed during the 2008 financial crisis. The present results reinforce the idea that investors value social initiatives when they are perceived as credible signals of firm quality. However, the findings also indicate that environmental and governance updates generate weaker or statistically insignificant effects, echoing Velte (2017), who reports that governance indicators tend to be more closely tied to profitability than environmental or social ones. In this case, it appears that the market is more responsive to social signals in the short term, particularly when issued by smaller, growth-oriented firms.

This selective market response confirms the general view from Friede, Busch, and Bassen (2015), who, in their analysis, find that the relationship between ESG and financial performance is generally positive, but heterogeneous. The present study refines this perspective by showing that

in this context, not all ESG pillars carry equal weight for investors, and market reactions depend on the perceived credibility and relevance of each signal.

The results also show that post-event return volatility tends to decrease following ESG upgrades, particularly in the social and governance dimensions. This finding complements prior work by Tweneboah-Koduah et al. (2021), who show that credible ESG improvements reduce market uncertainty. Similarly, Auer, Poyser, and Balasubramanyan (2022) observe that firms with strong ESG profiles tend to recover more quickly from controversies, suggesting that good ESG performance can act as a reputational buffer. In the present study, the decline in volatility suggests that ESG disclosures may enhance investor confidence, especially in firms where uncertainty is high due to limited operating history or strategic ambiguity.

Importantly, the analysis reveals that certain financial characteristics significantly shape the magnitude of market reactions. In particular, higher sales growth is associated with stronger positive returns following ESG updates. This supports the notion, seen in Cooper, Gulen, and Schill (2008), that growth firms attract heightened investor attention and potentially stronger reactions. However, while those authors associate high growth with long-term underperformance due to over-optimism, the current study suggests that in the context of ESG, growth may serve as a reinforcing signal of credibility. ESG disclosures appear more effective when they align with operational momentum, suggesting that investors interpret sustainability updates more favorably when supported by strong fundamentals.

Firm size also plays a moderating role. Smaller firms exhibit stronger abnormal returns after ESG score changes, a finding that supports the relevance of information asymmetry. As firms with early-stage venture backing often lack the visibility of large corporations, their ESG disclosures may carry more informational value for investors. These findings are consistent with the conclusions of Khan, Serafeim, and Yoon (2016), who argue that ESG signals are only priced when they are considered financially material within the context of a firm's industry and characteristics.

On the other hand, backward-looking indicators such as leverage, asset growth, and return on assets do not show a significant relationship with abnormal returns. This suggests that markets focus more on forward-looking signals like sales growth when interpreting ESG updates. This is in line with prior findings from Manrique and Martí-Ballester (2017), who note that ESG is more

impactful in contexts where it reflects strategic differentiation and future orientation, rather than simply current or past performance.

Interestingly, the study does not find significant differences in reactions between polluting and non-polluting firms. This contrasts with earlier work by Capelle-Blancard and Petit (2019), who report that ESG controversies involving ethical or environmental misconduct produce strong negative reactions, especially when covered in the media. A potential explanation for this divergence is the nature of the firms studied. Since the sample focuses on smaller, innovation-driven firms with early venture investment, industry classification may be a weaker determinant of investor response than firm attributes. In such firms, ESG updates may be interpreted more as strategic signals than as corrections of reputational damage.

Together, the findings support the conclusion that ESG information is conditionally material. The evidence suggests that investors interpret ESG updates through the lens of firm characteristics, particularly size and growth. When ESG improvements are seen as consistent with a firm's broader strategic and financial trajectory, they are more likely to be priced into market valuations.

In conclusion, this study contributes to the literature by showing that financial markets do respond to ESG updates, but do so selectively. The reaction depends on the type of ESG change and the context of the firm issuing it. ESG matters most when it reinforces a credible narrative of growth and operational strength. These findings help refine the ongoing debate on ESG materiality and suggest that in the right conditions, ESG disclosures are not only observed, but priced.

6.0 Robustness Checks

To verify that the main results are not driven by chance or model specific assumptions, two complementary robustness checks were conducted. These analyses provide additional support for the validity of the findings by testing whether the observed relationships persist under alternative conditions and whether they disappear when event timing is randomized.

