The impact of ESG characteristics on startup valuation:

An empirical study in the Venture Capital setting

Master's Thesis

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The impact of ESG characteristics on startup valuation: An empirical study in the Venture Capital setting

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Preface and acknowledgements

"Whenever you want to cheer yourself up, consider the good qualities of your companions, for example, the energy of one, the modesty of another, the generosity of yet another, and some other quality of another; for nothing cheers the heart as much as the images of excellence reflected in the character of our companions, all brought before us as fully as possible. Therefore, keep these images ready at hand."

– Marcus Aurelius

While writing this preface and acknowledgements section of my master's thesis I am reflecting upon my time as a student, and especially on the last two and a half years here in Delft. Still I consider joining the Management of Technology programme as one of the greatest decisions that I have made. The programme has allowed me to broaden my knowledge from a purely technical domain to a broad understanding of innovation management and the inner workings of technological firms. The programme enabled me to further develop my interests in business and finance, and made me discover a new personal quality for entrepreneurship. But most importantly the programme enriched my life through new friendships. I want to thank Renzo, Julia, Felix, Fin, Niklas, Saskia, Marleen, Nikki and Masa, and of course my long lasting friend Giliam and my cousin Stanley, whom I consider brothers, for making my time in Delft unforgettable. Your companionship with your diverse qualities have quite honestly cheered the heart. I wouldn't want to have missed a single thing.

I would like to express my gratitude to my, oddly large, graduation committee. I am grateful for each of you to have reserved the time to supervise me and for showing sincere interest in the research topic. But also for showing interest in the human aspect of writing a thesis - making clear that personal health should always be prioritized over work. As I can easily lose myself in hard work and ambitious goals, this human touch provided me with some moments of self-reflection. My deepest gratitude goes out to my advisor Dr. Aleksandrina Ralcheva, without whom I would have been lost at sea. Her guidance and constructive feedback made my research stronger. Furthermore, I would like to thank my chair and first supervisor Dr. Geerten van de Kaa, my second supervisor Dr. Hanieh Khodaei and my advisor Dr. Fátima Delgado Medina. I am grateful for your valuable input.

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Finally a big word of thanks goes out to my parents Harmen and Marleen, who supported me throughout my studies with their love and with all the resources necessary. To my sister Suzanne, and to my girlfriend. I am looking forward to what the future holds.

Thomas Bos
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Executive summary

While substantial academic work has addressed the environmental, social and governance (ESG) topic and how firms' ESG characteristics impact their financial performance and valuations, relatively little ink has been spilled on the issue in the entrepreneurial finance literature. Important questions such as how economically attractive it is for entrepreneurs that seek funding from professional investors to focus on their sustainability performance, remain unanswered. An important impediment for researchers and for investors in the entrepreneurial finance markets wanting to adopt the practice of responsible investing, has been the lack of a unified framework for the assessment and quantification of startups' ESG characteristics. Therefore, the research objective of this thesis is first to propose a framework that can measure startups' ESG risk. And second, to establish the initial empirical linkage between startups' ESG characteristics and their financial valuations by venture capitalists, through applying this framework.

To accomplish the first objective, the status quo of ESG frameworks and related literature is assessed. The proposed startup ESG framework builds on this theoretical background and is based on relevant risk categories, indicators and risk models of established frameworks. One major strength of this framework is that it can evaluate a startup on its sustainability performance purely based on its pitch deck and publicly available documentation. A second major strength is that it is transparent. Entrepreneurs can use it to assess their own startups and discover how they can improve their sustainability performance.

The framework is then applied to a sample of 47 technological startups that seek funding from the Dutch venture capital (VC) firm FORWARD.one, covering the period 2017 - 2022. The resulting ESG risk scores are used to empirically examine what the impact is of startups' ESG characteristics on their financial valuations by venture capitalists. A review of the literature on the relationship between firms' ESG characteristics and financial valuation, together with anecdotal evidence from the VC industry, leads to the hypotheses that ESG risk is lower in VC-backed startups as compared to non-backed startups, and that there exists a negative relationship between startups' ESG risk scores and their financial valuations by venture capitalists. Multiple one-tailed Independent Sample t-Test and Multi Linear Regression (MLR) analyses are performed to test these hypotheses.

Results of the Independent Sample t-Tests indicate that the ESG risk of a startup does have an impact on the investment decision of the venture capitalist. The VC-backed startups have on average 12.46% lower ESG risk than non-backed startups. The results of the MLR analyses furthermore indicate that there exists a negative relationship between ESG risk and financial valuation. For every one full point increase in ESG risk score, the pre-money valuation of a startup decreases by 28.92%.

As a result, also those entrepreneurs that seek funding from venture capitalists have an economic incentive to work on their sustainability performance. However, the results of post-hoc analyses with impact scores used instead of ESG risk scores, indicate that sustainability performance is only valued to the extent that it concerns ESG risk management, i.e. minimising ESG-related negative externalities. The creation of ESG-related positive externalities is not valued by purely financially driven (i.e. non-impact) VC firms. While this study does not attempt to establish a causal mechanism, the results can be explained through anecdotal evidence which suggests that institutional investors are increasingly

incorporating the practice of responsible investing due to social norm pressure and new regulations, and are pushing their asset managers - among which venture capital General Partners (GPs) - to follow suit (e.g. Botsari & Lang, 2020; Florman & MacKay, 2012; Lloyd & Schraven, 2020; Wiek & Villegas, 2022). The startup ESG framework proposed in this study can help these GPs to abide to the expectations of their investors to adopt more meaningful approaches to responsible investing. Fund managers can use the framework during the due diligence process to assess the startups in their deal flow but also during their fund lifetime to monitor the sustainability performance of portfolio companies over time.

The existence of an economic incentive for entrepreneurs to focus on sustainability performance implies that the Schumpetarian logic of 'creative destruction' might also apply to the notion of sustainable entrepreneurship (Schumpeter, 1934, 1942). Namely, due to high demand for ESG, sustainable startups might replace unsustainable businesses (Mansouri & Momtaz, 2022). This demand for sustainable entrepreneurial ventures furthermore highlights the importance of recent regulation initiatives, such as the Sustainable Finance Disclosure Regulation (SFDR), aiming to tackle greenwashing. Without such regulations, opportunistic fund managers might be inclined to greenwash VC funds to their investors who demand responsible investments, in an attempt to raise more capital and increase management fees.

