Determinants and Capital Market Consequences of Net Zero Targets

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Abstract

Net zero emission - Recently, a frequently cited climate target in the corporate sector. Meeting public pressure, gaining reputation, and optimizing resources are among the core motivations to pursue such a target. Opposed to this stand a high level of complexity and costs. Thus, from an investor's view, an assessment of profitability can be mixed. Moreover, the risk of greenwashing renders it challenging to assess the sincerity of such a target. The goal of this paper is twofold. First, I analyze which firm and industry determinants might explain net zero target announcements by Russell 1000 listed companies. Second, I measure the capital market reaction by means of an event study and examine the influence of target characteristics defined within a purpose-developed ESG score. The results reveal a significant correlation between a variety of determinants and a net zero target announcement (e.g., industry profile, firm size) and show a significant negative capital market response irrespective of a target's individual attributes. The latter result indicates a general skepticism of investors towards net zero pledges. I conclude that enhanced external enforcement options and greater transparency by companies regarding their actual target realization plans may reduce this skepticism.

Keywords: Net zero; Carbon neutral; Climate target; Determinants; Capital market consequences.

1. Introduction

"Further and Faster, Together" (Amazon, 2021, 1)

This is the slogan Amazon adopted when it published its 2020 sustainability report reaffirming its goal of reaching net zero carbon emissions by 2040. To realize this target, Amazon co-founded "The Climate Pledge" initiative in 2019. A commitment aimed at cross-industrial partnership to combat climate change. With now, more than 100 subscribed companies from sixteen different countries and 25 industries, the initiative has experienced strong growth since its inception (Amazon, 2021, 16). However, The Climate Pledge is not the only initiative that has seen a significant increase in collaborators. The Science Based Targets initiative (SBTi), a partnership of the Carbon Disclosure Project (CDP), the

United Nations Global Compact, the World Resources Institute (WRI), and the World Wide Fund for Nature (WWF), intended to guide emission reduction targets in the private sector, has also seen a surge in signatures. Since its foundation in 2015 as a result of the Paris Climate Agreement adopted at the 21st Conference of the Parties (COP21) to the UN Framework Convention on Climate Change, more than 1,000 companies have committed to emission reduction targets validated by the SBTi. In the period from November 2019 to October 2020, 370 companies joined the initiative, doubling the preceding rate of new signatures (SBTi, 2021a, 2–5).

These two examples clearly show that, as also suggested by Flammer (2013, 758), environmental responsibility is gaining importance in the corporate sector. According to the SBTi (2022), in particular, net zero targets have rapidly become mainstream endeavors. In addition to Amazon, other well-known companies such as Apple and Microsoft committed to achieving a net zero (carbon neutral) status. While Apple is committed to carbon neutrality by 2030 (Apple, 2020), Microsoft pledges to become carbon negative by 2030 and also to neutralize all emissions ever emitted in the

past by 2050 (Microsoft, 2020).

However, according to the Intergovernmental Panel on Climate Change (IPCC), this development in the corporate sector is indeed a necessity. In its most recently published sixth assessment report, "AR6 Climate Change 2021: The Physical Science Basis" the IPCC states that limiting global warming to a certain level requires at least a reduction of cumulative anthropogenic carbon dioxide (CO_2) emissions to net zero together with significant mitigation of other greenhouse gas (GHG) emissions (IPCC, 2021, SPM-36). And in 2018, in its special report on "Global Warming of 1.5°C", the panel already pointed out that this has to be achieved by around 2050 in order to avoid global warming overshooting 1.5°C and thus catastrophic consequences (IPCC, 2018b, SPM-12).

In conclusion, public pressure on companies to initiate activities to combat climate change has increased in recent years. Nevertheless, private net zero pledges are still voluntary (Lin, 2021, 16) and while a company certainly has several motivations to follow the market movement, such a commitment also comes with drawbacks. On the one hand, net zero pledges might be motivated, similarly to environmental governance in general, by "a mixture of efficiency, resource supply, competition, and reputational goals that can all be squared neatly with profit maximization, along with altruistic preferences or norms by managers, shareholders and customers" (Vandenbergh, 2013, 180). More specifically, net zero engagements may lead to more energy-efficient operations, improved morale of the employees, an enhanced reputation, and finally address pressures from external stakeholders such as customers, investors, and lenders (Vandenbergh & Gilligan, 2017, 138–53). On the other hand, however, a drawback of implementing a net zero emissions strategy is the high amount of costs associated with it. According to McKinsey (2022), a worldwide additional annual spending of $3.5 trillion on physical assets is required on average to reach a net zero economy. This corresponds to about half of the world's corporate profits. Thus, companies have several motivations to pledge net zero emissions, but probably fewer to achieve them (Lin, 2021, 23). This poses the threat of greenwashing. Net zero targets might just act as empty promises misleading consumers about actual environmental performances in order to contradict regulatory and market-related pressures (Delmas & Burbano, 2011, 66–68).

Having this in mind, from an investor's perspective, it is further quite challenging to evaluate net zero targets in their meaning. While these require, among other things, significant changes in existing production processes, transportation modes, as well as energy and economic systems (Lin, 2021, 3), they often lack precise terminology and implementation information (NewClimate Institute & Data-Driven EnviroLab, 2020, 1). Also, net zero targets can vary in their actual level of ambition and comprehensiveness. They can differ in their target timeline, can cover merely own operations or the entire supply chain, or can be narrowed down on specific regions or products (Watanabe & Panagiotopoulos, 2021, 6). Concluding, from an investor's perspective, it is not only the

sincerity but also the actual meaning of the targets that are of critical matter.

Based on these considerations, the research questions to be answered within this study are, first, to determine which firm- and industry-specific determinants and motivations relate to the publication of net zero or carbon neutral targets, which I consider synonymously within this study, and second, to what extent investors are sensitized to these. More specifically, the objective of the second part is to examine the investors' awareness on the targets by measuring the capital market reaction upon their publication in general and to investigate whether certain content-related characteristics of the announcements impact investors' capital allocations.

Because of this two-part structure of the research question, the study builds on two somewhat different strands of literature. First, the one that identifies determinants of voluntary Corporate Social Responsibility (CSR) reporting (e.g., Belkaoui & Karpik, 1989; Cormier, Magnan, & Velthoven, 2005; Reverte, 2009; Gamerschlag, Möller, & Verbeeten, 2011) and second, the one that establishes a relationship between CSR activities and financial performance (e.g., Hamilton, 1995; Klassen & McLaughlin, 1996; Flammer, 2013; Krueger, 2014; Capelle-Blancard & Petit, 2019).

While certainly environmental CSR is an already studied topic in these contexts, due to the recency of corporate efforts towards net zero emissions none of the previous work has, to the best of my knowledge, addressed this very specific topic so far. Also, in contrast to foregoing research which covers determinants and consequences of CSR disclosure mostly individually (e.g., Reverte, 2009, Krueger, 2014) I analyze both and thereby provide a comprehensive picture on this subject.

To identify determinants of net zero targets, I use a binary logistic regression model. The dichotomous dependent variable corresponds to the value 1 if a company in the US index "Russell 1000" has published such a target in the period from the beginning of 2019 to mid-2021. As independent variables, I use firm and industry-specific characteristics already found to correlate with CSR reporting in previous literature. In total, I find seven with net zero pledges significantly correlating determinants, namely, a company's country profile, industry profile, firm size, degree of innovation, financial constraints, board size, and finally past environmental performance.

In the second part of the study, I then examine the investors' awareness on net zero targets by measuring the capital market consequences. Without going into more detail on the specific content of the targets, I first examine the awareness of investors in general. For this purpose, I use an event study methodology and determine the cumulative abnormal returns over a period from one day before to five days after the target publication. Following the event study, I then compare the climate pledges in more detail using a customized Environment Social Governance (ESG) score. The ESG score includes variables to measure the level of ambition and seriousness of the targets, as well as formal characteristics of the associated announcements. I test these ESG score variables in a multiple linear regression model as potential drivers of

the calculated cumulative abnormal returns. Thereby, the significant determinants from part one function as control variables in order to separate the market effect of the disclosure caused by firm or industry characteristics from the actual content. The results of the event study allow for the conclusion that investors seem to be aware of net zero targets and to evaluate corresponding ESG investments as not profitable, at least in short term. The cumulative abnormal returns deviate significantly negatively from zero by -0.839%, on average. However, none of the as benchmark used ESG score variables seem to explain any variation in the cumulative abnormal returns. Consequently, one might assume that investors are more concerned about the fact of the target setting itself than about specific details or do not regard target specifications to be reliable. Considering the latter potential explanation, this study implies the requirement of mechanisms to increase the reliability or trustworthiness of net zero targets.

The results of my work further create a need for future research. In particular, the long-term investigation of the financial performance of companies with a net zero target is of interest. In the light of impending governmental regulations and possible cost savings through more efficient processes, a long-term competitive advantage is conceivable. Thus, investors' assessments might change over time.

The remainder is structured as follows. First, chapter 2 provides relevant definitions regarding net zero targets. Then, chapter 3 provides an overview of related theoretical frameworks and literature combined with the development of hypotheses. Thereafter, chapter 4 outlines the data collection and sample selection process. The ESG score development, as a basis for the empirical analysis, I reveal within chapter 5. Consequently, chapters 6 and 7 elaborate on the analyses performed. Finally, I discuss and conclude the findings in chapters 8 and 9.

2. Classification and definition of net zero targets

The European Commission defines CSR as "a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis" (European Comission, 2001, 8). Thus, with the environmental pillar being a subset of CSR, net zero targets can be considered as a specific CSR activity.

However, as the overarching goal of this study is to identify determinants and consequences of net zero and carbon neutral targets, the meaning of a carbon neutral or a net zero target needs to be defined in more detail. Here, two definitions by the IPCC are relevant.

a. Net zero CO_2 emissions: "Net zero carbon dioxide (CO_2) emissions are achieved when anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period. Net zero CO_2 emissions are also referred to as carbon neutrality" (IPCC, 2018a).

b. Net zero emissions: "Net zero emissions are achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period" (IPCC, 2018a).

From these definitions of the IPCC, I conclude that a "net zero" and "neutral" emission status may be regarded as synonymous, but the types and amounts of emissions covered by the targets can vary. However, I comment on this distinction at a later stage. Within this study, I use the term "net zero" as a proxy for both net zero and neutrality targets.

3. Literature review and hypothesis development

As indicated, this study can be considered as two-folded in its content and structure. Considering this and regarding net zero announcements as CSR activity in general, it contributes to two distinct strands of literature. First, to the literature on identifying determinants of voluntary disclosure and initiative adoption related to CSR, and second, to the literature on assessing the impact of CSR disclosure on economic performance and thus the awareness of investors on these. This chapter is structured accordingly. It presents for each part related literature and hypotheses.

3.1. Determinants of net zero target announcements – Theoretical frameworks

Several theoretical frameworks are used in prior research to explain the determinants of voluntary reporting of CSR-related issues by companies (Tagesson, Blank, Broberg, & Collin, 2009, 353). Among others, the agency theory, the legitimacy theory, and the stakeholder are applied.

First, the economic agency theory or positive accounting theory is used (e.g., Belkaoui & Karpik, 1989). It views the firm as a nexus of contracts between parties acting opportunistically in efficient markets. Thereby, CSR disclosure may be useful to identify implicit political costs, debt contractual relationships, or compensation contracts of managers (Cormier et al., 2005, 7). The system-oriented, social-political legitimacy and stakeholder theories, however, are considered more suitable for explaining the motives of voluntary CSR disclosure (e.g., Gray, Kouhy, & Lavers, 1995; Milne, 2002; O'Dwyer, 2003). While Gray et al. (1995, 52) view them as the ones that might allow for the most insights into CSR behavior, they posit that CSR disclosure is a means for companies to legitimize their continued existence or operations to society (Cormier et al., 2005, 7). Consequently, corporate CSR disclosure can be regarded as a way to manage public impressions and to control for political and economic influences by constructing an image or symbolic impression of itself (Neu, Warsame, & Pedwell, 1998, 267).