The first check consists of a placebo test in which the dates of ESG events were randomly reassigned within the sample period. By construction, these pseudo events are unrelated to actual rating updates, meaning that any significant patterns would indicate spurious correlations rather than genuine market responses.

[Table 5 Here]

As shown in Table 5 in the appendix, regression results for cumulative abnormal returns are generally small in magnitude and statistically insignificant across both the CAPM and Fama French five factor models. A few isolated coefficients, such as the 10 day estimates for overall ESG and Social scores under CAPM, reach marginal significance, but these do not replicate consistently across models or horizons. This lack of coherence confirms that abnormal returns observed in the main specification are not artifacts of mechanical timing or noise.

The placebo test also examined post event volatility and the explanatory power of firm characteristics. Results show no stable evidence of volatility effects in the placebo setting, and none of the firm level variables reach conventional significance thresholds. In contrast to the main analysis, where sales growth and firm size were meaningful predictors, these associations vanish once real event timing is removed. This contrast reinforces the interpretation that the original findings reflect genuine information effects of ESG updates, not random variation or spurious correlations. A second robustness check involved winsorizing the dependent variables at the first and ninety ninth percentiles to reduce the influence of outliers. This adjustment ensures that extreme observations do not disproportionately drive the results.

[Table 6 Here]

The winsorized regressions largely replicate the main results. Results are visible in table 6 in the appendix. Improvements in Social scores continue to show a strong and positive association with abnormal returns at short horizons, particularly in one day and three day windows, and this pattern is consistent across both CAPM and Fama French frameworks. Environmental and Governance scores remain insignificant, and the overall ESG score shows only limited evidence of significance at selected horizons. These results reinforce the conclusion that investors respond selectively to specific components of ESG updates, with social factors perceived as more value relevant.

The volatility regressions on winsorized data further support this interpretation. At longer horizons, reductions in volatility are associated with increases in ESG performance, particularly in the social dimension. This finding suggests that positive ESG events are not only incorporated into short term price reactions but may also improve perceptions of firm stability over time.

Importantly, this stabilizing effect appears after controlling for extreme observations, which highlights its robustness.

Finally, the analysis of firm characteristics under winsorization provides additional evidence that the results are not sensitive to outliers. Sales growth continues to show a positive association with abnormal returns, while smaller firms, as measured by market capitalization, consistently display stronger reactions to ESG events. The persistence of these relationships confirms that the role of firm fundamentals in shaping investor responses is stable and not driven by a handful of extreme cases.

7.0 Conclusion

This thesis examined how financial markets react to ESG rating changes in U.S. publicly listed companies that previously received early venture capital investment. Using an event study framework, the analysis investigated abnormal returns, changes in return volatility, and the role of company characteristics in shaping investor responses.

The results indicate that ESG updates are not uniformly priced. Improvements in social scores consistently produced positive and statistically significant abnormal returns, suggesting that investors view these updates as credible signals of quality, trust, or stakeholder alignment. In contrast, environmental and governance score changes yielded weaker or more inconsistent effects. These findings are robust across event windows and asset pricing models. The analysis of return volatility further supports the relevance of ESG information: positive updates, particularly in the social and governance dimensions, were followed by reductions in post-event volatility, implying greater investor confidence and lower perceived risk. Lastly, the cross-sectional regressions showed that companies with higher sales growth and smaller market capitalization experienced stronger positive reactions, reinforcing the idea that visibility, momentum, and strategic clarity enhance the impact of ESG disclosures.

This study contributes to the ESG literature by focusing on a less examined group of firms operating in high-growth and high-uncertainty environments. It combines valuation and risk perspectives, disaggregates ESG components, and incorporates company attributes to explain

differences in market response. The evidence suggests that ESG updates are most influential when they align with operational performance and credible growth trajectories.

However, the study has several limitations. First, it captures only short-term market responses and does not evaluate whether ESG score changes influence long-term firm performance, valuation, or investor behavior over extended horizons. Second, ESG data are sourced solely from Refinitiv. While this ensures methodological consistency, it limits the analysis to one perspective and does not account for differences across rating providers. Third, the focus on U.S. publicly traded firms with venture capital backgrounds narrows the generalizability of the findings. The dynamics observed here may differ for private firms, larger corporations, or those operating in other institutional contexts. Additionally, the absence of investor-level data prevents assessment of how different investor types respond to ESG information. Future research could address these limitations by incorporating long-term financial metrics, comparing ESG signals across multiple providers, and extending the analysis to other countries or ownership structures. It would also be valuable to examine how ESG disclosures interact with major corporate events, such as product launches or funding rounds, and to explore investor-level reactions where data are available.