The finding that the creation of positive ESG-related externalities is not valued by purely financially driven investors does not come as a surprise. Where considering ESG risks is part of the fiduciary duty of the institutional investor, because these risks can be financially material, philanthropy or maximising impact is not part of this fiduciary duty. As a consequence, impact startups that want to raise funding from purely financially driven venture capitalists should still have a solid business case, because there needs to be the prospect of a profitable exit opportunity. In essence, the market takes care of allocating capital to startups that operate sustainably, but is not by itself able to fund all organisations that actively aim to contribute to solving today's societal challenges. Intergovernmental policy initiatives such as the European Green Deal have enabled viable business cases for impact startups, through giving a strong directional signal to the market about the necessity and future demand for certain products and technologies. Thereby these initiatives have also opened up broader funding possibilities to these impact startups in the private market. But dedicated impact funds with an impact or philanthropy mandate, as well as government subsidies, are essential funding mechanisms for the remaining impact startups that, because of a weak business case, find themselves unable to raise funding from purely financially driven investors.

The findings contribute to the still emergent literature around the role of ESG in entrepreneurial finance markets and several promising avenues for further research are suggested.

Keywords: startup; ESG framework; financial valuation; entrepreneurial finance; venture capital

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Abbreviations and acronyms

AUM	Assets under management
CV(s)	Control variable(s)
DD	Due diligence
DV	Dependent variable
EBRD	European Bank for Reconstruction and Development
ESG	Environmental, social and governance
GICS	Global Industry Classification Standard
GP(s)	General Partner(s)
IPO	Initial public offering
IV	Independent variable
KPI	Key Performance Indicator
LP(s)	Limited Partner(s)
MLR	Multiple Linear Regression
NACE	Nomenclature of Economic Activities
OLS	Ordinary Least Squares (regression)
PCA	Principal Component Analysis
PRI	Principles for Responsible Investment
RI	Responsible investment
SAM	Serviceable Addressable Market
SDGs	Sustainable development goals
SE	Sustainable Entrepreneurship
SFDR	Sustainable Finance Disclosure Regulation
SOM	Serviceable Obtainable Market
SRI	Socially responsible investment
TAM	Total addressable market
UN	United Nations
VC	Venture Capital

1 Introduction

1.1 Background

The increase in public awareness about global social and environmental issues has had its impact on the social norms governing our society. This shift in norms is reflected by recent European legislation initiatives such as the Sustainable Finance Disclosure Regulation (SFDR) which has required financial market participants, including pension funds, insurance companies, investment firms and asset managers, to disclose whether and how they integrate sustainability risk in their investment processes (Autoriteit Financiële Markten [AFM], 2021; Martini, 2021). According to Hong and Kacperczyk (2009) social norms are shaping factors in economic behaviour and occasionally overthrow the financial profit motive of market participants. Especially institutional investors who are subject to social norm pressures (e.g. pension funds, insurance companies and state-owned investment funds) stay away from assets that promote vice and in the process incur a financial cost in the form of a lower risk-return ratio - being the result of a less diversified portfolio. Hence, those institutional investors who have been disregarding these important social and environmental issues have increasingly been subject to public scrutiny (Anand et al., 2021).

The practice of responsible investing incorporates the consideration of environmental, social and governance (ESG) issues in investment decision-making (United Nations, 2021) and can be seen as the conciliation of finance with the United Nations' Sustainable Development Goals (SDGs). These goals intend to ensure that the needs of the present are met in such a way that the ability of future generations to meet their own needs is not compromised (Brundtland, 1987). In order to effectuate these goals appropriately allocating capital is crucial (Widyawati, 2020). Since the publication of the United Nations' Principles for Responsible Investment (PRI) the notion has gained considerable traction in academia (e.g. Arefeen & Shimada, 2020; Camilleri, 2021; Martini, 2021; Saci et al., 2022; Sciarelli et al., 2021) but also in practice. At the moment of writing almost 4,000 institutional investors, who together manage 121 trillion US dollars in assets, have signed the principles.

1.2 Research problem and objective

Recently, industry experts have started to question the magnitude of the impact of responsible investment practices in the public market domain (Kishan, 2021). ESG funds operating in this space merely shift capital in the secondary market and divestment actions have proved to be hardly effective (Kishan, 2021; Teoh et al., 1999). According to these experts much larger impact can be made by private long-term funds that seek to finance impactful endeavours: startups.

But while substantial academic work has addressed the ESG topic and how firms' ESG characteristics impact their financial performance and valuations, relatively little ink has been spilled on the issue in the entrepreneurial finance literature. Similarly, only few scholars in the related Sustainable Entrepreneurship (SE)[1] domain have examined the economic implications of SE (e.g. Guzmán et al.,

[1]While there exists some disagreement about the exact definition of sustainable entrepreneurship I will build on the

2020; Hörisch, 2015; Mansouri & Momtaz, 2022; Vismara, 2019). A rather large impediment has been the lack of publicly available data on startup funding and sustainability characteristics. It is therefore that researchers have thus far only focused on the crowdfunding and token offering setting, where relevant information is provided to the public in order to obtain funding. These funding arenas significantly differ from conventional entrepreneurial funding sources however, as these platforms are predominantly populated by relatively young retail investors with profound sustainability preferences (Fisch et al., 2021; Mansouri & Momtaz, 2022). The question thus remains how economically attractive it is for entrepreneurs that seek funding from professional investors to focus on their sustainability performance.

This thesis empirically tests whether the positive relationship between ESG characteristics and firm valuation that is found in the public market setting and the crowdfunding and token offering setting also holds true within the Venture Capital (VC) context. The analysis exploits detailed deal flow and investment data from the Dutch VC firm FORWARD.one, covering the period 2017 - 2022. This confidential data is generously shared for the purpose of this study, enabling for the first time the empirical linkage between ESG factors and startup valuation by venture capitalists.

FORWARD.one is a Dutch independent venture capital firm with registered office in Amstelveen and EUR 180 million in assets under management (AUM). The firm invests in high-tech startups that develop hardware technologies and has over the last five years positioned itself as one of the leading Dutch investors in the deep tech sector. Some of their investments have for example been in the photonics and quantum computing fields. Other focus areas within their investment scope include robotics, chips and circuitry, and smart industry. FORWARD.one is furthermore specialised in Business-to-Business propositions and works with a geographical scope covering the Netherlands, Germany and the Nordics. Their investments - or 'ticket sizes' - typically range from EUR 0.5 million to EUR 5.0 million focussing mainly on early-stage companies that have some initial traction such as a working prototype or pilot projects. The firm aims to help their portfolio companies' founders grow their companies from 5 to 50+ employees. FORWARD.one started to include ESG considerations in their due diligence process from the start of their second fund onward - July 2021. Before this moment no considerations for ESG were made. This thus enables the inspection of a structural break in the data. The following main research question is derived:

What is the impact of startups' ESG characteristics on their financial valuations by venture capitalists?

