COLLECTION OF THESES

Martin Márkus

Green Choices, Grey Areas: Risk Management and Investor Behavior in the ESG Landscape

Ph.D. dissertation

Supervisors:
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Associate professor

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Institute of Finance

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1. Motivation and research background

1.1. *Motivation*

Environmental, Social, and Governance (ESG) factors have taken central place in the modern financial landscape. As investors, regulators, and society place greater emphasis on sustainability and ethical business practices, companies are compelled to prioritize ESG values. While ESG scores have been broadly used to assess and compare companies on their ethical, social, and environmental impact, the empirical implications of these scores, particularly in the realm of financial performance, risk management and investor behavior, remain subjects of robust academic inquiry.

This dissertation investigates the connection between ESG scores and operational losses as well as between ESG scores and investor behavior in public companies. Through two researches, we attempt to uncover the underlying relationships and provide insights that can not only expand the boundaries of current knowledge but also shape future corporate and investment strategies. Studying both topics concurrently is important as it allows for a nuanced exploration of the broader impact of ESG considerations on businesses and financial markets. The interconnectedness of risk, returns, and investor behavior forms a complex web that merits simultaneous examination. By studying these topics together, the research aims to provide a comprehensive understanding of how sustainable practices not only influence risk and financial performance but also how investor sentiment and choices play a crucial role in shaping these relationships. Ultimately, these insights can guide businesses, investors, and policymakers towards more effective and sustainable decision-making.

Risk management practices have undergone significant evolution over the past few decades, especially in the wake of financial crises and growing global interconnectedness. Historically, much of the focus in both academic literature and industry best practices was around market and credit risks. These were often seen as the primary threats to financial stability and corporate integrity, which led to plenty of research and literature dedicated to understanding, measuring, and mitigating them.

Operational risk, defined as the risk of losses stemming from inadequate or failed internal processes, people, systems, or from external events, was recognized only after the 1990's in risk management paradigms. This delayed recognition means that there's been less time for academic investigation into operational risk as compared to the more traditional market and credit risks. Consequently, when it comes to the integration of ESG criteria into risk management, this skewness in academic attention persists.

Considering ESG's increasing prominence in corporate strategy and investment decision-making, many studies have dug into understanding how ESG factors influence or correlate with market and credit risks. This makes sense, given that market and credit risks were already well-established areas of study, and researchers sought to understand how new ESG considerations might impact these existing risk categories. However, the nexus between ESG and operational risk remains comparatively underexplored in academic literature. This is somewhat surprising since many elements within the ESG framework, especially those related to governance and social responsibilities, have direct implications for operational risk. Issues like employee well-being, robust internal governance mechanisms, and adherence to environmental regulations can all significantly impact a firm's operational risk profile.

The limited body of literature in this area may also be indicative of the inherent challenges in measuring and quantifying operational risk compared to market and credit risks. While the latter can often be assessed using established financial metrics and models, operational risk can manifest in countless ways, from IT system failures to issues related to employee misconduct or external fraud (Csernobai, Rachev, and Fabozzi [2008]).

The large severity and frequency of corporate operational losses, stemming from such as frauds, legal battles, and systems failures, poses a significant threat to the stability of companies and the broader financial system. It's vital to understand whether adhering to ESG principles acts as a shield against these losses. A nuanced understanding can provide companies with strategies to mitigate these risks and offer investors a clearer view of potential vulnerabilities.

In the literature review in the subsequent sub-chapters, we show that the relationship between ESG scores and stock returns is ambiguous, with various studies yielding mixed results. By examining this through the lens of behavioral finance, we aim to further nuance these findings, which might provide an explanation as to why different studies arrive at varying conclusions regarding the relationship between stock returns and ESG.

At the intersection of psychology and finance, behavioral finance has altered our understanding of market dynamics. As ESG becomes an integral part of the investment lexicon, there is a pressing need to decode the behavioral patterns associated with ESG investing. Are responsible investors' decisions purely rational, or do recent gains or losses cloud their judgment? Shedding light on this can help align investment strategies with cognitive realities.

The duo of researches presented in this dissertation share a common thematic core: the various impacts of ESG scores in the financial domain. Understanding the collective impact of ESG factors on operational risk

and stock returns, coupled with insights into investor behavior, empowers decision-makers with a more integrated perspective. This knowledge can assist businesses in aligning their operations with sustainability goals and guide investors in making informed and socially responsible investment choices.