In fact, however, theories are often used complementary instead of contradictory to explain a company's motivations for voluntary CSR disclosure (e.g., Cormier et al., 2005; Reverte, 2009). Thereby, they follow Gray et al. (1995, 67) who state that CSR practice cannot fully be captured by only one theoretical lens. In my study, I analyze a wide range of

determinants that might explain the voluntary disclosure of net zero targets. Their potential influence, thereby, can be justified by several theories. Thus, similar to Tagesson et al. (2009) I do not rely on one specific theory, rather I use an eclectic approach to explain their content.

3.2. Determinants of net zero target announcements – Hypothesis development

In the following, I describe all the determinants I analyze. These were mostly found in prior literature to correlate significantly with the extent of CSR activism. I provide potential explanations for their associations and, thereby, refer to relevant literature. Since the pursuit of net-zero targets is a specific CSR-related area of activity, I infer hypotheses for the relationship between these determinants and the announcement of net-zero targets based on these explanations.

3.2.1. Country profile

While literature with a focus on companies located in developing countries is mainly characterized by single-country case studies (Ali, Frynas, & Mahmood, 2017, 290), related literature with a focus on developed countries considers cross-border differences and identifies significant variations in disclosure behavior (e.g., Adams, Hill, & Roberts, 1998; Maignan & Ralston, 2002; van der Laan Smith, Adhikari, & Tondkar, 2005). For instance, van der Laan Smith et al. (2005, 147) explain this effect by assuming different levels of stakeholder orientation. Thus, I hypothesize:

> **H1a:** *There is a significant relationship between country profile and net zero pledges.*

3.2.2. Industry profile

In prior research, the association between the industry sector affiliation and voluntary CSR disclosure is analyzed. Thereby, it is often shown that companies operating within industry sectors with a greater negative environmental impact disclose and report more on CSR topics. (e.g., Cowen, Ferreri, & Parker, 1987; Adams et al., 1998; Reverte, 2009). Hence, legitimacy theory might be seen as a relevant theory for reasoning. Following the findings of prior literature, I hypothesize:

> **H1b:** *There is a positive significant relationship between an industry's environmental impact and net zero pledges.*

3.2.3. Firm size

Legitimacy theory describes a public pressure perspective, which discusses the intervention of public and state institutions in organizations that are assumed to violate the social contract (Reverte, 2009, 354). This view is in line with the political cost hypothesis of Watts and Zimmerman (1990, 139) that considers size as a proxy for political attention. Consequently, large companies, in particular, tend to disclose more in order to point out that activities are legitimate and compatible with good corporate citizenship (Brammer &

Pavelin, 2006, 1173). In line with this conclusion, Dowling and Pfeffer (1975, 133) argue that due to their higher political visibility larger companies are assumed to legitimize themselves more. The firm size is one of the most frequently examined determinant in literature (Ali et al., 2017, 275). In general, in line with theory a significant positive relationship is found (e.g., Brammer & Pavelin, 2008; Reverte, 2009; Gamerschlag et al., 2011). Thus, I hypothesize:

> **H1c:** *There is a positive significant relationship between firm size and net zero pledges.*

3.2.4. Leverage

In light of agency theory, Jensen and Meckling (1976, 337–39) claim that firms with higher debt levels are likely to report voluntary information in an effort to mitigate agency costs and the cost of capital, respectively. In contrast, Brammer and Pavelin (2008, 125) argue that managers are less constrained by creditors with regard to CSR activities if the company has low leverage ratios. Belkaoui and Karpik (1989, 48) support the direction in relationship of the latter with their findings. Due to the two-fold argumentation, I do not hypothesize a directed relation:

> **H1d:** *There is a significant relationship between leverage and net zero pledges.*

3.2.5. Profitability

When looking at profitability as a potential determinant for voluntary CSR disclosure, several theories were used in prior literature for explanations. Belkaoui and Karpik (1989, 40) argue that a positive association between profitability and disclosure activism is caused by management skills. Skilled managers who achieve high profitability of their company would also have an understanding of social responsibility and thus engage more actively in related behavior. Next, based on agency theory and political cost theories, Inchausti (1997, 54) argues that managers in more profitable companies are eager to support their position and compensation through more detailed reporting. According to Ng and Koh (1994, 33), more profitable companies are subject to higher public and political pressure, wherefore voluntary reporting can be understood as a self-regulating mechanism to avoid regulatory action. Pirsch, Gupta, and Grau (2007, 127–28) link the stakeholder theory with CSR disclosure and argue that the reason for the positive correlation could also be that more profitable companies just have the economic means to consider social responsibilities in addition to their core businesses. Considering the legitimacy theory, however, Neu et al. (1998, 270) argue in two directions. First, a company with high profitability might want to show that this was not achieved at the expense of the environment. Second, companies with lower profitability might want to distract from the same or point to long-term competitive advantages. Considering again the two-folded argumentation possibility, I hypothesize:

> **H1e:** *There is a significant relationship between profitability and net zero pledges.*

3.2.6. Innovation

The determinant innovation was not selected based on findings from previous literature but on my own reasoning. The basic idea is that a company with large investments in research and development (R&D) activities concerns long-term competitiveness and is willing to allocate resources to this end. The realization of a corporate net zero status could provide a competitive advantage in the future, in particular, in light of potential improvements of processes, technological assets and competencies (Kolk & Pinkse, 2005, 9). Hence, I hypothesize:

> **H1f:** *There is a positive significant relationship between innovation and net zero pledges.*

3.2.7. Financial constraints

Reasons for the influence of the determinant "financial constraints" on CSR disclosure are probably to be seen similar to those for profitability. In particular, the argument that companies that are profitable can invest money in non-core activities seems applicable (Pirsch et al., 2007, 128). However, if one considers a company to be financially constrained if no dividends are paid, as I do within this study, a further explanation is also imaginable. For instance, a company could suspend voluntary payments in order to build up financial reserves for the costs associated with planned CSR activities. Because of the contrasting approaches, I hypothesize in a non-directed way that:

> **H1g:** *There is a significant relationship between financial constraints and net zero pledges.*

3.2.8. Board size

While a company's board size can serve as a proxy for board governance (Zainon, Atan, Ahmad, & Adzrin, 2012, 484), considering it as a predictor for voluntary CSR disclosure one can argue in two directions. On the one hand, Jensen (1993, 865) argues that a larger board size leads to lower coordination, communication, and decision-making effectiveness as well as to a more difficult monitoring process by the chief executive officer (CEO). On the other hand, as cited by Abeysekera (2010, 507), a larger board size might imply more diverse and innovative knowledge to meet global challenges more efficiently. Also, Giannarakis (2014, 410) who finds a positive correlation supports this assumption. Based on the latter, I hypothesize:

> **H1h:** *There is a positive significant relationship between board size and net zero pledges.*

3.2.9. (Independent) Non-executive board members

Empirical governance literature supports the view that the board's extent of independence is linked to its composition, and that independence promotes board effectiveness (Said, Zainuddin, & Haron, 2009, 215). Based on the results of Webb (2004, 275), who finds that socially responsible firms generally do have more independent directors,

Said et al. (2009, 215) conclude that independent directors are essential for monitoring proper company management. Further, Haniffa and Cooke (2005, 400) interpret CSR disclosures as a strategy initiated by non-executive directors to close perceived legitimacy gaps among shareholders and the management. Accordingly, I hypothesize:

> **H1i:** *There is a positive significant relationship between the proportion of non-executive board members and net zero pledges.*

3.2.10. Ownership concentration

Evidence suggests that principal agency conflicts in form of opportunistic management behavior or conflicts of interests are more likely to occur for companies with a more dispersed ownership structure (Reverte, 2009, 356). As small shareholders must rely on corporate disclosures to gather information about a company's environmental impacts, information asymmetries are likely to occur in case of their absence (Brammer & Pavelin, 2008, 124). Therefore, companies with a more dispersed ownership are expected to disclose more to reduce information asymmetries (Prencipe, 2004, 326–27). Concluding, I hypothesize:

> **H1j:** *There is a negative significant relationship between ownership concentration and net zero pledges.*

3.2.11. Government ownership

I examine the factor "government ownership" in the form of increased stockholdings by the government or by governmental institutions since the resulting increased proximity to the government could lead to increased regulatory pressure (Zeng, Xu, Yin, & Tam, 2012, 311–12). Consequently, as Patten and Trompeter (2003, 93) show, environmental disclosure could help reduce potential regulatory costs. Said et al. (2009, 223) also find a positive correlation between government shareholding and CSR disclosure. They justify this by stating that the state is an authority trusted by the public. Hence, I hypothesize:

> **H1k:** *There is a positive significant relationship between governmental stockholdings and net zero pledges.*

3.2.12. Environmental score

The idea of analyzing past environmental performance as a predictor for voluntary disclosure of net zero targets emerged from the identified positive relation between social performance and the decision to disclose social information by Belkaoui and Karpik (1989, 48). This finding supports the assumption that the aim of an in social activities engaging company is to create an impression of sensitivity to topics that might not be profitable in the short run but be of long-term shareholders' interest (Abbott & Monsen, 1979, 511–12). Additionally, one might assume that entering a net zero

target pursuit is more feasible when previous environmental performance is already high thus the gap to achieving the target is smaller. Concluding, I hypothesize:

H1l: *There is a positive significant relationship between the environmental score and net zero pledges.*

3.3. Investors' awareness on net zero target announcements – Literature review

When trying to depict the association between CSR performance and economic performance literature provides different forms of theories. Representative for early literature, Friedman's (1970) Doctrine "The Social Responsibility of Business Is to Increase Its Profits" considers social investments as additional costs that contradict profit maximization and represent a violation of the contractual principal-agency relationship between shareholders and managers. This view is challenged by the following literature. Porter (1991) as well as Porter and van der Linde (1995), for example, describe a "win-win" situation between social investments and economic benefits. Often referred to as the "Porter hypothesis" (Flammer, 2013, 760), Porter and van der Linde (1995, 105–10) argue that pollution is a manifestation of economic waste due to inefficient processes in handling resources bearing hidden costs. Thus, diminishing pollution enables cost reduction or profit maximization, respectively. Further, strict environmental standards would spur innovation and might thus promote competitiveness (Porter, 1991, 168).

By combining the two theories described above to some extent, there is a third approach to describing the relation between CSR performance and economic performance. That is, a non-linear inverted u-shaped or u-shaped correlation arguing that depending on the level of environmental performance the sign of association can turn from positive to negative or vice versa (e.g., Fujii, Iwata, Kaneko, & Managi, 2013; Lankoski, 2008).

In the spirit of the described academic work, a broad range of empirical studies analyzes the relation between CSR activities and financial performance. More specifically, the CSR awareness of equity investors by studying the impact of CSR news on firm value or stock returns, respectively. This is the research field this work may be assigned to.

Prior research finds mixed results. On the one hand, evidence is provided that positive and negative CSR events lead to market responses in the same direction (e.g., Hamilton, 1995; Klassen & McLaughlin, 1996; Capelle-Blancard & Laguna, 2010; Flammer, 2013; Crifo, Forget, & Teyssier, 2015). On the other hand, it is also shown that the news content and market responses might go in different directions (e.g., Lyon, Lu, Shi, & Yin, 2013; Oberndorfer, Schmidt, Wagner, & Ziegler, 2013; Krueger, 2014, Groening & Kanuri, 2018). For instance, using an event study methodology Krueger (2014, 40–41) finds that shareholders react strongly negatively upon negative CSR news and slightly negatively upon positive CSR news, showing the latter to be subject to the presence of agency problems and prior social responsibility.

However, some studies further indicate an asymmetric reaction on CSR news by the market (e.g., Flammer, 2013; Crifo et al., 2015; Capelle-Blancard & Petit, 2019). While negative news seems to trigger quite strong negative market reactions, positive CSR policies are not or only slightly rewarded. Capelle-Blancard and Petit (2019, 557–58), for example, find that there is a significant decrease in a firm's market value of around 0.1% on average following the publication of negative ESG news, but a barely significant effect following positive ESG news.