The lack of publicly available data is however not the only barrier that has withheld scholars from answering this question. Another large impediment for both researchers and investors in the entrepreneurial finance domain is that one cannot rely on ESG ratings provided by rating agencies. Over the years numerous agencies such as analysts and research firms have started to collect and analyse firms' environmental, social and governance data and have developed their own ESG frameworks to assess these firms on their sustainability performance (e.g. KLD, ASSET4, Bloomberg, Sustainalytics, EIRIS, SAM, Vigeo, and Innovest) (Camilleri, 2021; Mansouri & Momtaz, 2022; Widyawati, 2020). The assessments are then provided to the market in the form of ESG ratings, quantitative and easy to compare outputs of the assessments. These ratings are used by market participants to operationalise the abstract concept of sustainability and serve as an important enabler for the responsible investing paradigm (Widyawati, 2020). However, ESG rating agencies only provide ratings for mature firms listed on public stock exchanges, and their widely used frameworks for measuring ESG characteristics are not directly applicable to startups. A recent article by the World Economic Forum highlights the importance of startup-friendly ESG metrics (Yoon & Watt, 2022). But a unified framework for

inclusive definition formulated by Mansouri and Momtaz (2022, p. 5). Namely, "SE encompasses all entrepreneurial activity that, in addition to positive financial returns, aims to generate non-negative non-financial returns related to environmental, social and governance aspects."

the assessment and quantification of startups' ESG characteristics is still absent from the literature (Mansouri & Momtaz, 2022; Zhang, 2022). This begs the question, when there exists no valid method for measuring sustainability risk in startups, how should investors in the entrepreneurial finance markets incorporate the practice of responsible investing?

The first step in answering the main research question is therefore to determine how sustainability risk in startups can be measured. The status quo of ESG frameworks and related literature is critically assessed and a new framework is proposed that is especially tailored to startups. The lack of such a framework is currently the most important impediment for investors wanting to implement the practice of responsible investing in the entrepreneurial finance markets (Wiek & Villegas, 2022; Zhang, 2022). Adoption of this framework by other scholars furthermore creates the opportunity to compare results across subsequent ESG studies in the entrepreneurial finance setting (Mansouri & Momtaz, 2022).

Sub-question 1: *What indicators can be used to measure ESG risk in startups?*

Sub-question 2: *How can the ESG risk rating of a startup be determined?*

The framework is then used to assess the sample of startups on their sustainability characteristics. The resulting ESG risk scores form the basis for the empirical investigation into the impact of startups' sustainability characteristics on their valuations. First it is checked whether ESG risk does matter for venture capital decision-making. The literature and anecdotal evidence suggest that it does. Multiple independent sample t-tests are performed to empirically confirm this. Subsequently numerous Multiple Linear Regression (MLR) models are estimated to examine the relationship between ESG risk and financial valuations.

Sub-question 3: *Does ESG risk matter for venture capital decision-making?*

Sub-question 4: *To what extent do startups' ESG scores impact their valuations by venture capitalists?*

The results show that the level of ESG risk within a startup does impact venture capital decision-making and the startup's financial valuation: for every one full point increase in ESG risk score, the startup's valuation decreases by 28.917%. This means that also those entrepreneurs that seek funding from venture capitalists have an economic incentive to work on their sustainability performance. However, this study finds that sustainability performance is only valued to the extent that it concerns ESG risk management, i.e. minimising ESG-related negative externalities. The creation of ESG-related positive externalities is not valued by purely financially driven venture capitalists.

The study thus contributes to the still emergent literature around the role of ESG in entrepreneurial finance markets in two ways. First, by proposing an ESG framework that is applicable to startups. Researchers can use this framework in further studies to quantify startups' sustainability performance. Investors can use this framework during the due diligence process to assess the startups in their deal flow but also during their fund lifetime to monitor the sustainability performance of portfolio companies over time. And second, by extending the findings of previous studies about the relationship between firms' ESG characteristics and their financial valuations into the venture capital setting.

The study is relevant from the perspective of the Management of Technology master programme, because it addresses how firm characteristics might influence the financing ability of technological firms. It can furthermore be argued that venture capitalists play a vital role in the open innovation process, as VC firms fund innovative spin-out projects and other startups that might later be acquired by a corporate as a form of technology insourcing.

1.3 Setting

Venture capital provides an interesting setting because it is regarded as one of the most prominent sources of startup funding (Bocken, 2015). Anecdotal evidence furthermore suggests that institutional Limited Partners (LPs)[2] are increasingly expecting their VC fund managers to adopt more meaningful approaches to responsible investing (Florman & MacKay, 2012; Lloyd & Schraven, 2020). This picture is also painted by the results of a recent PitchBook survey, showing that 59% of venture capital LPs evaluate fund managers' implementation of an ESG risk factor framework during their due diligence (DD) and only 25% indicated that the use of such a framework by fund managers is not at all important (Wiek & Villegas, 2022). Presumably this is driven by the new regulations and shifts in social norms these institutional LPs are subject to.

As a result however, there exists an economic incentive for General Partners (GPs) to incorporate ESG considerations in the investment decisions of the fund. Namely, if institutional investors are sorting for VC funds that incorporate ESG considerations, VC funds that do not incorporate those considerations will increasingly struggle to raise funds from these institutional investors. Thus, by incorporating ESG considerations more institutional LPs can be attracted, increasing the assets under management of the fund which in turn increases the management fees and carried interest for the GPs. The mechanism through which this works and how this presumably impacts startup valuations is presented in Figure 1.1.

This makes it clear that ESG is becoming an increasingly important topic for venture capitalists. A survey by the European Investment Fund in 2019 indeed showed that 73% of all European VC respondents had implemented some sort of ESG considerations in their investment decision processes (Botsari & Lang, 2020), and the PitchBook survey results show that 59% of GPs is planning on further increasing attention to ESG risk factors in the coming year (Wiek & Villegas, 2022).