The current dissertation has relevance for numerous reasons, given the contemporary shifts in the economic, societal, and regulatory landscapes.

Firstly, due to the growing investor interest, more sophisticated and naiver investor are directing their capital towards sustainable investments. By 2024, ESG assets have been rapidly growing, and they're projected to represent a significant chunk of total global assets.

Secondly, governments and regulatory bodies in the U.S. and the EU are implementing guidelines and regulations around the disclosure of ESG risks and practices. Understanding ESG factors is becoming crucial for businesses to anticipate and adapt to these regulatory changes, which can impact business models and market dynamics.

Last but not least, incorporating ESG metrics provides a more holistic understanding of a company's risk profile. The integration of ESG criteria enables a more forward-thinking risk assessment, as it considers evolving regulatory landscapes, societal expectations, and environmental constraints that can affect a company's future performance. Ultimately, ESG metrics enrich the traditional risk analysis by adding layers of non-financial information, ensuring a multi-dimensional understanding of a company's position in an increasingly complex and interconnected business environment.

In essence, the dissertation collectively chart a comprehensive map of the ESG landscape, from the internal workings of companies to the external actions of investors, providing a panoramic view of the modern financial ecosystem.

1.2.   *The current debate on the effect of ESG scores on corporate financial performance*

A substantial proportion of these articles identify a positive association between ESG and financial performance. Friede, Busch and Bassen (2015) provide a meta-analysis summarizing more than 2000 studies, concluding that the majority of the papers show positive correlation between ESG performance and financial performance (financial performance here is defined as corporate fundamental value, operational, and accounting performance). Orlitzky, Schmidt and Rynes (2003) find during an integrative rigorous meta-

study, that companies who actively invest in social responsibility, particularly based on aspects reflected in their reputation, are more likely to see positive financial outcomes, especially when measured by traditional accounting methods and not by market performance. Cheng, Ioannou and Serafeim (2013) analyze a broad sample of firms, and their research reveals that companies with superior corporate social responsibility (hereafter CSR[1]) performance encounter lower capital constraints through higher transparency and better stakeholder engagement. Other studies arrive at the same conclusion investigating the phenomenon from different angles (Barnett and Salomon [2012], Khan, Serafeim and Yoon [2016]).

On the other hand, there have been contrasting findings, and it remains questionable whether there is a positive relationship between performance measured by stock returns. Eccles, Ioannou and Serafeim (2014) reveal that high ESG performer companies tend to outperform in terms of stock returns. Based on a new quantitative model developed by Kumar et al. (2016), it shows that lower volatility of equity returns was also paired with higher risk-adjusted returns. A study of Verheyden, Eccles and Feiner (2016) shows that using ESG filters, particularly a 10% best-in-class approach, significantly improves risk-adjusted returns in global and developed markets portfolios. The findings of Khan et al. (2016) indicate that companies with favorable ratings on material sustainability issues demonstrate a significant stock outperformance compared to those with poor ratings in the same category. However, there is no significant outperformance observed for companies with good ratings on immaterial sustainability issues when compared to those with poor ratings in the same category.

In contrast, Cornell and Damodaran (2020) argue that ESG is good for the society but cannot provide excess stock returns. Halbritter and Dorfleitner (2015) also support the previous conclusion by applying an ESG portfolio approach using the Carhart four factor model on a large dataset between 1991 and 2012 and did not find any abnormal returns related to sustainable investing. Cornell (2021) further emphasizes, that however highly rated ESG companies are able to reduce their cost of capital, due to the risk-return tradeoff, they realize lower expected return. Lööf, Sahamkhadam and Stephan (2022) confirm the conclusion of Cornell during turbulent market conditions. Their research horizon is narrowed to the COVID-19 Pandemic period and during this time they reveal that while high CSR stocks can lower their downside risk, also have lower upside potential therefore support Cornell's risk-return trade-off hypothesis.

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[1] While ESG and CSR both address the ethical and sustainable aspects of business operations, they are not exact synonyms. However, both concepts have gained significant attention in recent years, reflecting a growing recognition of the importance of ethical, sustainable, and responsible business practices hence we will use both measures to express the company's responsible intention (Gillan et al. [2021]).

As Cornell (2021) highlights, two factors determine the expected return of high ESG rating companies, these are investor preferences and their risks. We believe that the inconsistent outcomes observed in the literature regarding the relationship between ESG and anticipated stock returns can be attributed to the lack of pure rationality among investors when establishing their preferences and managing their portfolios.