Another stream in the previous literature examines the effect of positive CSR activities or news as an "ex-ante insurance" effect to offset the impact of negative events (Christensen, Hail, & Leuz, 2021, 1199). Godfrey, Merrill, and Hansen (2009, 441–42), as an example, describe this insurance-like effect to appear for institutional CSR activities aiming at society at large but to disappear for technical CSRs aiming at trading partners. Also, Hoepner, Oikonomou, Sautner, Starks, and Zhou (2021, 25–26) show this effect while pointing out downside risk is lowered the most for environmental matters. Additionally, this effect, which appears to generate goodwill among shareholders, has been noted in various specific contexts including corporate scandal revelations (e.g., Janney & Gove, 2011), restatement announcements (e.g., Wans, 2020), negative events in form of negative press coverage (e.g., Shiu & Yang, 2017), the financial crisis (e.g., Lins, Servaes, & Tamayo, 2017), and the BP oil spill (e.g., Heflin & Wallace, 2017).

My study builds on the literature cited so far in that it analyzes a very recent environmental phenomenon, the target announcement of eliminating or neutralizing corporate emissions. While, in general, such an announcement by a company can certainly be interpreted as positive news related to the environment, the actual achievement of the goal is often still far away. Hence, this study analyzes not an environmental performance per se but the intention to perform well. Accordingly, the questions to be answered within this research paper are therefore on the one hand to which extent such an intention is classified as relevant from an investor's perspective and on the other hand whether differences between the announcements and the targets described therein influence investors' reactions. With respect to the latter, my work differs from previous literature. Through the results of the first part of my analysis, I can control for factors that have an impact on the CSR behavior of companies, and thus conduct a more focused content-specific investigation.

3.4. Investors' awareness on net zero target announcements – Hypothesis development

Building on previous literature that addresses the topic of emissions and investor valuation in more detail, I develop my hypotheses. Although preceding literature indeed addresses the negative pricing of emissions (e.g., Konar & Cohen, 2001; Chapple, Clarkson, & Gold, 2013; Matsumura, Prakash, & Vera-Muñoz, 2014; Clarkson, Li, Pinnuck, & Richardson, 2015; Griffin, Lont, & Sun, 2017) and the positive effect of voluntary disclosure of GHG emissions (e.g., Griffin & Sun,

2013), the question regarding the market reaction specifically to net zero targets as of the date of publication remains, to the best of my knowledge, unattended. However, based on these findings one might expect a positive stock market reaction upon net zero target announcements.

Contrary to this conclusion, Fisher-Vanden and Thorburn (2011, 444) find that companies that participate in voluntary climate initiatives suffer negative stock market reactions. Also, Dam and Petkova (2014, 600) find stock prices to drop when companies commit voluntarily to environmental supply chain sustainability programs. Since net zero targets represent the desired outcome of voluntary climate strategies while often involving the whole supply chain, I hypothesize the following:

> **H2a:** *Investors are aware of net zero targets and react negatively upon their announcement.*

Regarding the analysis of content-related drivers, I consider the finding of Johnson, Theis, Vitalis, and Young (2020, 659–60) as relevant. Their results suggest that investors value differing climate strategies unequally indicating that investors indeed consider not only the climate targets themselves but also how these are planned to be achieved. Therefore, I conclude the following hypothesis:

> **H2b:** *Announcement characteristics, especially content characteristics related to the net zero targets, affect investors' reactions significantly.*

4. Data

This chapter aims to describe the data basis for the performed analyses. To this end, it is shown what defines a relevant target, which sources are approached and how the final sample is selected. Thereafter, a summary of the final sample follows.

4.1. Data collection and selection

Following the definitions provided in chapter 2, for the purpose of data collection, I regard all climate targets with the following key terms as equally relevant: "carbon neutrality", "net zero carbon (emissions)", "net zero CO_2 emissions", "net zero CO_2 equivalents (CO_2e)", "net zero emissions", "net zero GHG emissions", "zero carbon", "zero emission", "carbon-free", "carbon negative", "climate neutral", "climate positive", "resource positive", "climate negative". In this context, it must be mentioned that "climate neutrality" according to the IPCC (2018a) glossary must be considered as a somewhat more ambitious goal, since, in addition to the net zero goal, it means that regional or local bio-geophysical effects are accounted for. Within this study, however, I do not differentiate here.

In case a company has not announced a target including the above-mentioned key terms, I regard a further type of announcement as net zero goal, namely corporate climate targets approved by the SBTi in line with a 1.5°C trajectory.

More specifically, the cross-industrial organization founded to combat climate change in line with the 2015 Paris Agreement recently founded the "Business Ambition for 1.5°C", a campaign which is intended to provide a guideline for science-based net zero targets. To become an official member of the campaign, companies must set climate targets with sufficient ambition. Simplified, a company that commits to climate targets across all scopes of emission in line with the 1.5°C future will be approved as a signatory (SBTi, 2021b, 2–3)[1,2]. Accordingly, corporate announcements stating SBTi approved climate targets across scopes in line with the 1.5°C trajectory or, more specifically, with the Business Ambition's requirements are counted as equivalent to net zero target announcements.

For my research, I focus on the US capital market because with the US rejoining the Paris Climate Agreement under President Biden in January 2021, the issue of climate change may become more prevalent again (U.S. Department of State, 2021). I treat the companies included in the Russell 1000 index as the underlying population. According to FTSE Russell (2022, 1), this index comprises about 1000 of the largest securities measured by market capitalization. Thereby, it covers about 93% of the entire US market, which is why I consider it representative. For an overview of index constituents, I start with an excel excerpt from the Stock Market MBA (2021) website. This contains a total of 1022 shares from 1014 different companies. Further, the list presents for each company the respective ticker symbols, Global Industry Classification Standard (GICS) sector specifications, insights on market capitalization as well as other information that is, however, less relevant for this work. In preparation for the empirical analyses, I supplement the list with columns for the International Securities Identification Number (ISIN) and the announcement date. Based on the list, I examine the websites, or more precisely the newsrooms, of the individual companies for announcements concerning the climate targets described above. The term "announcement" therefore means short disclosures published by a company, mainly in form of press releases, news releases, or blog posts. In a two-month data collection phase, from mid-August 2021 to mid-October 2021, I have surveyed the newsrooms for relevant announcements from the beginning of 2019 until the respective accessing date. In order to be able to draw an up-to-date conclusion about the capital market consequences of the de-

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[1]The requirement for inclusion in the Business Ambition for 1.5° C has changed to some extent from 29 October 2021 with the introduction of the "Net-zero Standard". From now on, each applicant must commit to this new standard. However, as the data collection phase has already been completed at that time, this standard is not taken into account (SBTi, 2021b, 2).

[2]Within GHG Protocol Corporate Accounting and Reporting Standard of the World Resources Institute and World Business Council for Sustainable Development (2004, 27) scope 1 emissions are defined as "direct GHG emissions [that] occur from sources that are owned or controlled by the company [...]", "scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company", and "scope 3 emissions are [all other indirect emissions and, author's note] a consequence of the activities of the company, but occur from sources not owned or controlled by the company."
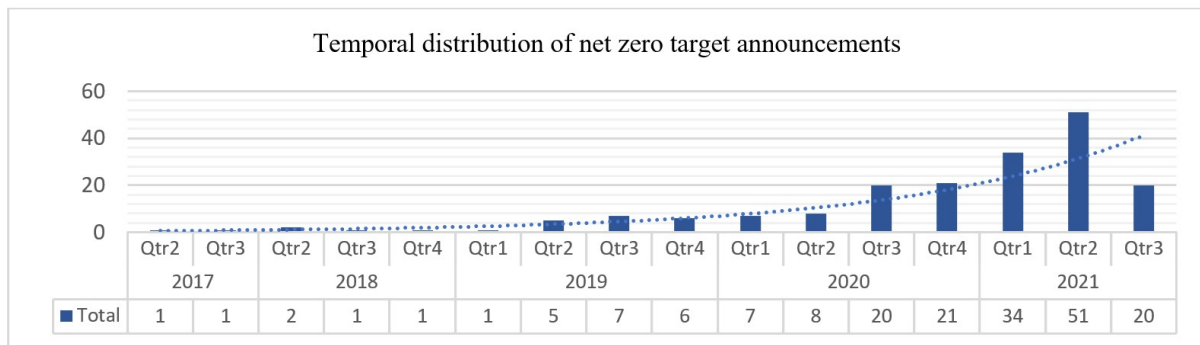
Figure 1: Temporal distribution of net zero target announcements

fined climate targets, those with a temporal scope beyond the year 2020 are under focus. For this reason and given the impending start of a new decade that could spur increased new environmental initiatives by companies, I choose 2019 as a starting point for observation. Overall, this process resulted in a total number of 186 announcements of climate targets that I classify as net zero targets. The first part of the analysis, the estimation model for firm-specific determinants, in total deals with 169 of these as I drop 17 due to lack of available financial information for certain variables.

The event study in the second part of the analysis, concerning the investors' awareness measurement, merely deals with 122 targets since several assumptions of the related research design have to be met here. First, announcements that only contain information related to the climate targets (isolated announcements) shall be considered in order to increase the probability that market effects are solely caused by these targets. Announcements that also comprise other sustainability-related, or financial information (non-isolated announcements) cannot be regarded (Gerpott, 2009, 213–14). As a consequence, starting again from the 186 identified announcements I drop 63. I classify 123 announcements as isolated. Second, the related research design requires a sufficient stock price history for each of the companies. Here, I have to drop one further announcement so that in total, as mentioned, 122 announcements build the final sample of the event study. Finally, in the second part of the analysis, I run a regression that examines investors' awareness on certain content-related factors. For this purpose, in addition to the 64 announcements already excluded, three further have to be ruled out. Two because of missing information for certain variables and one because of a parallel target announcement of two subsidiaries with somewhat distinct content at announcement date. This makes it impossible to attribute the stock price change of the group to the content published. In total, the regression specification deals with 119 announcements. Appendix 1 summarizes the sample selection process in tabular form. In the next subchapter, I describe the derived final samples in more detail.

4.2. Sample description

Without considering sample subtractions, the temporal distribution of the release dates from the initially collected 186 net zero announcements is as shown in Figure 1. In a few cases, companies referenced to net zero targets with release dates prior to 2019, but since these are still focused on a period beyond 2020, they are part of the study. Nevertheless, it should be noted that I have not actively studied the period before 2019. Thus, the number of announcements is not representative. However, even the period from 2019 onwards outlines a rising trend in the number of announcements. The increasing importance of environmental aspects within the corporate sector is reflected.

For carrying out the analysis concerning the identification of CSR determinants I use 169 of the 186 presented. Due to the consideration of prerequisites of the second part's research design, however, I discard 64 (67) announcements. Thus, the measurement of the investors' awareness is based on 122 (119) announcements. The following Table 1 presents a detailed overview of the number of collected announcements structured by GICS sector affiliation of the respective companies. In addition to the absolute numbers, the percentages of identified companies with such announcements relative to the total number of companies per GICS sector are listed.

5. ESG score for content analysis

Upon the sample definition, I perform a content analysis of the announcements. Thereby, I develop an ESG score which should enable the comparability of the announcements among the companies. The targets, so far treated as equivalent, are now examined in more detail. For the first time, this differentiated view is applied in chapter 7.3, when I measure the influence of content-related factors on capital market reactions. In the preceding analyses, I do not distinguish between the identified targets. However, in order to create an awareness that net zero targets can differ in essential characteristics, I present this chapter in advance.