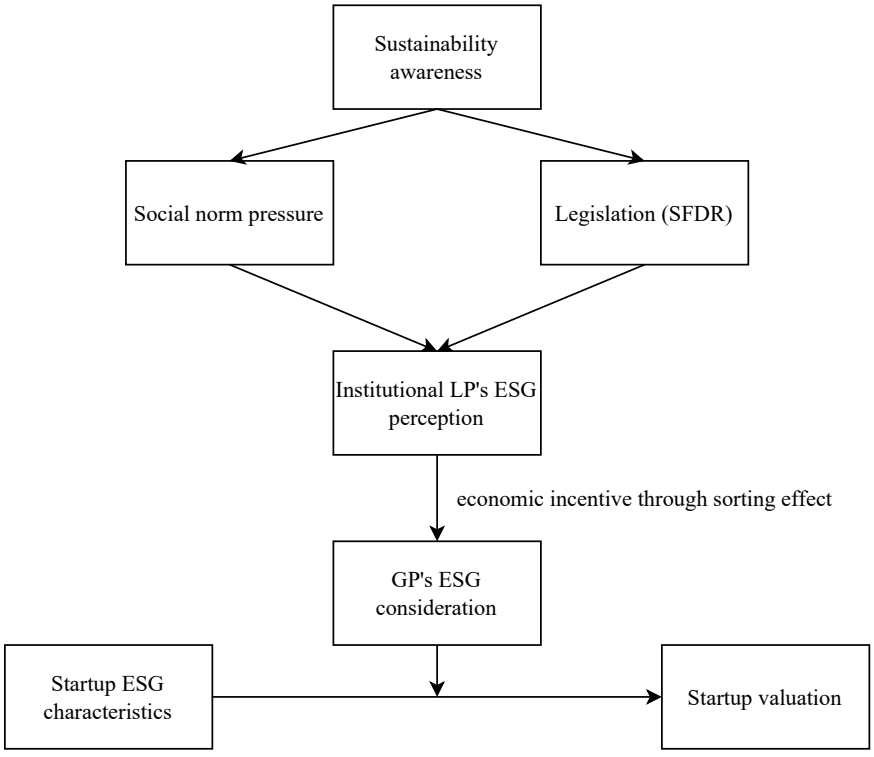

Figure 1.1: The mechanism through which startups' ESG characteristics are expected to impact their valuations in the VC setting

[2]A brief introduction to the VC governance structure and business model can be found in Figure A.1

1.4 Outline

The remainder of the thesis is organised as follows. Chapter 2 presents the theoretical background. The chapter discusses the various definitions that are related to the notion of responsible investing and makes explicit the definition that is used in this study. The status quo of ESG frameworks and related literature is furthermore assessed. Chapter 3 provides a review of existing literature on the relationship between ESG performance and firm valuation and presents the derivation of hypotheses. Chapter 4 then answers sub-questions 1 and 2. Here the startup ESG framework is developed, one of the main theoretical contributions of this study. The framework builds on the theoretical background and is based on existing frameworks' indicators and risk models. This framework then, through its ability to assess and quantify startups' ESG characteristics, enables the empirical research in the remainder of the chapters.

Chapter 5 sets about the empirical part of the study and discusses the sample of startups and the empirical methodology used to examine what the impact is of startups' ESG characteristics on their financial valuations. Independent sample t-test and MLR analyses are performed to test the hypotheses developed in chapter 3. Hereby the startup ESG framework proposed in chapter 4 is operationalised to quantify each startup's ESG performance. In chapter 6 the empirical results of the t-test and MLR analyses are reported, as well as the results of multiple post-hoc analyses. The results of the t-tests answer sub-question 3 and the results of the MLR analyses answer sub-question 4 as well as the main research question.

Finally, chapter 7 concludes the thesis with a discussion of the results, a description of the theoretical contributions and practical implications, the limitations and avenues for further research and some concluding remarks. Figure 1.2 presents this outline and shows how the sections are organised.