Most of the research about ESG and stock returns is inconclusive because they do not account for the already documented psychological effects. Rational investor theory, a cornerstone of traditional finance, posits that individuals act in their best interest to maximize utility, making decisions based on all available information and without the interference of emotions. However, in many cases, behavioral finance has already provided answers, where the traditional finance could not have, particularly in non-ESG contexts (Kahneman and Tversky [1984], Shefrin and Statman [1985], Odean [1998], Barberis, Huang and Santos [2001]). Within this field, the examination of gain-loss asymmetry (reference point effects as discussed in Wang, Yan, and Yu [2017]) has yielded insights. It is plausible that this asymmetry holds significant relevance in the context of ESG evaluation as well. Investors may have different approaches to risk and financial decisions, and it's worth considering whether this holds true for ESG considerations.

Behavioral finance offers a unique perspective on the understanding of stock returns by highlighting the psychological factors and biases that can influence investment decisions. Traditional finance models, such as the Efficient Market Hypothesis (EMH), assume that all investors are rational and that they have access to and process all available information correctly. However, real-world observations often contradict these assumptions. Traditional models often fail to explain various stock market anomalies, such as the momentum effect or the value premium. Behavioral finance provides explanations based on investor psychology for why stocks might exhibit patterns not predicted by standard financial theories. Furthermore, while traditional finance suggests that mispriced assets should be quickly arbitraged away, behavioral finance points to factors like limits to arbitrage (due to constraints on certain investors) and investor psychology as reasons why mispricing can persist (Ritter [2003]).

Behavioral finance's importance in understanding stock returns lies in its ability to provide a more holistic view of market dynamics. By accounting for human emotions and biases, it presents a more comprehensive framework for understanding price movements, market anomalies, and investor behavior. Recognizing these biases can lead to better ESG investment strategies and a deeper understanding of stock market dynamics.

1.3. *The current debate on the effect of ESG scores on risk management*

Starting with the credit risk aspect we can conclude, that the vast majority of the relevant studies found negative correlation between ESG scores and credit risk indicating that ESG considerations can serve as valuable indicators of creditworthiness. By incorporating ESG criteria into investment strategies, investors aim to reduce exposure to companies with higher environmental and social risks, potentially mitigating credit risk in their portfolios. In the following, we highlight research article findings regarding the connection between different credit risk measures (like CDS spread, probability of default, credit rating) and ESG/CSR scores.

Goss and Roberts (2011) find that companies with CSR issues pay 7 to 18 basis points higher spread on their loans than their more responsible counterparts. However, the authors document varied response to optional CSR investments: low-quality borrowers that voluntarily spend on CSR face increased loan costs, whereas lenders show no preference concerning CSR investments made by high-quality borrowers. According to Barth, Hüber and Scholz (2022), one standard deviation increase of ESG scores is reducing the CDS spreads of European and US firms. They find a U-shaped risk mitigation effect of ESG improvement among companies in different ESG quantiles. Firms with average ESG score can reduce their CDS spreads by 8% while ESG over and underperformers by 3% and 4% respectively if their ESG score improves by one standard deviation.

Jiraporn et al. (2013) and Attig et al. (2013) conclude the same by investigating the connection between CSR-scores and credit ratings. They show that more socially responsible firms enjoy favorable credit ratings and hence lower financing costs through their higher credit ratings. Next to the credit spreads and credit ratings, while those are somehow related, CSR also strongly reduces the probability of default (Sun and Cui [2014]).

With an international data sample covering 14 years of observations in 36 countries, Do (2022) concludes the same negative association between CSR and default probability. According to the study, the effect is even stronger regarding long-term probabilities than in the short run. Moreover, the association gets stronger among different countries where the capital markets and legal circumstances are weaker.

The association between ESG and market risk, as price volatility, tail and downside risk is also negative, according to the majority of the studies. Responsible firms can relatively reduce their market related losses compared to non-responsible companies. The subsequent articles discuss the correlation between ESG

scores and widely acknowledged market risk metrics such as Value-at-Risk, market beta, and idiosyncratic risk.