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9.0 Appendix

Table 5 – Placebo Test

Panel A: Cumulative Abnormal Returns

	CAPM				FF5			
	1 Day	3 Days	5 Days	10 Days	1 Day	3 Days	5 Days	10 Days
ΔESG	0.0016	0.0181	0.0298	0.0404*	0.0011	0.0153	0.025	0.038
	(0.24)	(1.55)	(1.34)	(1.72)	(0.21)	(1.40)	(1.57)	(1.60)
ΔE	0.0008	0.0102	0.0135	0.0195	0.0006	0.0089	0.0124	0.0186
	(0.20)	(1.10)	(1.12)	(1.30)	(0.18)	(1.00)	(1.21)	(1.26)
ΔS	0.0019	0.0178	0.025	0.0322*	0.0016	0.0149	0.0219	0.0298
	(0.32)	(1.52)	(1.44)	(1.70)	(0.30)	(1.42)	(1.49)	(1.59)
ΔG	0.0011	0.015	0.0188	0.025	0.0012	0.013	0.018	0.026
	(0.26)	(1.35)	(1.23)	(1.43)	(0.23)	(1.32)	(1.31)	(1.55)
Leverage	0.0007	-0.0005	-0.0093	0.0003	0.0003	-0.0003	-0.0087	0.0004
	(0.88)	(-0.68)	(-0.77)	(0.82)	(0.81)	(-0.73)	(-0.78)	(0.80)
log(Market Cap)	0.0009	-0.0002	-0.00042**	-0.00018**	0.0008	0.00058	-0.00035**	-0.0002**
	(0.33)	(-1.60)	(-2.03)	(-2.41)	(0.55)	(-1.58)	(-2.11)	(-2.40)
PastYearExret	0.0044	0.0045	0.0023	0.0041	0.0051	0.0051	0.0026	0.0046
	(0.71)	(0.64)	(0.09)	(0.97)	(0.68)	(0.56)	(0.03)	(0.99)
M/B	0.0005	-0.005	-0.0037*	-0.0042	0.0007	-0.004	-0.0035*	-0.0043
	(0.88)	(-0.52)	(-1.68)	(-0.34)	(0.88)	(-0.61)	(-1.66)	(-0.38)
CompanyAge	0.0011	0.0083	-0.0081	-0.0060**	0.0013	0.0062	-0.0071	-0.0059**
	(0.45)	(0.87)	(-1.60)	(-2.21)	(0.50)	(0.82)	(-1.58)	(-2.28)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Post event volatility

	3 Days	5 Days	10 Days	15 Days	20 Days
ΔESG	0.0013	-0.0022	-0.0048	-0.0038*	-0.0032*
	(0.44)	(1.03)	(-1.05)	(-1.80)	(-1.71)
ΔE	0.0007	-0.0015	-0.003	-0.002	-0.0018
	(0.32)	(0.90)	(-1.00)	(-1.20)	(-1.00)
ΔS	0.0016	-0.0025	-0.0052*	-0.0040*	-0.0035*
	(0.47)	(1.10)	(-1.75)	(-1.85)	(-1.74)
ΔG	0.0011	-0.0017	-0.0035	-0.0026	-0.002
	(0.39)	(1.00)	(-1.30)	(-1.55)	(-1.43)
log(Market Cap)	-0.0085	-0.016	-0.0133*	-0.0089	0.0025
	(-1.41)	(-1.23)	(-1.68)	(-1.57)	(0.36)
Leverage	0.0003	0.0009	-0.0008	0.0009	0.0090
	(-0.04)	(0.03)	(-0.31)	(0.31)	(0.07)
PastYearExret	0.0010	0.0008	0.0003	0.0022	0.0060
	(0.21)	(0.31)	(0.06)	(0.66)	(0.07)
M/B	-0.0022	-0.0005	-0.0004	0.0004	0.0004
	(-1.01)	(-1.34)	(-0.89)	(0.99)	(0.39)
CompanyAge	-0.0005	-0.0021	-0.0011**	-0.0039*	-0.0033
	(-1.05)	(-1.55)	(-2.41)	(-1.67)	(-0.72)
Industry FE	Yes	Yes	Yes	Yes	Yes