In order to come up with a set of potential characteristics, applicable for the evaluation of net zero targets published within corporate announcements, I combine elements of four

Table 1: Overview of final samples

GICS sector	Russell 1000 constituents	Part 1 Non-isolated targets		Part 2.1 Isolated targets		Part 2.2	
		absolute	relative	absolute	relative	absolute	relative
Communication Services	47	9	19.15%	6	12.77%	6	12.77%
Consumer Discretionary	125	26	20.80%	19	15.20%	19	15.20%
Consumer Staples	52	10	19.23%	6	11.54%	6	11.54%
Energy	31	6	19.35%	4	12.90%	4	12.90%
Financials	144	15	10.42%	15	10.42%	14	9.72%
Health Care	122	10	8.20%	4	3.28%	4	3.28%
Industrials	153	22	14.38%	13	8.50%	13	8.50%
Information technology	177	27	15.25%	21	11.86%	21	11.86%
Materials	56	14	25.00%	11	19.64%	10	17.86%
Real Estate	68	11	16.18%	6	8.82%	6	8.82%
Utilities	39	19	48.72%	17	43.59%	16	41.03%
total	1014	169	16.67%	122	12.03%	119	11.74%
		Determinants model		Event study		Regression	

Table notes: This table presents the number of net zero target announcements of the final samples for each of the analyses performed.

Table 2: Announcement indicators

Dimension	Indicator	Reference concept			
		CA 100+	MSCI	SBTi	CAT
Content dimension	Timeframe	Yes	Yes	Yes	Yes
	Scope coverage	Partial	Yes	Yes	Partial
	Interim targets	No	No	No	Yes
	Reporting process	Yes	No	No	Yes
	Third party involvement	Partial	Yes	No	No
	Capital allocation	Yes	No	No	No
	Climate government	Yes	No	No	No
	Past activities reference	No	Yes	No	No
Formal dimension	Length	-	-	-	-
	Headline conciseness	-	-	-	-

Table notes: This table presents the indicators along which I examine the identified announcements. Additionally, it references the single indicators to the underlying theoretical concepts. "Yes", "No", and "Partial" indicate whether a reference concept uses, does not use, or uses a similar indicator, respectively.

net zero target classification concepts. First, "The Climate Action 100+ Net-Zero Company Benchmark" established by the investor-led Climate Action 100+. (2021) initiative, second, the guide of "Breaking Down Corporate Net-Zero Climate Targets" published by financial services provider MSCI (Watanabe & Panagiotopoulos, 2021), third, SBTi's concept of key dimensions of corporate net zero targets (SBTi, 2020, 14–17), and fourth, the evaluation methodology designed by the Climate Action Tracker (2021) initiative focused on national net zero targets. Table 2 presents an overview of the derived indicators and their connection with the four underlying concepts. In addition to the indicators related to the comparability of the climate targets, I consider two further indicators which categorize an announcement's length and headline conciseness.

Continuing from here, in order to enable actual compara-

Table 3: ESG score for content analysis

Dimension	Score variable	Indicator	Categorization	
Content dimension	Target level of ambition (Var.: target_amb)	Timeframe	Long-term (2036 to 2050)	1
			Medium-term (2026 to 2035)	2
			Short-term (up to 2025)	3
		Scope coverage	Not applicable	1
			Part of scopes	1
			All scopes (1,2,3)	4
				7
	Target supporting characteristics (Var.: target_su)	Interim targets	No	0
			Yes	1
		Reporting process	No	0
			Yes	1
		Third party involvement	No	0
			Yes	1
		Capital allocation	No	0
			Yes	1
		Climate government	No	0
			C-suite executive	0,33
			Sustainability related person	0,66
			CEO + Sustainability related person	1
		Past activities reference	No	0
			Yes	1
				6
Formal dimension	Announcement length (Var.: ann_l)	Length*	Word count < 300 (short)	-
			300 < Word count < 400 (medium)	-
			Word count > 400 (long)	-
	Announcement headline (Var.: ann_h)	Headline conciseness	No	-
			Yes	-

Table notes: This table presents the ESG score that should create comparability of net zero target announcements. ESG score variables, the included indicators and their potential values are defined.
*The classification within the indicator "length" is oriented on Murray (2014) who defines a press release with 300 to 400 words as optimal in its length.

bility between the announcements, I form the ESG score. In this score, I categorize and assign potential values to the respective indicators and aggregate them into variables, whose correlation with the investors' awareness I finally examine statistically. Before I go into more detail, Table 3 presents the ESG score developed. It contains the identified indicators, their potential values in qualitative and quantitative form as well as the final score variables to be tested.

Sorted by the ESG score variables, I discuss the associated indicators and their categories in the following. However, detailed keywords and identifiers within an announcement's text enabling the classification into indicator categories are presented in Appendix 2.

5.1. Target level of ambition

The variable "target level of ambition" (*target_amb*) is composed of the two indicators "timeframe" and "scope coverage". Both indicators describe how ambitious a climate target is. The "timeframe" indicator refers to the year in which the final climate target is to be achieved. Analogous to (Climate Action 100+., 2021, 1–2), I distinguish between long-term targets (target achievement in the period 2036 to 2050), medium-term targets (target achievement in the period 2026 to 2035), and short-term targets (target achievement by 2025). In general, a shorter timeframe might be considered more ambitious for a given emission reduction target (Watanabe & Panagiotopoulos, 2021, 12). The "scope coverage" indicator on the other hand distinguishes between partial consideration of the scopes of emission or consideration of all scopes of emission. The third possibility is that the company does not make any statements in this regard which is assumed to be equivalent to a partial coverage, at least when assigning quantitative values. In principle, the more scopes of emission are taken into account, the more ambitious the target (Watanabe & Panagiotopoulos, 2021, 7–10). The quantification of the categories aims at an ascend-

ing order of ambition when combining the two indicators: long-term & part of scopes (not applicable), medium-term & part of scopes (not applicable), short-term & part of scopes (not applicable), long-term & all scopes, medium-term & all scopes, short-term & all scopes. This order is based on my assumption that a change within the scope coverage categories implies a larger difference in ambition than a change of the timeframe. This is due to the fact that a consideration of all scopes of emissions implies the inclusion of emissions along the entire supply chain, thus, contrary to temporal aspects, large parts of the effort are not under the direct control of the company.

5.2. Target supporting characteristics

The variable "target supporting characteristics" (*target_su*) is designed to describe the degree of credibility of the target. It contains several indicators that would, if met, support a climate strategy, and thus increase the seriousness of the target pursuit. Therefore, the higher the quantitative value of the variable, the more credible the goal can be interpreted. Most of the included indicators, except "climate government", are dichotomous and only differ in whether they are specified in the announcement or not. More specifically, the indicator "interim targets" equals the value 1, if in addition to the final target also intermediate emission reduction targets with shorter timeframes are mentioned. Interim targets could make goals, in particular long-term ones, more transparent and accountable (SBTi, 2020, 10). The indicator "reporting process" has a value of 1 if the company states its intention to report regularly on progress. By this, the transparency on progress could be seen improved (Climate Action 100+., 2021, 11). Next, the indicator "third party involvement" is equal to 1 if the announcement mentions the cooperation with an external party to support the climate strategy. The feasibility of goal achievement could increase (Watanabe & Panagiotopoulos, 2021, 15). If the company states a fixed budget to support the realization of the target, the indicator "capital allocation" is equal to 1. The allocation of capital might enhance measurability of the goal trough quantification (Climate Action 100+., 2021, 3). It could also be a sign of the sincerity of the endeavor. Moreover, the indicator "past activities reference" is equal to 1 if the net zero target builds on previous activities to combat climate change. Preceding activities could indicate existing experience and knowledge as well as established processes to reduce emissions. The gap towards net zero status may be smaller and the probability of reaching the target higher (Watanabe & Panagiotopoulos, 2021, 13–14). Contrary to the dichotomous indicators presented, the "climate government" indicator finally is divided into several categories and describes potential responsibility allocation scenarios. These are to be considered in ascending order according to their potential of supporting the achievement of the target. In case no specific person is made responsible for achieving the target or no one is named, this is the solution assumed to be the least favorable. For the implementation of the goal, a superior solution is to assign the responsibility to a C-suite

executive (e.g., chief financial officer (CFO), chief innovation officer (CIO)). Through his/her decision-making power, an efficient realization process might be feasible. An even better solution may be to put someone who is specialized in sustainability in charge as expertise could imply higher quality decisions. I consider the best solution to be to divide the responsibility between a company's CEO and a person specialized in sustainability. Thus, the highest decision-making power of a company is backed by specialized knowledge. Efficient and high-quality decisions could be assumed from an investor's perspective. Overall, all indicators within the variable are weighted as equal in relevance. Each indicator can be assigned a maximum value of 1.

5.3. Announcement length

The variable "announcement length" (*ann_l*) does not imply an internal order, unlike the two described above. It should just be examined whether the length of the announcement has an influence on the reaction of the investors. In general, longer announcements might have the potential to provide more information to describe the climate goal and strategy in more detail. However, longer texts could also lose investors' attention.

5.4. Announcement headline

The last variable "announcement headline" (*ann_h*) is again a dummy variable. It denotes whether the final target already becomes apparent from the headline and thus the criterion "headline conciseness" is met. Including the keywords in the headline could increase the attention of investors to the announcement.

5.5. Excluded indicators

The two indicators "mitigation strategy" and "scope coverage", not listed in Table 2, were excluded from the final list in the course of the content analysis of the announcements. However, since these might be key characteristics of a climate strategy, I briefly explain the reasons here. First, the indicator "mitigation strategy" was excluded. It was designed to distinguish between climate strategies aiming at a net zero state predominantly through an actual abatement of emissions, such as through an increase in the efficiency of operations, or through offsets[3]. Previous literature finds investors to judge companies to be less valuable when emission reduction strategies rely on offsets (Johnson et al., 2020, 659). Thereby, the critics that offsets let firms appear to be environmentally responsible without changing their actual environmental impact are supported (Dhanda & Hartman, 2011, 126). However, the mitigation strategy is not considered as the analysis of the announcements has shown

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[3]According to the World Resources Institute (2010, 1) "a greenhouse gas (GHG) or "carbon" offset is a unit of carbon dioxide-equivalent (CO_2e) that is reduced, avoided, or sequestered to compensate for emissions occurring elsewhere. These offset credits, measured in tons, are an alternative to direct reductions for meeting GHG targets in a cap-and-trade system."

that information on this topic is, due to the limited length of the releases, often described only insufficiently. The second excluded indicator, "emission coverage", seeks to determine whether a company aims to reduce all forms of GHG emissions or merely CO_2 emissions. This difference in potential forms of emission coverage is indicated by the definitions of net zero CO_2 emissions and net zero emissions of the IPCC (2018a) presented in chapter 2. Emission coverage is not considered as the content analysis has revealed that keywords such as "carbon neutral", which would indicate a CO_2 emission neutralization, and "net zero emission", which would indicate the consideration of all GHGs, are often used synonymously. Capri Holdings, as an example, pledges according to the headline of its target announcement to reach net zero emissions by 2025. Later in the press release, however, the company describes the same goal as an effort to achieve a 100% carbon neutral state (Capri Holdings, 2020).

The following chapters now address the analyses based on the samples and ESG score described. First, I study corporate determinants that correlate with the publication of net zero announcements. Second, I examine the impact of these announcements on the capital market and thus the investors' awareness on these.

6. Determinants of net zero target announcements

This chapter outlines the analysis performed to identify determinants that are statistically significantly correlated with the announcement of net zero climate targets. The chapter begins with a description of the research design. Thereafter, I present the definitions of the variables under focus before I provide the descriptive and empirical results.