According to the paper of Hoepner et al. (2018), engagement in responsible practices can lower firms' downside risk, measured by Value-at-Risk. The downside protection and risk reduction have the most effect when companies are focusing primarily on climate-related topics. Relative to control firms, the authors show 9% reduction in Value-at-Risk measures for high ESG performers. Sassen, Hinze and Hardeck (2016) also investigates the systematic, non-systematic and hence, the total risk of firms' relation to their corporate social performance (CSP). They detect on a large, European dataset between 2002 and 2014 that high performance in CSP lower the total and non-systematic risk. They further shade their findings. Overall, idiosyncratic risk is the more sensitive to the environmental factor (E factor), while firm total risk and systematic risk are decreased only in the environmentally exposed industries. In addition, they find negative association between the social factor (S factor) and firm risk measures, but cannot find any significant relation between the governance factor (G factor) and market risk of firms.

Jo and Na (2012) further exploit the negative correlation between CSR and firm risk by industries with an extensive dataset representing US companies between 1991 and 2010. According to their results, companies within controversial industry can benefit more in risk reduction compared to non-controversial industry players by incorporating CSR strategies into their strategies because CSR engagement has more powerful effect on the alcohol, tobacco, gambling etc. firms than on the non-controversial companies.

Lastly, operational risk, often overlooked in the shadow of market or credit risks, plays a fundamental role in the day-to-day functioning and long-term success of an organization. In an era marked by technological advancements, regulatory changes, and global interconnectedness, the importance of understanding and effectively managing operational risks has never been more paramount.

In the academic literature, there is limited discussion concerning the relationship between ESG scores and operational risk. This can be attributed to at least two reasons. Firstly, the identification of operational risks emerged later than that of market or credit risks. Secondly, measuring operational risks is considerably more challenging than observing market or credit risks. In many instances, researchers cannot rely on actual loss data for their studies because of the harder observable nature of operational loss data. Instead, they attempt to approximate indicators of risk stemming from operations, using metrics such as the standard deviation of ROA (Return on Assets), ROE (Return on Equity), or the variance of the annual revenue of the firm.

Under the aforementioned limitations, Zhao, Song, and Chen (2016) show on the Chinese market that A-listed firms can reduce their operating risk if they complete their ESG fulfillment. Operational risk as a

container includes various categories of risks originating from completely different natures, like failed processes, systems, policies, or events therefore it could be necessary to exploit the relationship between responsibility and risk within these subcategories as well. There is a lack of comprehensive studies that mutually exclusively and collectively exhaustively explore the relationships between ESG scores and operational risk categories. Harjoto (2017) examines the severity and frequency of only the corporate fraud as an operational risk related to CSR performance and find a negative correlation between the two.

1.4.   Research questions

Based on the literature review, higher corporate responsibility can mitigate risk. However, the specific channels through which this occurs are not yet clear. Operational risk can serve as the root cause for risks through the frequency and severity of operational risk events. Consequently, in Chapter 2 our first hypothesis is that the frequency of operational risks decreases with an increase in ESG scores. Our second hypothesis is that the severity of operational risks decreases with an increase in ESG scores. Moreover, we further investigate the likelihood and severity of different types of operational loss events based on companies' ESG scores, hence we formulate two additional hypotheses. The severity and the frequency of operational risks decreases with an increase in ESG scores in those operational risk categories, where the involvement of the company cannot be questioned. Here, we seek to understand if companies with better ESG scores are more resilient when faced with operational challenges. We also dig into the relationship between ESG scores and various operational risk events in detail. The examination is essential given the various types of operational risk events, which often occur independently, sometimes influenced by external factors. Thus, it may be beneficial to analyze these events individually (Márkus [2023]).

Chapter 3 shifts the lens to the investors, exploring how their past financial experiences influence their decisions regarding ESG investments. Investor behavior is a key driver in financial markets. Analyzing how investor sentiments and preferences influence the relationship between ESG scores and stock returns contributes to a deeper understanding of market dynamics. This knowledge can be instrumental for investors, financial institutions, and policymakers in navigating the evolving landscape of sustainable finance. Studying the relationship between ESG scores, operational risk, stock returns, and investor behavior

together goes beyond isolated analyses and provides a more nuanced and realistic portrayal of the complexities involved.

Sustainability and responsibility are getting more and more important in investment decisions generating a huge demand for stocks with high ESG scores. Motivated by the literature of behavioral economics and finance, we study with a portfolio approach, whether investors are willing to sacrifice more return for sustainability and responsibility when they face prior gains rather than facing prior losses. We also wanted to understand, whether this phenomenon is driven by only the naïve investors.