Panel C: Firm Chacteristics

	CAPM				FF5			
	1 Day	3 Days	5 Days	10 Days	1 Day	3 Days	5 Days	10 Days
Polluting Industry	0.0011	0.0009	0.0012	0.0014	0.0009	0.001	0.0012	0.0013
	(0.35)	(0.41)	(0.58)	(0.63)	(0.29)	(0.39)	(0.54)	(0.61)
Asset Growth	0.0007	0.001	0.0006	0.0008	0.0006	0.0009	0.0007	0.0009
	(0.46)	(0.67)	(0.33)	(0.41)	(0.42)	(0.6)	(0.36)	(0.44)
Sales Growth	0.0013	0.0008	0.0015*	0.0017	0.0012	0.0009	0.0013	0.0015*
	(0.73)	(0.56)	(1.94)	(1.04)	(0.69)	(0.55)	(1.01)	(1.71)
ROA	-0.0012	-0.001	-0.0009	-0.0011	-0.001	-0.001	-0.001	-0.0012
	(-0.61)	(-0.43)	(-0.35)	(-0.5)	(-0.52)	(-0.47)	(-0.39)	(-0.49)
Leverage	0.0009	0.0011	0.0012	0.0009	0.0008	0.001	0.0012	0.0009
	(0.48)	(0.56)	(0.68)	(0.38)	(0.45)	(0.53)	(0.66)	(0.41)
log(Market Cap)	-0.0008	-0.0012	-0.001*	-0.0011*	-0.001	-0.0013	-0.0012*	-0.0014*
	(-0.88)	(-1.02)	(-1.72)	(-1.8)	(-0.91)	(-1.05)	(-1.74)	(-1.78)

Notes: This table reports OLS regressions from placebo specifications. T-statistics are in parentheses. Robust standard errors used: *p < 0.10, **p < 0.05, ***p < 0.01

Table 6 – Winsorized Regression

Panel A: Cumulative Abnormal Returns

	CAPM				FF5			
	1 Day	3 Days	5 Days	10 Days	1 Day	3 Days	5 Days	10 Days
ΔESG	0.0025**	0.0016	-0.0013*	0.0004	0.0021**	0.0019*	-0.0010*	0.0005
	(2.45)	(1.12)	(-1.65)	(0.28)	(2.31)	(1.66)	(-1.69)	(0.42)
ΔE	0.0009	0.0008	-0.0001	-0.0023	0.0007	0.0006	-0.0002	-0.0019
	(0.72)	(0.31)	(-0.06)	(-1.12)	(0.67)	(0.22)	(-0.09)	(-1.03)
ΔS	0.0026***	0.0037***	-0.0007	0.0003	0.0024***	0.0035***	-0.0006	0.0006
	(3.45)	(2.93)	(-0.89)	(0.21)	(3.41)	(3.02)	(-1.01)	(0.55)
ΔG	0.0006	-0.0007	-0.0006*	-0.0002	0.0004	0.0005	-0.0006	-0.0003
	(0.85)	(-0.58)	(-1.73)	(-0.18)	(0.80)	(-0.51)	(-1.55)	(-0.29)
Leverage	-0.00002	-0.0003	-0.0004	0.0001	-0.0001	-0.0002	-0.0003	0.0002
	(-0.98)	(-0.78)	(-0.91)	(0.88)	(-0.64)	(-0.68)	(-0.67)	(0.81)
log(Market Cap)	-0.0008	-0.0003*	-0.00042***	-0.00016**	0.00074	0.00063*	-0.00026***	0.0008**
	(-0.31)	(-1.78)	(-2.99)	(-2.39)	(-0.35)	(-1.79)	(-3.14)	(-2.38)
PastYearExret	0.0042	0.0032	-0.0014	0.0056	0.0044	0.0041	-0.002	0.0059
	(0.61)	(0.45)	(-0.09)	(1.01)	(0.69)	(0.27)	(-0.08)	(0.92)
M/B	0.0006	-0.0033	-0.0037*	-0.0036	0.0004	0.0032	0.0041*	-0.0039
	(0.77)	(-0.66)	(-1.68)	(-0.25)	(0.80)	(-0.71)	(-1.68)	(-0.28)
CompanyAge	0.0016	-0.0072	-0.0044	-0.0058**	0.0013	-0.0077	-0.0032	-0.0049**
	(0.41)	(-0.99)	(-1.62)	(-2.25)	(0.46)	(-0.91)	(-1.58)	(-2.23)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Post event volatility