6.1. Research design

I use a binary logistic regression model with the fact of target announcement as dependent dummy variable. Contingent upon the firm-specific determinants as independent variables this model allows for a consistent estimation of the probability of a target to be announced (i.e., the value of the binary dependent variable to become 1). While the exact definitions of the independent variables can be found in the next subchapter, the structure of a logit regression model can be generalized via the use of a logit link function as follows (Heck, Thomas, & Tabata, 2012, 16–20):

$$logit(Y=1) = \ln\left(\frac{p(Y=1)}{1-p(Y=1)}\right)$$
$$= \ln(odds(Y=1)) = \alpha + \sum_{j=1}^{m} \beta_j x_j \qquad (1)$$

with α being the intercept and β_j representing the unstandardized regression slopes for each of the predicting variables x_j. In order to minimize the influence of extreme values, I perform a 98% winsorization on independent variables (e.g., Krueger, 2014). Additionally, I use heteroscedasticity-robust standard errors (e.g., Flammer, 2013) and test for

multicollinearity using variance inflation factors (VIF) (e.g., Reverte, 2009; Cormier et al., 2005).

6.2. Variable definition

In this subchapter, I briefly outline the technical definitions of the dependent and independent variables that were identified as relevant regarding voluntary CSR disclosure by prior literature as pointed out in section 3.2.

The dependent variable "target" (*target*) is a dummy variable that equals 1 if a net zero target has been announced by a company. Among the set of independent variables, the first is the "country profile" (*non_US*), a dummy variable that equals 1 if the first two letters of a security's ISIN is not "US". It is used as a proxy that the headquarter of the corresponding company is located outside the US. Second, I analyze the influence of the "industry profile" (*GICS_sensitive*), a dummy variable that equals 1 for more emission sensitive GICS sectors (Energy, Utilities, Materials) and zero for less emission sensitive GICS sectors (all others). This differentiation between industries by their degree of environmental impact is oriented on Reverte (2009, 358). However, I reclassify the industries he defines as "more (less) sensitive" into GICS sectors (MSCI, 2018, 1–2). Third, I analyze the "firm size" (*ln_total_assets*). Following prior literature, it is measured by a firm's total assets (e.g., Gamerschlag et al., 2011; Haniffa & Cooke, 2005). In order to avoid the variable being subject to Skewness and Kurtosis, I apply the natural logarithm (e.g., Gamerschlag et al., 2011). Fourth, I observe the variable "leverage" (*leverage_ratio*). It stands for a firm's total debt to total capital ratio in percent. Fifth, I assess the "profitability" (*ROE*) as a potential impact factor. It is measured by a firm's return on equity ratio in percent (e.g., Tagesson et al., 2009, Haniffa & Cooke, 2005). The sixth variable describes a company's degree of "innovation" (*innovation*). It equals the percentage of expenses generated by R&D activities on total assets. In case no information has been available about a company's R&D expenses I assume a value of zero, i.e., no R&D activities. Seventh, I include the variable "financial constraints" (*div_pay*), a dummy variable that equals 1 if the annual dividend per share is larger than zero indicating that a company is not subject to financial constraints. Again, if no information has been available, I assume a value of zero. The eighth variable is the "board size" (*board_size*). It equals a company's absolute number of board members at fiscal year-end (e.g., Giannarakis, 2014). The ninth predictor is the proportion of non-executive directors at a company's board (*board_NonEx*) in percent (e.g., Haniffa & Cooke, 2005), the tenth regards the "ownership concentration" (*free_float*). The latter relates to the percentage of shares available to ordinary investors less the strategic holdings (e.g., Gamerschlag et al., 2011). Following Datastream's definition of the variable, holdings of 5% or more are seen as strategic. Eleventh, I regard the fact of "government ownership" (*gov_own*), a dummy variable that equals 1 if the government or a governmental institution has strategic holdings of 5% or more of a company's shares according to Datastream. The twelfth variable I consider is a company's

"environmental score" (*enscore*). The so called "Environmental Pillar Score" calculated by Refinitiv is designed to compare the publicly-reported ESG performance, commitment, and effectiveness of companies based on the three sub-categories resource use, emissions, and innovation (Refinitiv, 2022). The ESG performance classification table provided by Refinitiv can be found in Appendix 3. Finally, I control for industry fixed effects (*gics_1,…,n*) by using a dummy variable for each GICS sector (e.g., Flammer, 2013). The central sources for all the variables and their definitions are Refinitiv's Datastream International (Datastream International, n.d.) on the one hand and the list of Stock Market MBA, 2021 that I used as a starting point for the data collection on the other hand. While I relate the values of the variables for companies with a net zero target to the fiscal year preceding the announcement date, I relate the values of the variables for the companies in the Russell 1000 Index without an announcement, the control group, to fiscal 2020, the central year of the observation period.

Following the variable clarification, the binary logistic regression model for a company i, with ε_i representing the error term, is composed as follows:

$$
\begin{aligned}
target_i = {} & \alpha + \beta_1 non\_US_i + \beta_2 GICS\_sensitive_i \\
& + \beta_3 \ln\_total\_assets_i + \beta_4 leverage\_ratio_i + \beta_5 ROE_i \\
& + \beta_6 innovation_i + \beta_7 div\_pay_i + \beta_8 board\_size_i \quad (2) \\
& + \beta_9 board\_NonEx_i + \beta_{10} free\_float_i \\
& + \beta_{11} gov\_own_i + \beta_{12} enscore_i + \varepsilon_i
\end{aligned}
$$

The following Table 4 presents for each variable the respective abbreviation, explanation, official definition within Refinitiv's Datastream, if applicable, as well as the respective source.

6.3. Results

First, I compare the characteristics of the companies with and without a net zero target announcement. Table 5 presents the results. The proportion of firms headquartered outside the US is greater in the "companies with target" group. The same conclusion can be drawn for companies operating in more emission-sensitive sectors and companies paying dividends. Furthermore, on average, firms with a net zero target have a higher amount of total assets, a higher leverage ratio, a larger board size, a higher proportion of non-executive directors on board, a less concentrated ownership structure, and higher environmental scores. All named differences are significant at a 5% level at least using a two-tailed t-test. The differences in means regarding the companies' return on equity, degree of innovation, and government ownership are not statistically significant.

Table 6 reports the correlations among all the variables in the logistic regression model. It can be seen that some correlations, for example, *ln_total_assets* to *GICS_sensitive* ($\rho = 0.12$) or *board_size* to *leverage_ratio* ($\rho = 0.13$), are statistically significant at a 10% level. However, all VIFs –

not reported – are less than 10. Therefore, multicollinearity is no problem in this study (Wooldridge, 2013, 98).

Table 7, finally, reports the empirical results of regressing the defined explanatory variables on the dichotomous dependent variable *target*. The table does not list the odds ratios associated with the variables, as these do not reveal any new conclusions compared to the coefficients presented. While model (1) includes all potential variables that have been considered so far, model (2) only includes the significantly correlating variables of model (1). Model (2) is the one that I use further in the next chapter, the measurement of investors' awareness on net zero announcements. From Table 7 it can be concluded that the likelihood of publishing a net zero target is statistically significantly positively associated with the location of the companies outside the US (*non_US*) and the operation in emission-sensitive industry sectors (*GICS_sensitive*). Furthermore, the company size (*ln_total_assets*), the degree of innovation (*innovation*), the board size (*board_size*), and the past environmental performance (*enscore*) correlate significantly positively with the probability of a net zero target pledge. However, the dummy variable *div_pay* that was intended to show the effects of financial constraints is negatively correlated. The variables intended to describe a company's leverage (*leverage_ratio*), profitability (*ROE*), number of non-executive board members (*board_NonEx*), and government ownership (*gov_own*) appear not to be significantly correlated at a 10% level. Overall, one can summarize that the hypotheses H1a, b, c, f, g, h, and l can be confirmed. Hypotheses H1d, e, i, j, and k are rejected. An overview of the hypotheses and their results is provided in Appendix 4.

Comparing the pseudo R^2 values of the two models, one can see that model (2) (0.198), reduced by the non-significant factors, has an only slightly lower pseudo R^2 as model (1) (0.200). The predictive power can therefore be considered comparable (University of California, Los Angeles (UCLA), 2021). This is the reason why only the reduced model is used in the second part of the analysis.

7. Investors' awareness on net zero target announcements

Following the identification of relevant determinants, the second part of the analysis, explained within this chapter, examines the impact of net zero target announcements on the capital market, i.e., the investors' awareness on these. First, I use an event study to examine the impact in general, before I subsequently analyze content-related drivers of the announcements based on the ESG score presented in chapter 5 by means of a regression specification. The regression specification also relies on the identified CSR determinants to serve as control variables.

7.1. Research design

In order to measure the impact of net zero target disclosures on the capital market I perform an event study methodology. In general, an event study examines the movement

Table 4: Definition of variables in logistic regression model

Variable	Measure Abbreviation	Explanation (Definition by Datastream)	Source
Target (dependent)	target	Dummy variable: Equals 1 if a net zero target has been announced (incl. not-isolated targets).	Corporate websites
Country profile	non_US	Dummy variable: Equals 1 if the first two letters of a securities ISIN are not "US".	Datastream (ISIN) / Stock Market MBA (2021)
Industry profile	GICS_sensitive	Dummy variable: Equals 1 for more emission sensitive GICS sectors (Energy, Utilities, Materials) and zero for less emission sensitive GICS sectors (all others).	
Firm size	ln_total_assets	Total assets (Datastream: "Total assets represent the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets.") - The natural logarithm is applied to avoid Skewness and Kurtosis.	Datastream (WC02999)
Leverage	leverage_ratio	Debt on Capital in percent (Datastream: (Long Term Debt + Short Term Debt & Current Portion of Long Term Debt) / (Total Capital + Short Term Debt & Current Portion of Long Term Debt) * 100))	Datastream (WC08221)
Profitability	ROE	Return on equity in percent (Datastream: (Net Income - Bottom Line-Preferred Dividend Requirement) / Average of Last Year's and Current Year's Common Equity * 100)	Datastream (WC08301)
Innovation	innovation	R&D expense on total assets in percent (Datastream: "Research and development expense represents all direct and indirect costs related to the creation and development of new processes, techniques, applications, and products with commercial possibilities.")	Datastream (R&D: WC01201)
Financial constraints	div_pay	Dummy variable: Equals 1 if the dividend per share is larger than zero. (Datastream: "Dividend per share represents the total dividends per share declared during the calendar year for U.S. corporations and fiscal year for non-U.S. corporations. It includes extra dividends declared during the year.")	Datastream (WC05101)
Board size	board_size	Number of board members (Datastream: "The total number of board members at the end of the fiscal year.")	Datastream (CG-BSDP060)
Non-executive board members	board_NonEX	Datastream: "Percentage of non-executive board members."	Datastream (CG-BSO06V)
Ownership concentration	free_float	Percentage of free float shares (Datastream: "The percentage of total shares in issue available to ordinary investors. That means total number of shares less the strategic holdings. In general, only holdings of 5% or more are counted as strategic.")	Datastream (NOSHFF)
Government ownership	gov_own	Dummy variable: Equals 1 if "[...] strategic holdings of 5% or more [are] held by a government or a government institution" (Datastream).	Datastream (NOSHGV)
Environmental score	enscore	Environmental score (Datastream: "Refinitiv's Environment Pillar Score is the weighted average relative rating of a company based on the reported environmental information and the resulting three environmental category scores.")	Datastream (EN-SCORE)
Industry fixed effects – control variable	gics_	Dummy variable for each GICS sector.	Stock Market MBA (2021)

Table notes: This table presents the definitions of all variables in the logistic regression model.

Table 5: Comparison of companies with and without net zero target announcement

	Companies without target				Companies with target				Difference
	N	Mean	p50	σ	N	Mean	p50	σ	p-value
non_US	704	0.05	0	0.22	169	0.10	0	0.30	0.012**
GICS_sensitive	704	0.10	0	0.30	169	0.23	0	0.42	0.000***
ln_total_assets	704	16.17	15.99	1.40	169	17.07	16.82	1.41	0.000***
leverage_ratio	704	40.29	40	24.74	169	48.16	49.53	20.45	0.000***
ROE	704	11.76	9.59	48.06	169	18.07	13.24	42.84	0.118
innovation	704	2.68	0	5.03	169	2.41	0	4.78	0.535
div_pay	704	0.65	1	0.48	169	0.76	1	0.43	0.0096***
board_size	704	10.16	10	2.10	169	11.22	11	2.10	0.000***
board_NonEx	704	84.29	86.67	7.57	169	86.20	88.89	7.07	0.003***
free_float	704	84.42	88	14.49	169	88.43	92	12.74	0.001***
gov_own	704	0.02	0	0.13	169	0.02	0	0.15	0.565
enscore	704	39.24	39.15	27.47	169	62.62	67.31	20.89	0.000***

Table notes: This table compares the characteristics of companies with and without a net zero target along with all independent variables in the logistic regression model. *, **, *** indicate statistical significance at the 10, 5, 1% level, respectively. Table 4 defines all variables. The continuous variables of the model are winsorized at the 1st and 99th percentiles.