Table 1. Hypothesis, research questions and empirical methods of the dissertation.

Research question	Hypothesis	Research method
How ESG scores correlate with the frequency of operational loss events?	H1: The frequency of operational risks decreases with an increase in ESG scores	Yearly and risk category fix effect logit regression
How ESG scores correlate with the severity of operational loss events?	H2: The severity of operational risks decreases with an increase in ESG scores	Yearly and risk category fix effect regression, Heckman selection
How ESG scores correlate with the frequency of operational loss events in different risk event categories?	H3: The frequency of operational risks decreases with an increase in ESG scores in those categories where the company involvement cannot be questioned.	Yearly and risk category fix effect logit regression
How ESG scores correlate with the severity of operational loss events in different risk event categories?	H4: The severity of operational risks decreases with an increase in ESG scores in those categories where the company involvement cannot be questioned.	Yearly and risk category fix effect regression, Heckman selection
How investors past financial experiences influence their decisions regarding ESG investments?	H5: Investors might be more willing to sacrifice return for social benefits when they face prior gains in a stock	Portfolio approach
Do naïve investors drive the revealed relations?	H6: Naïve investor group drives the mispricing due to the limits of arbitrage	Sub-sample portfolio approach

Table 1 summarizes the hypotheses of the dissertation, the formulated research questions and the applied empirical models, which are detailed in the next chapter.

2. Research methodology

To test the first hypothesis H1 and H3, we use the complemented database where the dependent variable is binary. We model loss frequency as

$$P(loss\ event_t) = f(ESG_{t-1}, A_{t-1}, M_{t-1}, F_{t-1}, YEAR_t) \qquad (1)$$

where t is an index for years. A public loss event occurs if (i) there is a loss event and (ii) it becomes public. We assume that variables of ESG, attention of external monitors (A), market valuation (M), fundamentals (F), and the year of the incident are all relevant for modelling both the existence of a loss event and its likelihood of becoming public.

To test the second hypothesis H2 and H4, we use the basic database where the dependent variable is continuous. We model loss severity as

$$\ln\left(\frac{loss}{revenue}\right)_{i,t} = \alpha_0 + \beta \cdot ESG_{i,t-1} + \sum_j \gamma_j A_{j,i,t-1} + \sum_k \delta_k M_{k,i,t-1} + \sum_l \mu_l F_{l,i,t-1} + \sum_m \theta_m TYPE_m +$$

$$\sum_n \tau_n YEAR_n + \varepsilon_{i,t} \qquad (2)$$

where i is an index for firms and t is for years. As loss is divided by the yearly revenue of the firm, the size of the firm is taken into account, hence, we no longer include a size variable on the right side of (2).

In the panel regression models, first we introduce the aggregate ESG score, then its E, S, and G elements, and the ESG dummy separately. We use the whole sample (financial firms are also included but controlled for). To avoid reverse causality, explanatory and control variables are lagged by one year. The database has an annual frequency. Neither the exact date of damage events nor intra-year changes in ESG data are known on a daily basis. ESG scores can affect damage events, and vice versa, damage events have effect on ESG scores due to corrections involving ESG-controversary variables. Hence, ESG scores appear in the equation with a one-year lag, filtering out the feedback when damage events change the ESG score, for instance, due to tax fraud or illegal trading practices. Risk events in the database were recorded in the first year of their occurrence, so ESG scores from the previous year could not yet include corrections applied due to the risk event. Analyzing both variables simultaneously could mix causal effects, but this is avoidable by lagging the ESG score. The loss/revenue ratio, trading volume, and size (market capitalization), variables are logarithmized. All continuous variables are winsorized at 1% and 99% (except for the ESG scores). Standard errors are clustered at a firm level in all specifications.

As firms have a strong interest in hiding loss events for reputational reasons, our sample of public losses can suffer from selection bias (Berlinger et al. [2022]). To tackle this problem, we use the two-stage Heckman method (Bascle [2008], Heckman [1976]).

From the severity model (2), we exclude all variables related to the attention of external monitors (A) which are the bid-ask spread and the Amihud illiquidity measure. We can assume that the attention of investors and other external monitors has an effect only on the probability of a public loss event, but not on the loss severity. Once a loss is revealed, loss severity cannot be manipulated due to the high transparency of exchange-traded firms we investigate. Furthermore, according to Becker's (1968) crime model, deterrence depends on the probability of detection and much less on the severity of the punishment. Thus, the intense attention of external monitors discourages firms from committing a crime, but not from committing a larger crime. Therefore, it is reasonable to assume that the attention of external monitors affects the observed number of losses, but not their size.