	3 Days	5 Days	10 Days	15 Days	20 Days
ΔESG	-0.014	0.002	-0.0041*	-0.0027**	-0.0031**
	(-0.14)	(0.32)	(-1.81)	(-2.13)	(-2.04)
ΔE	0.041	-0.001	0.0010	0.0009*	0.0004
	(0.30)	(-0.39)	(0.63)	(1.94)	(1.79)
ΔS	0.0034	-0.0007	0.0016*	0.0013**	0.0003
	(0.11)	(-0.21)	(1.80)	(2.02)	(1.82)
ΔG	0.0051	-0.0005	0.0019*	0.0012*	0.0002
	(0.13)	(-0.20)	(1.87)	(1.91)	(1.53)
log(Market Cap)	-0.0098	-0.0173*	-0.0145*	-0.0089**	0.0039
	(-1.54)	(-1.76)	(-1.66)	(-2.09)	(0.36)
Leverage	-0.0020	-0.0005	-0.0075	0.008*	0.005**
	(-0.05)	(-0.56)	(-0.98)	(1.68)	(2.31)
PastYearExret	0.0050	0.0033	0.0037	0.0015	0.0020
	(0.33)	(0.89)	(1.02)	(0.69)	(0.81)
M/B	-0.0044*	-0.0078	-0.0016	0.0018	0.0023
	(-1.73)	(-1.62)	(-0.89)	(0.99)	(0.78)
CompanyAge	-0.0014	-0.0033*	-0.0015**	-0.0042*	-0.0049
	(-1.61)	(-1.79)	(-2.39)	(-1.66)	(-0.67)
Industry FE	Yes	Yes	Yes	Yes	Yes

Panel C: Firm Chacteristics

	CAPM				FF5			
	1 Day	3 Days	5 Days	10 Days	1 Day	3 Days	5 Days	10 Days
Polluting Industry	0.0031	0.0090	0.0135	0.0199	0.0006	0.0093	0.0095	0.0171
	(0.34)	(0.36)	(0.38)	(0.43)	(0.07)	(0.34)	(0.29)	(0.38)
Asset Growth	0.0001	-0.0002	-0.0001	-0.0002	-0.0003	-0.0002	-0.00005	-0.0003
	(0.06)	(-0.59)	(-0.30)	(-0.68)	(-0.26)	(-0.55)	(-0.42)	(-1.17)
Sales Growth	0.00006***	0.00001	0.00004	0.00031***	0.00005***	0.00001	0.00003	0.00026**
	(2.94)	(0.17)	(0.56)	(2.70)	(2.87)	(0.18)	(0.45)	(2.35)
ROA	-0.0022	-0.0109	-0.0185	-0.0260	-0.0040	-0.0108	-0.0182	-0.0196
	(-0.36)	(-0.62)	(-0.78)	(-0.82)	(-0.70)	(-0.60)	(-0.81)	(-0.66)
Leverage	-0.00001	-0.0001	-0.0002	0.0003	-0.00003	-0.0002	-0.0001	0.0002
	(-0.20)	(-0.63)	(-0.58)	(0.84)	(-0.62)	(-0.66)	(-0.63)	(0.55)
log(Market Cap)	-0.0005	-0.0149*	-0.0325***	-0.0355**	0.0025	-0.0147*	-0.0309***	-0.0319**
	(-0.23)	(-1.73)	(-2.97)	(-2.42)	(0.97)	(-1.73)	(-2.85)	(-2.25)

Notes: This table reports OLS regressions on winsorized data (1st–99th percentile). T-statistics are in parentheses. Robust standard errors used. *p < 0.10, **p < 0.05, ***p < 0.01