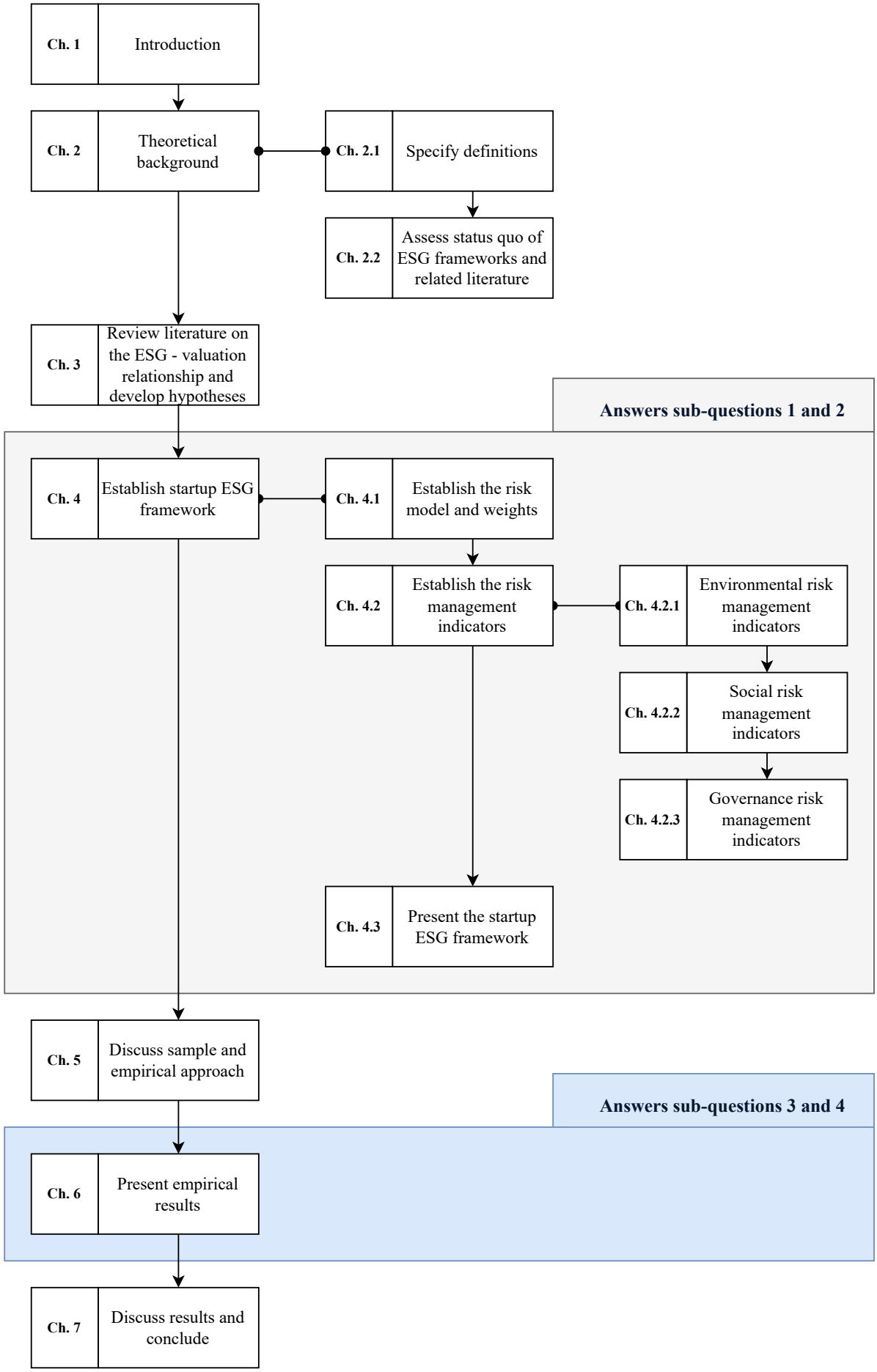

Figure 1.2: Thesis outline

2 Theoretical background

2.1 The definition of responsible investing

In the vast literature on responsible investing many definitions of investment approaches are used, such as responsible investing (RI) (e.g. Gillan et al., 2021), socially responsible investing (SRI) (e.g. Arefeen & Shimada, 2020; Martini, 2021; Sciarelli et al., 2021), sustainable investing (e.g. Bocken, 2015; Mansouri & Momtaz, 2022), and impact investing (e.g. Zhang, 2022). While not all these approaches have the same intentions (e.g. impact investing is aimed at creating positive financial returns as well as positive non-financial returns, while responsible investing is aimed at creating positive financial returns and non-negative non-financial returns) they are often used interchangeably in the literature.

In this research I follow the definition that is used by the United Nations in their Principles for Responsible Investment. "The PRI defines responsible investment as a strategy and practice to incorporate environmental, social and governance (ESG) factors in investment decisions and active ownership. (....) A key to understanding how responsible investment is broader than [other] concepts is that where many make moral or ethical goals a primary purpose, responsible investment can and should be pursued by the investor whose sole focus is financial performance, as well as those looking to build a bridge between financial risk/opportunities and outcomes in the real world." United Nations (2021, p. 4) In other words, responsible investing is concerned with sustainability risk management - as opposed to impact investing which is concerned with pursuing sustainability opportunities.

According to the PRI, ESG issues can have financially material implications for investors. Therefore, integrating ESG criteria in the investment decision-making and portfolio management processes of institutional investors is part of their fiduciary duty (United Nations, 2021). Relating this to the venture capital setting it is clear that whereas impact investing should only be pursued by impact funds, every VC should pursue responsible investing.

Young-Ferris and Roberts (2021) criticise the PRI in their case study for stating that ESG issues can have financially material implications, because they claim the issues which are assumed to be costly are externalities and are thus not a cost for the focal firm and its investors but a cost for third parties. However, while the costs of irresponsible everyday operations might be externalities, such a modus operandi creates risks of social or environmental incidents which costs are certainly not externalities. This is in line with Krüger's (2015) findings that negative sustainability events are followed up by strong negative market reactions. Furthermore, to achieve the United Nations' SDGs precisely these externalities need to be internalised (Bocken, 2015), requiring irresponsible firms to take costly measures. Therefore, in this research I assume that ESG issues can have financially material implications.

2.2 Status quo of ESG frameworks

2.2.1 Frameworks and indicators

Scholars have used ESG metrics for two reasons. Namely, qualitative and conceptual studies view ESG metrics as an enabler of the responsible investing paradigm, while quantitative studies generally use ESG metrics as a proxy measurement for sustainability performance (Widyawati, 2020). This is because sustainability is an abstract concept which cannot be measured directly. Moreover, Widyawati (2020) finds that the operationalization of the concept through the use of ESG metrics as a proxy has developed in line with the responsible investment paradigm. Namely, in the nineteen-nineties responsible investing predominantly consisted of negative screening, i.e. excluding companies that were not considered ethical from investment consideration (Camilleri, 2021; Sciarelli et al., 2021). During this time the first generation of ESG metrics emerged which were basically dichotomous values indicating compliance or non-compliance with social or environmental impact criteria. In later years the responsible investment paradigm started to shift towards a balance between negative and positive screening, where positive screening refers to a best-in-class approach to include the best performing companies from the investment opportunity set (Sciarelli et al., 2021; Widyawati, 2020). To accommodate positive screening, ESG metrics evolved from dichotomous values to aggregated ratings on the interval measurement scale, consisting of many scores on the individual E, S, and G dimensions making up the ESG metric. Hereby environmental factors refer to factors such as climate change, emissions, resource depletion, waste and pollution. Social factors refer to factors such as human rights, working conditions and employee relations. Governance factors refer to factors such as board diversity and structure, tax strategy, bribery and corruption, executive pay, and political lobbying and donations (Sciarelli et al., 2021; United Nations, 2021). This is a non-exhaustive list but it serves to grasp the taxonomy of ESG and the ESG metrics.

The introduction of ESG metrics and ESG rating agencies has significantly accelerated the adoption of responsible investment practices in markets where these metrics and agencies have been introduced (e.g. Gond & Boxenbaum, 2013; Solomon et al., 2004). While this finding concerns geographical markets, the same thing presumably also holds true for different asset classes. This highlights once more the importance of startup-friendly ESG metrics as an enabler for responsible investment practices in the venture capital context and other entrepreneurial finance markets. In the public market setting scholars have mostly used the KLD ESG ratings (Widyawati, 2020). Other rating providers that have been widely used by scholars are ASSET4, Bloomberg, Sustainalytics, EIRIS, SAM, Vigeo and Innovest (Camilleri, 2021; Mansouri & Momtaz, 2022; Widyawati, 2020). The frameworks of these rating providers are however not applicable to startups because only few are transparent. Yet, the established transparent ESG frameworks are neither directly applicable to startups because a considerable amount of their indicators are tailored to mature firms. For example, the Invest Europe framework assesses whether companies have implemented an environmental management system certified by ISO 14001. While this might be an indicator of environmental performance for a mature firm, it is unlikely that startups, with limited resources available, have the implementation of such a system listed as one of their priorities. Another example is the measure of whether a company has a human rights policy and, additionally, a human rights due diligence process in place to identify any deviations from this policy. The encoding of such a policy and the existence of such a process can be expected from large mature firms with sophisticated management infrastructures, whereas startups cannot reasonably be expected to have these in place.

2.2.2 Rating construction: risk models and weights

Besides ESG risk categories and indicators a framework requires a quantification mechanism in order to output an ESG rating. In general, the risk models that are used by the rating agencies all

fall into one of two categories, the conventional one-dimensional risk model and the more recently introduced two-dimensional risk model. Most rating agencies (e.g. KLD, ASSET4) provide an ESG rating that is based on numerous positive and negative indicators (Dorfleitner et al., 2015). These are basically Key Performance Indicators (KPI's) of firms' sustainability risk management performance and the resulting ESG rating thus reflects how well a firm performs its sustainability risk management. This one-dimensional risk model however neglects the unique context of each individual firm's exposure to ESG risk. Different industries and different economic activities are not all exposed to the same ESG issues and are therefore not all inherently exposed to the same level of ESG risk. For example, companies in the business of oil extraction might be exposed to high levels environmental risk, while information technology companies might be exposed to lower levels of environmental risk, but higher levels of governance risk due to cyber security threats. Comparing the one-dimensional ESG profiles of firms operating in different industries is thus flawed.