To check the robustness of the models, further specifications are estimated. In the baseline setup, all variables are windsorized at 1% and 99% to avoid the problems deriving from the extreme outliers. To confirm the robustness of our results, we check the models without winsorization as well. As a second check, we use imputation since many missing variables decreased the number of observations. Missing data are imputed using a predictive mean matching technique, a special MICE (Multivariate Imputation by Chained Equations) method (Stata [2023]). The third analysis focuses on explicit misconducts, defined as when the loss resulted from regulatory action or legal liability (76% of all losses).

To address the endogeneity problem, we perform a two-step least squares estimation using industry mean ESG scores as an instrumental variable (IV), following (Bofinger et al. [2022]). We can assume that the industry average ESG score has an effect on a firm's ESG strategy (relevance), but besides this channel, there is no direct relation between the industry mean ESG score and its operational losses (exogeneity).

To test the hypotheses H3 and H4, we conduct formula (1) and (2). To draw conclusions concerning the various risk categories, the population was initially segmented into seven parts (events resulting from system failures causing business interruptions, improper business practices, events causing physical damage to assets, occupational harm or workplace-induced damages, incorrect (faulty) execution procedures, external fraud, internal fraud) based on the categories, followed by performing linear regression, logit regression analysis and Heckman selection.

In order to proof H5, based on Lakonishok, Shleifer and Vishny (1994) we double-sort the dataset first by past performance, then by ESG. We sort the firms, firstly into 3 past performance categories (top 30%,

middle 40%, bottom 30%) based on their compounded last 12 months returns, where we identify the top 30% as the past winners, and the bottom 30% as the past losers. After that, within each investor performance category, we perform a univariate sort along ESG scores into 3 (top 30%, middle 40%, bottom 30%) categories. The portfolios are re-balanced hence the double sort is performed monthly. The portfolio-level analysis is applied to reveal, how investors price ESG depending on their recent performance. With long-short strategies, we long the best ESG category portfolios and short the bottom ones from the same past performance category each month. To test the expected return difference of the strategy, we use the Student t-test with an alternative hypothesis that the expected return difference is significantly different from zero. After that, we run linear regression in each past performance category, where the dependent variable is the return difference between the top and bottom ESG portfolios and the independent variables are the Fama-French 3 and 5 factors, and the momentum factor.

To further explore the investor behavior behind responsibility investing (and also to test H6) we additionally perform the previous portfolio-level analysis by segmenting along firm size, the number of analysts following, and market price. The previous three variables turned out to be decent proxies to segment financial market participants along sophisticated (often institutional) and naive (often retail) investor groups. Sophisticated investors are more able to buy companies with high price magnitudes, more likely to invest in large-cap stocks, and higher number of analysts following them. In the case of naïve investors, the opposite is true. Due to the more professional trading of sophisticated investors and the particular attention to large-size stocks, the potential of mispricing is lower compared to naive investors. Therefore, after the double sorting, we divide the database into two sections along the monthly median and monthly top and bottom 30% of the observations regarding size, market price, and the number of analysts following.

3. Results of the thesis

- We find no evidence for the effects of ESG performance on the frequency of corporate misconducts, thus, Hypothesis H1 is rejected. The frequency of public loss events depends on at least two, potential offsetting effects. If higher ESG performance is associated with more prudent and transparent operations, then it is likely to reduce the number of corporate misconducts (deterrence) but increase the likelihood of misconducts becoming public (detection). It is possible that ESG actually has a strong effect on both damage occurrence and discovery, but the two effects roughly offset each other, and this is why we do not see statistically significant coefficients (Berlinger et al. [2022]). Of course, it is also possible that ESG does not have effects on the frequency of misconducts.