Table 6: Correlations among variables in logistic regression model

		1	2	3	4	5	6	7	8	9	10	11	12
target	1	-											
non_US	2	**0.08**	-										
GICS_sensitive	3	**0.16**	-0.04	-									
ln_total_assets	4	**0.25**	0.01	**0.12**	-								
leverage_ratio	5	**0.13**	-0.04	**0.13**	**0.25**	-							
ROE	6	0.05	**-0.07**	**-0.08**	0.07	**0.15**	-						
innovation	7	-0.02	0.00	**-0.17**	**-0.34**	**-0.23**	-0.03	-					
div_pay	8	**0.09**	-0.00	**0.22**	**0.40**	**0.20**	**0.11**	**-0.40**	-				
board_size	9	**0.20**	-0.00	**0.10**	**0.52**	**0.13**	0.06	**-0.20**	**0.29**	-			
board_NonEx	10	**0.10**	0.03	**0.14**	**0.24**	**0.13**	0.07	**-0.12**	**0.16**	**0.28**	-		
free_float	11	**0.11**	0.04	**0.06**	**0.22**	0.03	**0.07**	-0.06	**0.12**	**0.16**	**0.17**	-	
gov_own	12	0.02	0.00	-0.03	0.01	0.05	0.01	**-0.06**	0.00	-0.00	0.01	-0.05	-
enscore	13	**0.33**	0.01	**0.19**	**0.42**	**0.26**	**0.19**	**-0.14**	**0.40**	**0.30**	**0.24**	**0.20**	0.02

Table notes: This table shows the Pearson pairwise correlations for all variables in the logistic regression model. Bold numbers denote statistically significant correlations at the 10 percent level. Table 4 defines all variables. The continuous variables of the model are winsorized at the 1st and 99th percentiles.

of stock prices in response to corporate events. It is a common research methodology used to analyze the awareness of investors regarding various kinds of unexpected events (Kothari & Warner, 2007, 6–9). The theoretical premise of an event study is the efficient market hypothesis (Fama, Fisher, Jensen, & Roll, 1969, 20). That is, "a market in which prices always "fully reflect" available information is called efficient" (Fama, 1970, 383). This implies that shareholders always fully consider new information. Consequently, it should be possible to determine the effect of such information on the market in its size and direction by observing stock price de-

velopments.

MacKinlay (1997) describes the procedure of an event study. In the following, I start with a summary of the basic steps. Thereafter, each step is explained in more detail. The first step is to define the event of interest as well as the period around the event in which the stock price development should be considered, the so-called event window. In practice, the event window usually comprises several days before and after the event under consideration, but at least the day of the announcement and one day thereafter. In order to control for information leakage to the market, the pre-

Table 7: Regression coefficients in logistic regression model

Dependent variable target	Model (1) Coef. / t-stat	Model (2) Coef. / t-stat
non_US	1.123***	1.107***
	(2.93)	(2.90)
GICS_sensitive	1.127**	1.089**
	(2.10)	(2.09)
ln_total_assets	0.330***	0.352***
	(2.99)	(3.24)
leverage_ratio	0.002	
	(0.51)	
ROE	0.001	
	(0.28)	
innovation	0.050*	0.049*
	(1.71)	(1.72)
div_pay	-0.563*	-0.537*
	(-1.95)	(-1.88)
board_size	0.126**	0.127**
	(2.22)	(2.24)
board_NonEx	-0.002	
	(-0.11)	
free_float	0.008	
	(0.82)	
gov_own	0.282	
	(0.40)	
enscore	0.027***	0.028***
	(5.39)	(5.46)
Constant	-10.024***	-9.702***
	(-5.04)	(-6.04)
Fixed effects	Industry	Industry
N	873	873
pseudo R^2	0.200	0.198

Table notes: This table shows the coefficients and t-statistics of all variables in the logistic regression model predicting the probability of a net zero target announcement. Model (2) only includes the significant variables of model (1). All models use robust standard errors and are controlled by industry-fixed effects. *, **, *** indicate statistical significance at the 10, 5, 1% level, respectively. Table 4 defines all variables.

event stock returns can also be of interest. To come up with the impact of the event abnormal returns need to be calculated within the event window. Abnormal returns are derived when subtracting the normal returns from the actual ex-post returns of a share on a daily basis. Thereby, the normal returns are the calculated expected returns under the assumption that the event under consideration did not occur. Various models exist to determine normal returns. These are usually based on past stock price developments over a defined estimation window, a period of 120 days, or similar prior to the event. The models come up with parameter estimates that allow for the calculation of the normal returns and thus the abnormal returns. Finally, for interpretation, the daily abnor-

mal returns need to be aggregated over the event window and to be tested for their statistical significance (MacKinlay, 1997, 14–16).

As mentioned, several models exist to measure the normal performance. In general, these can be classified into two groups – economic and statistical. While the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) are the most common economic models, the market model, the constant mean return model as well as multifactor models can be allocated to category of the statistical models (MacKinlay, 1997, 17–19). Following the discussion by MacKinlay (1997, 17–19), I choose the market model as research methodology for this study. Therefore, below I de-

scribe the steps of the event study when using the market model as normal performance model. The information provided in the following paragraphs refers to (MacKinlay, 1997, 18–24)

The first step is to set the timeline for an event study including the definition of the event window and the estimation window. Therefore, notation is required. The following Figure 2 illustrates the timeline. The subsequent Table 8 provides the related notation.

For this study, I choose the event date to be the date a company publishes its target via a press release or similar formats on its website for the first time. The choice of the event window's length (L_2) varies in prior related literature. While Flammer (2013, 769) observes the periods (-1, 0), (-1, 1), (-1, 2), and (-1, 3), Krueger (2014, 16) observes (-5, 5) and (-10,10), and finally, Capelle-Blancard and Petit (2019, 553–54) observe (-1,1) and (-5, 5). However, due to the fact that I only regard first-hand information, I assume that the potential period for information gathering on the market prior to the announcement date is limited. Regarding the posterior end of my event window, I follow Krueger (2014) and Capelle-Blancard and Petit (2019). Consequently, I consider a 7-day period from one day before the event date to 5 days thereafter (-1, 5) as my main event window. Alternative windows are also examined. More information on these follows in the next subchapter. My estimation window (-226, 26) comprises 200 trading days analogous to Krueger (2014, 15) and ends 25 trading days before the event window in order to avoid the event window to influence the normal performance parameter estimates as recommended by MacKinlay (1997, 15).

Once the event date and the lengths of event window and estimation window are defined, the market model is to be applied in order to come up with normal performance parameter estimates. The market model is a statistical, single-factor model that uses a linear relationship, based on a joint normality assumption, to estimate the return of any given security by the return of the market portfolio. For the market portfolio typically, there is a broad-based stock index chosen such as the S&P 500 Index or the CRSP Value Weighted Index. For the purpose of this study the Russell 1000 index, representing the entirety of the companies examined in chapter 6, is selected. The market model, in general form, is composed as follows (MacKinlay, 1997, 18):

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad with : E(\varepsilon_{it} = 0); \; var(\varepsilon_{it}) = \sigma_{\varepsilon_i}^2 \quad (3)$$

Thereby, R_{it} and R_{mt} are the returns of security i and the market portfolio at time t, respectively. Further, ε_{it} equals the zero mean disturbance term, α_i, β_i and $\sigma_{\varepsilon_i}^2$ are the parameters to be estimated by the model.

Given the returns of the individual securities and the market portfolio, those parameters are computed for each security using ordinary least squares (OLS) as estimation procedure. Here, the period within the estimation window is observed. For this study I use the total return index (RI) of Datastream as central source for both the returns of the single securities as well as the market portfolio. Based on these

I calculate the daily total returns in percent. By inserting the derived parameters into the market model, the returns of the individual securities that would have been expected without the occurrence of the event can be approximated within the event window. Considering these and the actually achieved returns $R_{i\tau}$, the abnormal returns $AR_{i\tau}$ for firm i caused by the event under study are derived as follows (MacKinlay, 1997, 20–21):

$$AR_{i\tau} = R_{i\tau} - \widehat{\alpha}_i - \widehat{\beta}_i R_{m\tau} \quad with : \tau = T_1 + 1, \ldots, T_2 \quad (4)$$

For large L_1 the variance $\sigma^2(AR_{i\tau})$ of the abnormal return approaches:

$$\sigma^2(AR_{i\tau}) \approx \sigma_{\varepsilon i}^2 \quad (5)$$

Continuing from here, the next step is to calculate the cumulative abnormal return (CAR) (MacKinlay, 1997, 21). The abnormal returns within the event window are added up for each company. The $CAR_i(\tau_1, \tau_2)$ is defined as the cumulative abnormal return per security i from τ_1 to τ_2, with $T_1 < \tau_1 \leq \tau_2 \leq T_2$. It is calculated as follows:

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i\tau} \quad (6)$$

For large values of L_1, its variance is composed as shown below:

$$\sigma_i^2(\tau_1, \tau_2) = (\tau_2 - \tau_1 + 1) \; \sigma_{\varepsilon_i}^2 \quad (7)$$

In order to draw conclusions about the event's impact, the abnormal returns, however, need to be considered across all companies involved. Therefore, one could calculate the average abnormal return ($\overline{AR}_\tau$ or AAR_τ) and the cumulative average abnormal return ($\overline{CAR}(\tau_1, \tau_2)$ or $CAAR(\tau_1, \tau_2)$) with the following formulas (MacKinlay, 1997, 21–24).

$$\overline{AR}_\tau = AAR_\tau = \frac{1}{N} \sum_{i=1}^{N} AR_{i\tau} \quad (8)$$

$$\overline{CAR}(\tau_1, \tau_2) = CAAR(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} \overline{AR}_\tau$$

$$= \frac{1}{N} \sum_{i=1}^{N} CAR_i(\tau_1, \tau_2) \quad (9)$$

with variances for large L_1:

$$var(\overline{AR}_\tau) = \frac{1}{N^2} \sum_{i=1}^{N} \sigma_{\varepsilon_i}^2 \quad (10)$$

$$var(\overline{CAR}(\tau_1, \tau_2)) = \frac{1}{N^2} \sum_{i=1}^{N} \sigma_i^2(\tau_1, \tau_2) \quad (11)$$

In this study, I test the statistical significance of the $CAR_i(\tau_1, \tau_2)$ across all companies for the chosen event windows following the recommendation of The Truestees of
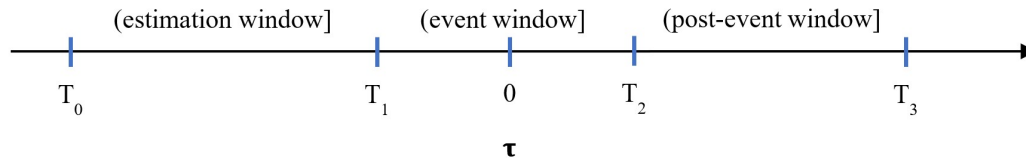
Figure 2: Timeline for an event study (MacKinlay, 1997, 20)

Table 8: Notation of timeline for an event study (MacKinlay, 1997, 19)

Timeline variable	Notation
event date	$\tau = 0$ with: $\tau \triangleq$ event time
event window	$\tau = T_1 + 1$ to T_2
estimation window	$\tau = T_0 + 1$ to T_1
post-event window	$\tau = T_2 + 1$ to T_3
length event window	$L_1 = T_2 - T_1$
length estimation window	$L_2 = T_1 - T_0$
length post-event window	$L_3 = T_3 - T_2$

Table notes: This table presents the notation required to define the event date, event window, and estimation window of an event study.