More recently Sustainalytics, a leading global provider of ESG products and services, introduced the two-dimensional risk model[1] (Oprean-Stan et al., 2020). This model decomposes ESG risk into an ESG risk *exposure* dimension and an ESG risk *management* dimension. The exposure dimension refers to the ESG risk a company is exposed to through its economic activities and is assessed at the sub-industry level. The ESG risk management dimension refers to the degree to which the ESG risk a company is exposed to is in fact managed. Not all risks can actually be managed, e.g. for some types of transportation companies it is unavoidable to emit (a minimum level of) carbon emissions. But also not all manageable risk will generally be managed in practice, e.g. governance risk that can be managed through policies which the company does not have in place. Sustainalytics therefore decomposes ESG risk management into unmanageable risk and manageable risk, which is further decomposed into managed risk and the management gap, see Figure 2.1. The ESG risk management performance of a company is, as with the one-dimensional risk model, determined at the company level and is assessed through ESG metrics.

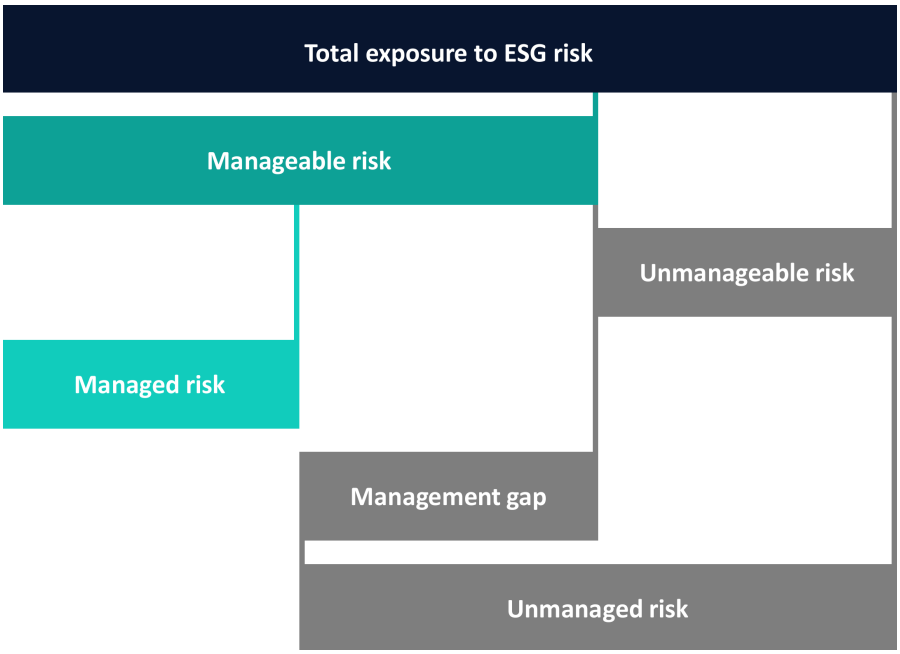

Figure 2.1: Two-dimensional ESG risk structure according to Sustainalytics

It is also important to define the relative importance of the ESG themes in creating an aggregated ESG score. Scholars already showed more than two decades ago that "independent judges do not see

[1] See: https://www.sustainalytics.com/esg-data

the areas as equally important" (Sharfman, 1996, p. 290). To account for the relative importance of the different themes weights can be assigned to the separate E, S and G scores.

In a study from the MSCI ESG Research team, Nagy et al. (2020) benchmark three approaches for creating an aggregate ESG score. Namely, equal weighting of the E, S and G themes, static optimization using historical data (i.e. backtested weights), and dynamic optimization with industry-specific weights. While the static optimization approach showed the strongest correlation with short-term financial performance, the dynamic optimization approach with industry-specific weights showed the strongest correlation with long-term financial performance (Nagy et al., 2020), reflecting ESG as a set of long-term value factors (Edmans, 2022).

2.2.3 An intermezzo on rating divergence

In a paper by Berg et al. (2019), the authors put forward a compelling analogy between ESG ratings and credit ratings. Much like credit ratings allow investors to screen companies for creditworthiness, or credit risk, investors may use ESG ratings to screen firms for sustainability risk. More technically, Sustainalytics describes an ESG risk rating to be reflecting the economic value that is at risk due to sustainability issues.

Berg et al. (2019) point out however that there are a few significant distinctions between credit ratings and ESG ratings. For example, while the definition of creditworthiness — the likelihood of default — is fairly straightforward, the definition of ESG performance is less so. It is a concept founded on varied and changing values. Also, ESG reporting is still in its infancy, whereas financial reporting standards have developed and converged over the past century. There are various reporting standards for ESG disclosure, many of which are optional or only applicable in specific countries, giving corporations wide latitude in deciding whether and what information to disclose. Explaining what ESG performance means and compiling and combining data from a variety of sources disclosed in diverse reporting formats are thus crucial components of the service that ESG rating agencies provide (Berg et al., 2019).

These two points add up to a critique on ESG ratings that is widely acknowledged by scholars. Namely, that the between-provider correlation is very low (e.g. Berg et al., 2019; Chatterji et al., 2016; Mansouri & Momtaz, 2022; Martini, 2021; Widyawati, 2020). This divergence in ratings then introduces ambiguity and uncertainty for managers and investors, and poses difficulties to scholars in the field (Berg et al., 2019; Chatterji et al., 2016). In their empirical study Berg et al. (2019) decompose this divergence into three main contributing factors. Namely, (i) *scope* divergence, (ii) *measurement* divergence and (iii) *weight* divergence. Scope divergence refers to the lack of consensus between providers around which categories of indicators should be included in an ESG assessment and is accountable for 38% of the rating divergence. Measurement divergence refers to the use of dissimilar indicators for measuring a certain risk category and is accountable for 56% of the rating divergence. Weight divergence relates to the variability in the weights that different rating agencies use to account for the relative importance of risk categories and is accountable for only 6% of the rating divergence.

In their systematic review Park and Oh (2022) find that most scholars believe that standardisation of ESG reporting and metrics would hugely benefit the further integration of ESG information into investors' decision-making. Berg et al. (2019) note that imposing a common taxonomy whereupon the ESG data should be mapped would be a step in the right direction.