- Hypothesis H2 is accepted as we conclude that a one-unit of improvement in the ESG, E, or S scores decreases the severity of corporate misconducts by 3.55%, 2.85%, and 3.57% (Heckman model), or 4.47%, 4.49%, and 4.19% (instrumental variable model), respectively (in log percentages). We estimate the aggregate ESG coefficient to be between 3.55% and 4.47%. Consequently, one standard deviation (19.42) higher ESG score decreases loss severity by 50-58%, which is a significant effect also in economic terms. The aggregate effect can be attributed to pillars E and S, because G scores are not significant in most of the specifications, which is consistent with findings in the empirical literature; pillar G is the most controversial and least consensually measured part of ESG (Gillan et al. [2021]). In the finance sector, misconducts are more frequent but less severe. Interestingly, ESG (especially E and S) performance has an even stronger negative effect on the severity of misconducts in this highly regulated environment.

- Note that the ESG dummy indicating whether a firm has an ESG rating in the given year proved to be significant for severity in most of the specifications. The coefficient is between -2.77 (fixed effect panel regression) and -1.85 (Heckman model for explicit misconducts), which means that firms without ESG rating have 84-94% larger losses. This suggests that firms that refuse the invitation to participate in ESG rating programs can be extremely risky in terms of corporate misconducts.

- The results also suggest that the higher the responsibility score, the more likely a company is to experience or report an event causing physical damage to assets in the event of an operational risk incident that becomes public knowledge, hence we reject hypothesis H3. This phenomenon is

primarily explained by the fact that the damage is difficult to hide, and often the company lacks control over it, hence the market does not react negatively to these events (Perry and de Fontnouvelle [2005], Wang and Kutan [2013], Brounen and Derwall [2010]). Therefore, companies with higher ESG scores tend to admit environmental damages, as firms considering ESG factors are generally more transparent in their operations and in potential risks.

- We accept Hypothesis H4, as with a higher responsibility score, the expected loss will be lower in the category of improper business practices. Therefore, if a company improves its internal control processes and adequately trains its employees, losses in this category can be mitigated, regardless of other corporate parameters. We identify improper business practices category as a misconduct type, where the company involvement cannot be questioned.

- Hypothesis H5 is also accepted. Overall, investors tend to give away returns for higher ESG companies if they are sitting in gain. On the other hand, if they face a recent loss, they are not pricing ESG. This behavior can be originated from the house money effect, which details, that decision-makers are more risk seekers if they realized a gain in their wealth recently, and parallelly they are more conservative if they realized a loss.

- We accept Hypothesis H6 as well. Pricing the responsibility aspects of companies is more likely the case of the naive investors who are sitting in gain. The mispricing due to responsibility investing exists among them only, those who are not able to move back the prices to equilibrium due to the limits of arbitrage. There may be effects of the green investors on the sophisticated market, but the brown capital market participants immediately trade these arbitrage opportunities. The behavior model of the house money effect accelerates when the investor sentiment is relatively positive. In these times, the market anomalies become stronger, and the limits of arbitrage get more expensive. In the case of sophisticated investors, ESG is not priced in any of the market moods. In high liquidity, the potential mispricing of ESG disappears, however, the improvement of illiquidity makes the trades of this arbitrage opportunity more expensive.

Table 2. Summary of the research questions, hypotheses, and the validation of the hypotheses of the dissertation.

Research question	Hypothesis	The hypothesis has been validated	Reasonings/Findings
How ESG scores correlate with the frequency of operational loss events?	H1: The frequency of operational risks decreases with an increase in ESG scores	No	No connection or two offsetting effects
How ESG scores correlate with the severity of operational loss events?	H2: The severity of operational risks decreases with an increase in ESG scores	Yes	Higher ESG curtails operational risk severity
How ESG scores correlate with the frequency of operational loss events in different risk event categories?	H3: The frequency of operational risks decreases with an increase in ESG scores in those categories where the company involvement cannot be questioned.	No	Higher ESG score is paired with higher frequency in physical damage category, where the company involvement can be questioned due to improved transparency through higher ESG score
How ESG scores correlate with the severity of operational loss events in different risk event categories?	H4: The severity of operational risks decreases with an increase in ESG scores in those categories where the company involvement cannot be questioned.	Yes	Higher ESG score is paired with lower severity in the improper business practices category
How investors past financial experiences influence their decisions regarding ESG investments?	H5: Investors might be more willing to sacrifice return for social benefits when they face prior gains in a stock	Yes	Higher ESG score has a lower expected return for stocks with prior gains
Do naïve investors drive the revealed relations?	H6: Naïve investor group drives the mispricing due to the limits of arbitrage	Yes	Brown investors cannot immediately trade the mispricing due to the limits of arbitrage in the naïve investor group

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5. Dissemination

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