Princeton University (2007) and perform an intercept only regression model with $CAR_i(\tau_1, \tau_2)$ as dependent variable using heteroscedasticity-robust standard errors.

Similarly, to Flammer (2013), Krueger (2014), and Capelle-Blancard and Petit (2019), subsequently to measuring the direct impact of the announcements I apply a regression-based approach to determine if certain content or formal characteristics of the announcements have an impact on the cumulative abnormal returns over my main event window ($CAR_{ij}(-1, 5)$). Thereby, the variables which were found in chapter 6 to be significantly related with the company's net zero target announcements are used as control variables. The multiple linear regression model is built up as follows:

$$CAR_{ij}(-1, \ 5) = \alpha + \Gamma' X_j + \Lambda' Y_i + \varepsilon_{ij} \qquad (12)$$

where the firms are indexed by i and the events are indexed by j. Next, α represents the intercept, X_j is a vector of an announcement's characteristics, Y_i represents the vector of the firm-specific variables derived in chapter 6, and ε_{ij} is the error term. The announcement-specific characteristics are defined and explained in chapter 5. The regression coefficients in Γ' and Λ' are the ones of interest. Similar to the logistic regression I use a 98% winsorization in order to limit the influence of extreme values (e.g., Krueger, 2014). However, here I only winsorize the control variables and the dependent variable. The values of the ESG score variables are assumed not to bear outliers. Also, to contradict heteroscedasticity I apply robust standard errors (e.g., Flammer, 2013) and perform tests due to Cameron and Trivedi (1990). Furthermore, I perform collinearity diagnostics using VIFs (e.g., Matsumura et al., 2014) and test the residuals to be normally distributed by using the Skewness and Kurtosis test provided

in Stata (D'Agostino, Belanger, & D'Agostino, 1990; Royston, 1992).

7.2. Event study results

To draw conclusions about the investors' awareness on the announcement of net zero targets I test the cumulative abnormal return across the companies for statistical significance. Thus, the null hypothesis is that the $CAR_i(\tau_1, \tau_2)$, on average, equals zero. Any significant divergence - positive or negative - from random returns would imply an impact of net zero announcements on the capital market. For an initial overview of the capital market reaction, the following Figure 3 shows the development of the daily *CAARs* over a 21-day period from 10 days before to 10 days after the event date. Thereby, the figure allows for a comparison of market developments inside and outside the observed event windows.

Figure 3 generally suggests a negative impact on the capital market by net zero announcements. In particular, the period starting from the day immediately before the event date until around day 6 thereafter shows a noticeable negative development of the *CAARs*, except on day 2. Table 9 reports the statistical results derived from the event study.

The empirical results in Table 9 confirm the conclusions of Figure 3. The publication of net zero targets leads to negative stock returns around the event date. For all three event windows investigated, the intercept only model yields a negative intercept, which corresponds to $CAARs(\tau_1, \tau_2)$. For the event windows (-1, 5), the main event window, and (-5, 5), even a statistically significant negative intercept of -0.839% and -0.89%, respectively, is obtained. Accordingly, investors seem to be aware of net zero targets and to evaluate corresponding ESG investments as not profitable, at least in short term. Converted into absolute numbers, a drop in share price of
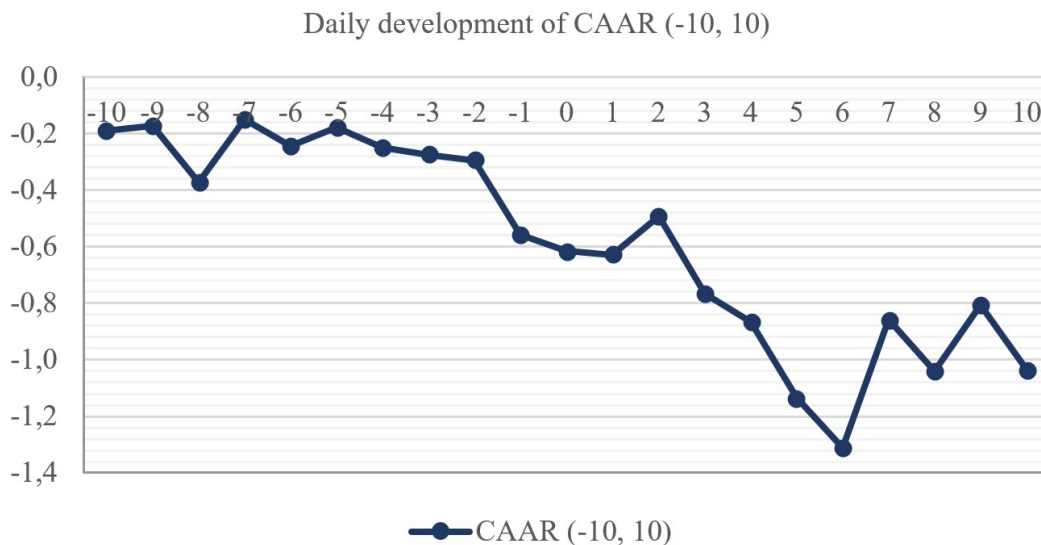
Figure 3: Development of daily CAARs over 21-day period

Table 9: Event study results

	Event windows		
	Main event window	Alternative event windows	
	(-1, 5)	(-1, 1)	(-5, 5)
$CAAR(\tau_1, \tau_2)$	**-0.839**	-0.333	-0.890
P-value	**0.049****	0.222	0.094*
N	**122**	122	122

Table notes: This table presents the results derived from an intercept only regression using robust standard errors with CAR as dependent variable for different event windows. CAAR equals the derived intercept in percent. The estimation window is (-226, -26). The shown p-value shows the statistical significance testing the null hypothesis that the mean CAR is equal to 0. *, **, *** indicate statistical significance at the 10, 5, 1% level, respectively.

0.839% relative to the median[4] market capitalization in the Russell 1000 index of USD 15.5 billion would translate into approximately USD 130 million (FTSE Russell, 2021). One could therefore also assign an economic significance to the impact on the share price. Overall, by this finding hypothesis H2a can be confirmed. Furthermore, this result is in line with the one by Fisher-Vanden and Thorburn (2011, 431). They find that announcements concerning a company's participation in voluntary environmental programs, more specifically the EPA's Climate Leaders program, and subsequent announcements of emission reduction targets lead to significant drops in stock prices of -1.0% (-1.1%) on average.

It should be noted, however, that this evaluation is based on equal treatment of all announcements and targets contained therein, although the ESG score in chapter 5 indicates, among others, potential differences in the actual level of ambition and the seriousness of target pursuit among net zero target announcements. In the following subchapter, I will therefore take a closer look at the actual content of the announcements.

7.3. Regression specification

In this subsection, I now examine the impact of the ESG score variables defined in chapter 5 on investors' investment decisions. To this end, I regress the ESG score variables as independent variables on the cumulative abnormal return of my main event window ($CAR_{ij}(-1, 5)$) using a multiple linear regression model. The significantly correlating determinants of voluntary net zero announcements from chapter 6.3 function as control variables. This is necessary as, for example, different levels of ambition might have different meanings in different industries. In the following, I will first summarize the included variables. Subsequently, I will present the results.

7.3.1. Variable definition

Table 10 below shows once again the variables used. The associated definitions are given in chapters 5 and 6.2.

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[4]Due to the large difference between median and mean (USD 411.9B (FTSE Russell, 2021)) of market capitalization, a strongly skewed distribution can be assumed. Thus, the median is chosen as the reference value.

Table 10: Overview of variables in multiple linear regression model

Dependent variable $CAR_{ij}(-1, 5)$	ESG score variables X_j	Control variables Y_i
	Target level of ambition (*target_amb*)	Country profile (*non_US*)
	Target supporting characteristics (*target_su*)	Industry profile (*GICS_sensitive*)
	Announcement length (*ann_l*)	Firm size (*ln_total assets*)
	Announcement headline (*ann_h*)	Innovation (*innovation*)
		Financial constraints (*div_pay*)
		Board size (*board_size*)
		Environmental score (*enscore*)

Table notes: This table presents the variables used to estimate the correlation between the ESG score variables and the cumulative abnormal returns over the main event window. Chapter 5 defines all ESG score variables. Table 4 defines all control variables.

7.3.2. Results

Table 11 provides the descriptive statistics of the dependent and independent variables included in the regression. The number of observations, mean, median, and standard deviation are displayed. In combination with Appendix 5 which shows the sample distribution on indicator level one can see that the cross-sample mean value of the target ambition variable (*target_amb*) (3.63) corresponds roughly to the middle of the maximum value of 7 that defines the highest level of ambition. This overall moderate level of ambition is characterized by predominantly long-term plans (68.07%) and climate strategies aiming at a partial consideration of the scopes of emission (58.82%). Furthermore, in the announcements, the companies describe the implementation of about half of the indicators included in the variable *target_su,* on average (3.2 points out of 6). In this context, interim targets (57.14%) are mostly defined, future reporting processes are mostly not mentioned (61.34%), third parties are mostly involved (79.83%), specific capital is mostly not allocated (73.11%), past activities are mostly referenced to (67.23%), and governance by a C-suite executive alone is the option indicated the most (61.34%). The announcements' headlines may predominantly be seen as concise (68.07%) and the included text is rather long (73.95%).

Table 12 presents the correlations among the variables included. Among the otherwise unremarkable associations, the high correlation between *length_2* and *length_3* ($\rho = -0.85$) is noteworthy. Both variables, however, are dummy variables representing the indicator categories long and medium of the ESG score variable "announcement length" (*ann_l*) and are thus in a natural relationship. A strong correlation is therefore not surprising. Furthermore, it should be noted that all VIFs - not reported - are lower than 10. Consequently, multicollinearity might be seen as uncritical (Wooldridge, 2013, 98).

Table 13 finally shows the coefficients derived from the multiple linear regression models performed. While model (1) only includes the ESG score variables, model (2) only examines the firm-level control variables. Model (3) combines all variables. From Table 13 it can be seen that none of the ESG score variables is significantly correlated with the cumulative abnormal return over the main event window (-1, 5). Merely the two control variables *non_US* and *board size* seem to have a weak significant influence. Also considering the adjusted R^2, it can be concluded that very little to no variance is explained by the ESG score variables. A similar result is obtained by correlating the cumulative abnormal return with the individual ESG score indicators, as shown in Appendix 6. This implies that it is not the aggregation of these to the ESG score variables that is the reason for the low predictive power. In summary, it seems that investors' awareness is not influenced by the actual content of the announcements, but more by the fact of setting a net zero target. Hypothesis H2b is therefore rejected.

8. Discussion

Taking the results of the two analyses into account, this chapter serves to discuss them further. To this end, I first briefly summarize the core findings, discuss implications based on them, point out limitations of the study, and conclude with recommendations for future research.