3 Literature review and hypotheses development

3.1 An assessment of ESG performance and economic effects

Numerous scholars have tried to shed light on the relationship between firms' ESG characteristics and financial performance or firm value in the public market setting. While the results have varied across studies the overall sentiment among scholars is that there exists a positive relationship. Friede et al. (2015) have performed a meta-analysis of more than two thousand empirical studies examining this relationship. They conclude that approximately 90% of the studies in their sample find a non-negative relationship between ESG characteristics and financial performance, and the majority of studies finds a positive relationship, thereby underwriting the responsible investment business case.

This positive relationship between ESG characteristics and financial performance and firm value can be explained by two causal mechanisms (Gillan et al., 2021). First, firms with great ESG profiles can presumably attract additional customers (Albuquerque et al., 2019) and enjoy greater employee productivity (Gillan et al., 2010), increasing cash flows and thereby increasing shareholder value. Higher demand for investments with great ESG profiles furthermore lowers the cost of capital for these firms (e.g. Goss & Roberts, 2011; Ng & Rezaee, 2015; Zerbib, 2019), which also directly increases financial performance and shareholder value. The second explanation says that in addition to financial returns, shareholders can also value the positive non-financial returns of firms with great ESG profiles. When controlling for cash flows this mechanism is assumed to increase shareholder utility (Gillan et al., 2021). Turning this statement around one can also assume that minimising negative non-financial returns (i.e. negative externalities) can also increase shareholder utility.

Saci et al. (2022) conclude from their empirical findings in the Chinese market that there is no significant difference between the returns of traditional funds and socially responsible funds. However, they do find that the risks to which the socially responsible funds are exposed are significantly lower and hence the risk-adjusted returns of these funds are higher. The academic community seems to be quite in agreement that better ESG performance decreases many types of firm risks, including systematic risk (e.g. Albuquerque et al., 2019; Ghoul et al., 2016; Oikonomou et al., 2012), credit risk (e.g. Jiraporn et al., 2014; Seltzer et al., 2022; Stellner et al., 2015), legal risk (e.g. Hong & Liskovich, 2015; Schiller, 2018) and downside risk (e.g. Hoepner et al., 2016). Investing in startups naturally comes with a high level of risk, and part of the venture capitalist's job is to assess the amount and nature of the risk a startup bears. Therefore, it seems likely that venture capitalists value startups with great ESG profiles better than their peers with worse ESG profiles. Interestingly, scholars have also found evidence that socially responsible funds are more resilient (Bénabou & Tirole, 2010) and that economic shocks lead investors' attention "towards more ethical, regulatory compliant, and responsible investments." (Arefeen & Shimada, 2020, p. 5)

A number of studies also finds a negative relationship between ESG characteristics and financial performance (Gillan et al., 2021). Here the general explanation of the results is that extra non-financial returns - also referred to as ESG rents - must come at the direct cost of financial returns, thereby

lowering shareholder value (Giuli & Kostovetsky, 2014). This thus goes for impact investments which create positive non-financial returns, but not so much for responsible investments which aim to create non-negative non-financial returns.

Finally, there is one section of scholars that argues that there is indeed a positive relationship between ESG characteristics and firm value, but that the causal mechanism is the other way around (e.g. Bénabou & Tirole, 2010). Firms with high valuations and better financial performance enjoy free cash flows which they can then spend on improving their ESG characteristics. In this case there may exist a managerial agency problem with managers investing in ESG improvement to increase their personal utility, rather than increasing shareholder value (Gillan et al., 2021).

Reflecting this on the startup and venture capital context is interesting. Startups are generally cash strapped and thus have no excess means which they can invest in improving their ESG characteristics. Founders furthermore have a simultaneous role as manager and shareholder, and thus have aligned economic interests with their VC investors, theoretically eliminating the case of the managerial agency problem. However, investor preferences are heterogeneous and investors and founders may not be aligned on the potential sacrifice of financial rents for ESG rents. But because multiple types of agency problems are very profound in venture capital - e.g. moral hazard, adverse selection, hold-up problems and window dressing (Tykvová, 2007) - venture capitalists incorporate strong investor protection mechanisms in their term sheets. They do so by continuous monitoring of portfolio companies and by staged investing. Startups need to show that certain objectives have been met before the next round of financing is released. It is furthermore common for venture capitalists to take a position on the board of the startup, thereby obtaining direct influence over the decision-making, which is an important incentive for the founder(s) to manage the company in a proper way (Lin, 2022). This reversed causal mechanism is thus an unlikely explanation in the VC setting if indeed a positive relationship between ESG characteristics and valuation is found.

Further zooming in on the entrepreneurial finance literature, both Mansouri and Momtaz (2022) and Zhang (2022) provide interesting, but contrasting insights. Mansouri and Momtaz (2022) have done a first try at seeking an answer to the question of how economically attractive SE is for both the entrepreneur and the investor. They find that SE ventures receive higher valuations than conventional startups in token offerings when controlling for the business case, presumably because the positive externalities add to the shareholder utility of the investor. Subsequently they find that SE ventures financially underperform conventional startups post-funding. The explanation they provide for this is the costly sustainability constraint, as in line with other studies. It is quite interesting to juxtapose their results with the findings of Zhang (2022). She finds that impact ventures which aim to generate positive non-financial returns outperform conventional startups post-funding. The US venture capital investors participating in her study expect startups that aim for environmental and social impact to be of lower quality, while impact ventures are found to have "about 3.4%-3.7% more likelihood to raise the next round of funding from investors (....) [and] impact ventures also have about 2% more likelihood to avoid bankruptcy or being out of business." (Zhang, 2022, p. 26) Solely profit-driven investors thus have lower interest in these ventures due to inaccurate beliefs and thereby miss valuable opportunities. Unfortunately she does not examine the effect this has on valuations.

While the VC investors participating in the study of Zhang (2022) showed little interest in impact ventures, this says only so much about their interest in ESG. As stated before, 73% of all venture capitalists surveyed by the European Investment Fund incorporated some sort of ESG considerations (Botsari & Lang, 2020) and 59% of GPs is planning on further increasing attention to ESG risk factors in the coming year (Wiek & Villegas, 2022). The PitchBook survey furthermore shows that 61% of institutional investors focus their sustainable investment efforts in the private equity and venture capital parts of their portfolios. This is twice as much as the amount of investors focussing their sustainability efforts on other asset classes making up their portfolios. Not surprisingly, stakeholder

demand is one of the top factors that have led GPs to incorporate ESG practices. Other important factors are environmental and social concerns, alignment of organisational values and investment practices, and the belief that ESG considerations lead to improved long-term investment results (Wiek & Villegas, 2022).