8.1. Summary and practical implication

The results from chapter 6 show that several determinants identified in previous literature as relevant to voluntary CSR reporting in general, can also be projected to the specific, environmental CSR topic of net zero targets. Thereby, the findings are to large extent in line with previous literature and suggest that net zero targets might be motivated by similar factors than other CSR topics. However, due to the large set of variables correlating with net zero pledges, many underlying theories could be used to explain their content. The complexity involved in this topic is indicated. Chapter 7 then suggests that investors generally react negatively or at least cautiously to such climate targets. Considering this finding stand-alone one could see this to support literature that argues CSR engagements to be costly and not valued by

Table 11: Descriptive statistics of variables in multiple linear regression model

	Variables	N	Mean	p50	σ
	Dependent variable				
	cumulative_abnormal_return	119	-0.92	-0.35	4.48
	Independent variables				
ESG score variables	target_amb	119	3.63	3	1.52
(X_j)	target_su	119	3.20	3.33	1.39
	ann_h	119	0.68	1	0.47
	length_2	119	0.20	0	0.40
	length_3	119	0.74	1	0.44
	non_US	119	0.08	0	0.27
	GICS_sensitive	119	0.25	0	0.44
Corporate determinants as	ln_total_assets	119	17.19	17.11	1.58
control variables	innovation	119	2.73	0	5.33
(Y_i)	div_pay	119	0.76	1	0.43
	board_size	119	11.29	11	2.08
	enscore	119	61.80	65.57	22.20

Table notes: This table presents the descriptive statistics for the dependent and independent variables in the multiple linear regression model. The variables length_2 and length_3 represent dummy variables for the announcement's length indicator categories medium and long, respectively. The category short is the reference length. Chapter 5 defines all ESG score variables. Table 4 defines all control variables. The dependent and continuous control variables of the model are winsorized at the 1st and 99th percentiles.

Table 12: Correlations among variables in multiple linear regression model

		1	2	3	4	5	6	7	8	9	10	11	12
CAR	1	-											
target_amb	2	0.02	-										
target_su	3	0.09	**0.29**	-									
ann_h	4	0.00	-0.00	-0.06	-								
length_2	5	-0.11	-0.06	**-0.44**	-0.10	-							
length_3	6	0.13	**0.18**	**0.54**	0.05	**-0.85**	-						
non_US	7	**-0.19**	0.01	-0.02	0.06	0.09	-0.05	-					
GICS_sensitive	8	-0.01	**-0.33**	0.02	0.02	-0.00	0.08	-0.09	-				
ln_total_assets	9	**0.22**	0.07	**0.37**	0.06	**-0.20**	**0.18**	**-0.16**	-0.01	-			
innovation	10	-0.13	**0.26**	-0.02	0.05	-0.01	0.04	0.03	**-0.25**	**-0.22**	-		
div_pay	11	**0.20**	-0.15	-0.03	0.03	-0.10	0.06	-0.06	**0.19**	**0.32**	**-0.46**	-	
board_size	12	**0.24**	-0.09	**0.18**	0.09	-0.02	0.05	-0.10	0.11	**0.43**	**-0.25**	**0.28**	-
enscore	13	0.15	-0.03	**0.21**	-0.04	**-0.27**	**0.23**	-0.06	0.12	**0.46**	**-0.30**	**0.44**	**0.34**

Table notes: This table shows the Pearson pairwise correlations for all variables in the multiple linear regression model. Bold numbers denote statistically significant correlations at the 10 percent level. Chapter 5 defines all ESG score variables. Table 4 defines all control variables. The dependent and continuous control variables of the model are winsorized at the 1st and 99th percentiles.

investors (e.g., Fisher-Vanden & Thorburn, 2011; Krueger, 2014). However, my study provides new insights for alternative explanations considering the fact that this reaction does not seem to be affected by different levels of ambition or credibility as defined by the ESG score developed.

In particular, the fact that indicators that might be ex-

pected to increase a target's credibility, such as interim targets or third-party involvements, do not impact investors' reactions in a positive direction raises questions. Considering the negative market reaction alone, one could conclude that the cost aspect associated with the realization process prevails in the assessment of the announcement or that advantages such

Table 13: Regression coefficients in multiple linear regression model

Dependent variable cumulative_abnormal_return	ESG score only Model (1) Coef. / t-stat	Control variables only Model (2) Coef. / t-stat	Combined Model (3) Coef. / t-stat
target_amb	-0.035		0.039
	(-0.13)		(0.12)
target_su	0.089		-0.122
	(0.23)		(-0.29)
ann_h	-0.016		-0.107
	(-0.02)		(-0.10)
length_2	-0.159		0.521
	(-0.09)		(0.29)
length_3	1.026		1.647
	(0.68)		(0.94)
non_US		-2.650*	-2.623*
		(-1.77)	(-1.73)
GICS_sensitive		-0.709	-0.809
		(-0.79)	(-0.80)
ln_total_assets		0.233	0.222
		(0.79)	(0.66)
innovation		-0.027	-0.043
		(-0.23)	(-0.34)
div_pay		1.242	1.213
		(1.12)	(1.03)
board_size		0.331	0.350*
		(1.66)	(1.74)
enscore		-0.001	-0.005
		(-0.05)	(-0.28)
Constant	-1.786	-9.085**	-9.752**
	(-0.95)	(-2.04)	(-2.02)
N	119	119	119
adjusted R^2	-0.027	0.055	0.023

Table notes: This table shows the coefficients and t-statistics of all variables in the multiple linear regression models estimating the cumulative abnormal return upon a net zero target announcement. Model (1) only includes the ESG score variables, model (2) only includes the control variables, and model (3) includes all variables. The variables length_2 and length_3 represent dummy variables for the announcement's length indicator categories medium and long, respectively. The category short is the reference length. Chapter 5 defines all ESG score variables. Table 4 defines all control variables. The dependent and continuous control variables of the model are winsorized at the 1st and 99th percentiles. The model is performed with robust standard errors. It is not controlled for industry-fixed effects since this results in multicollinearity issues with the variable GICS_sensitive. Also, no significant correlation for any of the GICS sectors could be observed. Controlling for time-fixed effects on a yearly basis does not lead to significant correlations, wherefore I refrain from using it. *, **, *** indicate statistical significance at the 10, 5, 1% level, respectively.

as long-term competitiveness and more efficient processes are simply not seen or not yet seen. Considering this result in conjunction with its robustness even against supposedly more reliable climate strategies, a further conclusion can be drawn. That is, little confidence is placed in the actual implementation of targets. This could be due, on the one hand, to a lack of transparency and accuracy of the measures described and, on the other hand, to a lack of enforceability and actual

accountability of companies to investors. The insights gained from the analysis of the content of the announcements, as described in chapter 5, generally confirm the lack of accuracy. It is shown that companies often do not clearly describe how a net zero status is to be achieved. For example, the question of whether this should be reached primarily through carbon reduction measures, or the purchase of carbon offsets often remains unanswered, although this difference is critical. Pur-

chasing offsets, although needed to zero out residual emissions that cannot be eliminated, is often criticized when climate strategies rely on them to a larger extent as it does not cause companies to change current processes (Kolk & Pinkse, 2005, 9–11). A company might appear to be environmentally responsible without reducing the its impact (Dhanda & Hartman, 2011, 126). So, if the implementation process is not clearly described, an investor cannot assume that processes will be lastingly optimized and that long-term benefits such as more efficient and sustainable processes will arise.

Moving on to the issue of enforceability and accountability, the following consideration is relevant. Assuming a company clearly defines which goal is to be achieved by when and with which strategy, how can the actual implementation be guaranteed to investors? Does a company really have to fear sanctions in 2050 if it fails to achieve a voluntary climate target committed to around 2020? The results of this study might suggest that investors doubt it. Lin (2021, 27–35) discusses various enforcement mechanisms on this question. More specifically, he examines securities fraud litigation, contractual arrangements, and consumer protection actions as options. While these indeed might help to enforce companies going through their climate pledges, Lin (2021, 61) concludes that it is challenging to enforce such targets due to their voluntary, long-term, and aspirational nature. Also, these mechanisms are just in the beginning to be tested for their applicability.

In summary, transparency and legal enforceability of net zero pledges might be two factors that could positively influence investors' perceptions. However, the results of the study imply that so far these are not sufficient enough to direct investors' attention towards the benefits incorporated and still bear a need for improvement.

8.2. Limitations and future research

My study is subject to limitations. First, I only use the market model as estimation model for calculating normal returns within the event window. This leads to the fact that the resulting abnormal returns and the conclusions based on them depend on the predictive power of the model design. Future research could benchmark my findings using other models such as the CAPM.

Second, one could criticize the sole consideration of short corporate releases as a source. It can be argued that press releases are particularly characterized by self-optimizing representations by the companies and therefore tend to receive little attention or credibility from investors. The results could be influenced from the outset by a skeptical attitude of investors towards them (Capelle-Blancard & Petit, 2019, 544). Supporting this hypothesis, Capelle-Blancard and Petit (2019, 554) find that press releases related to environmental CSR topics do not influence market movements. Further, it could be argued that these provide only limited opportunity for detailed descriptions of climate strategies and thus are not suitable for content analyses. While these points do indeed have their importance and should be taken into account in the interpretation, despite their drawbacks, press releases

are probably still the best possible choice. Any supposedly more objective secondary sources can only reflect the published forward-looking targets and thus are time-delayed, as are many longer CSR reports such as sustainability reports that usually follow a regular schedule. Furthermore, short releases offer the possibility to draw market-specific conclusions isolated to a specific topic. Contrary, sustainability reports, for example, also describe other non-climate specific initiatives that can also influence a market reaction. Hence, the latter cannot or only hardly be attributed to a single item of information.

Another underlying assumption of my study that might be seen as a limitation is that the study only considers short-term capital market reactions. This means that all conclusions presented refer to the changes in the total stock returns of the companies considered within a short observation window. Hence, the direction of the assessment of companies with net zero targets could change as the target is approached and milestones are reached or missed.

The latter limitation, at the same time, entails a recommendation for future research, the long-term financial performance assessment of companies with net zero pledges. Investors may evaluate companies differently if progress can be verified. This could be done in the form of a stock portfolio comparison of companies with and without these commitments.

9. Conclusion

Motivated by the scientific evidence of the urgent need to transform the economy towards net-zero emissions and the increasing number of net zero commitments in the corporate sector, in this study I examine the determinants as well as the capital market consequences of them. The objective is to understand which characteristics of a company lead to this voluntary effort and to what extent capital allocation decisions of investors are affected thereby.

The results reveal that corporate net zero pledges are significantly associated with seven of the analyzed determinants, namely, a company's country profile, industry profile, firm size, degree of innovation, financial constraints, board size, and finally a company's past environmental performance. While, in general, it seems that explanations for voluntary CSR disclosure can be transferred to voluntary net zero target commitments, the large body of correlating determinants exemplify the high complexity involved. Several underlying theories can be supported.

The company size and the environmental sensitivity of the industry profile appear to be positively correlated with a target announcement thus supporting the legitimacy theory in that companies seek to justify their existence and operations to society. Furthermore, the results suggest that especially companies that have been shown to be innovative and environmentally friendly in the past are geared towards giving the impression of long-term corporate orientation and sensitivity towards issues besides financial core activities. Furthermore, the likelihood of an announcement

seems to be positively correlated with a company's location outside the US and the size of its board. This could be seen as the stakeholder orientation being greater outside the US and a larger board leading to more diversified knowledge enabling a more efficient coverage of global challenges, respectively. The positive correlation between financial constraints in terms of non-payment of dividends in the year preceding the target setting could imply that companies withhold voluntary profit distributions to prepare for the upcoming investments required.

The analysis of the capital market consequences shows a significant negative development of stock prices as a result of net zero announcements. The cumulative abnormal returns average -0.839% over the main event window (-1, 5). This result could support the hypothesis that investors, at least in the short run, consider related ESG investments as not profitable. A content-based analysis of the announcements shows that the actual ambition of a target, several items described to support the credibility of the target, as well as formal characteristics of the announcement do not seem to have an impact on the investors' assessment.

Overall, if one wants to draw a conclusion based on the results of both parts of the analysis, one could state the following. The increasing number in net zero commitments implies the intention of companies to communicate to society that the importance of the transformation towards a net zero economy has been recognized. This seems to be particularly the case when companies are under increased scrutiny due to their size and industry affiliation, or when previous company orientations and internal structures support such a transformation. Nonetheless, it appears that investors are aware of the high costs involved and the risk of greenwashing and are acting cautiously in consequence. Two factors that could improve investor confidence are an improvement in transparency about the actual realization process being pursued and an enhancement of enforcement options. As a result, climate targets under aspirational slogans such as Amazon's (2021) "Further and Faster, Together" might receive more positive recognition on the capital market.

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