3.2 Hypotheses development

To answer the main research question it is first checked whether ESG risk does matter to venture capitalists. If ESG risk does not matter to venture capitalists it follows that there should not exist any relationship between startups' ESG risk scores and their financial valuations. Given that anecdotal evidence suggests that ESG is becoming an increasingly important topic to venture capitalists (Botsari & Lang, 2020; Wiek & Villegas, 2022), it is expected that ESG risk does impact the investment decisions of venture capitalists. More specifically, it is expected that a high ESG risk score following from the startup ESG framework proposed in this study (i.e. a startup with poor ESG characteristics) negatively impacts the investment decision of the VC.

H_{1a}: *ESG risk scores are lower for VC-backed startups as compared to non-backed startups.*

As FORWARD.one started to include ESG considerations in their due diligence process from the start of their second fund onward - July 2021, it is also expected that the ESG risk scores of startups that got offered a term sheet after July 2021 is lower than the ESG risk scores of startups that got offered a term sheet before July 2021.

H_{1b}: *ESG risk scores are lower for startups that got offered a term sheet after July 2021 as compared to startups that got offered a term sheet before July 2021.*

If the hypothesis that ESG risk does matter to venture capitalists is accepted, then it can be examined what the impact is of ESG risk on the financial valuation of a startup. In general, the sentiment in the literature is that there exists a positive relationship between firms' ESG characteristics and firm value - or in other words, a negative relationship between firms' ESG risk and firm value. There are three arguments that warrant the hypothesis that this relationship also holds in the venture capital setting. Namely, the consensus that great ESG performance leads to lower firm risk, the promising results of studies in the crowdfunding and token offering setting, and the anecdotal evidence showing the increasing importance of ESG for venture capitalists. Despite the possibility that ESG rents come at the cost of financial rents because a sustainability orientation might constrain the entrepreneur (Barber et al., 2021; Cornell, 2021; Gillan et al., 2021), ESG rents do add up to the nonpecuniary utility of the investor (Barber et al., 2021; Gillan et al., 2021; Mansouri & Momtaz, 2022). As a result of the incorporation of ESG considerations in the investment decisions of venture capitalists, startups with high ESG risk scores following from this study's startup ESG framework - or in other words, those startups with poor ESG characteristics - are expected to enjoy lower valuations. Accordingly, entrepreneurs might have an economic incentive to focus on ESG.

H_{2a}: *There exists a negative relationship between startups' ESG risk scores and their financial valuations by venture capitalists.*

Because FORWARD.one only implemented ESG considerations from July 2021 onward, it is expected that there exists an interaction effect between the ESG risk score of a startup and the timing of the term sheet - or in other words, the inclusion of explicit ESG considerations by the VC - on the startup's financial valuation. Hereby it is expected that the negative relationship between ESG risk score and valuation is larger for startups that got offered a term sheet after July 2021, i.e. those startups whereby the VC considered ESG risk, as compared to startups that got offered a term sheet before July 2021.

H_{2b}: *The effect of ESG risk score on the financial valuation of a startup is stronger for startups that got offered a term sheet after July 2021 as compared to startups that got offered a term sheet before July 2021.*

4 A framework for measuring ESG in startups

4.1 ESG risk structure and relative importance of ESG themes

The startup ESG framework proposed in this study uses a two-dimensional risk model, as first introduced by Sustainalytics, to enable cross-sectoral comparison of ESG risk ratings. The ESG risk *exposure* dimension is assessed at the economic activity level. For the categorisation of economic activities this research builds on the Nomenclature of Economic Activities (NACE) developed by the European Union. The European Bank for Reconstruction and Development (EBRD) has developed a list of the inherent environmental and social risk levels related to particular economic activities based on the NACE. Thus, in this framework the ESG risk exposure is determined by the overall risk level for the economic activity a startup performs, as defined in the EBRD Environmental and Social Risk Categorisation List[1]. The ESG risk *management* performance of a startup is determined on the company level and is assessed through ESG metrics.

While the Sustainalytics framework goes one step further and measures the degree to which a specific company's exposure deviates from the sub-industry's average exposure, trying to incorporate this goes beyond the scope of this research. The limited data that is available on startups and especially on a startup's peers hinders this comparison.

The framework bases the relative importance of the environmental, social and governance themes on the dynamic optimization approach with industry-specific weights. MSCI ESG Research LLC has published an Industry Materiality Map [2] with the industry-specific weights for the ESG themes as used for constructing their MSCI ESG ratings. These weights are readjusted annually on the basis of quantitative assessments and expert interviews. Since the introduction 13 years ago the E, S and G weights have averaged 30%, 39% and 31% respectively (Nagy et al., 2020). I will use the weights of the MSCI ESG Industry Materiality Map in this research for defining the relative importance of the ESG themes, as this is one of the only publicly accessible sources for (industry-specific) ESG weights.

The ESG Industry Materiality Map categorises sectors and sub-industries using the Global Industry Classification Standard (GICS). This is a counterpart nomenclature to the NACE, developed by MSCI and Standard & Poor's (S&P). The EU Technical Expert Group on Sustainable Finance published a mapping of GICS categories to NACE codes as an appendix to their Handbook on Climate Benchmarks and benchmarks' ESG disclosures (Technical Expert Group on Sustainable Finance, 2019). This map is used in this research to find the corresponding GICS category to the NACE code used to define the ESG risk exposure of a startup.

[1] See: https://www.ebrd.com/downloads/about/sustainability/ebrd-risk-english.pdf

[2] See: https://www.msci.com/our-solutions/esg-investing/esg-industry-materiality-map

4.2 Measuring risk management

Taking into account the concerns regarding rating divergence, the ESG framework developed in this study builds upon existing frameworks developed by highly credible and relevant organisations. Namely, (i) the World Economic Forum [3], (ii) the ESG Data Convergence Initiative [4], (iii) Invest Europe [5], (iv) ESG_VC [6] and (v) B Lab [7].

The World Economic Forum report on Measuring Stakeholder Capitalism is an initiative to come towards common ESG metrics and ESG reporting. The World Economic Forum is an influential organisation and the report has been prepared in collaboration with the world's four largest accountancy firms, indicating that this standard is likely to see a growing support base among large corporations. While the report sets out a clear taxonomy and lists the most important ESG risk categories, it does not define how these categories should be measured exactly. It is not a framework that tries to summarise the ESG performance of a company in one standardised rating but rather an ESG reporting guide for firms.

The World Economic Forum risk categories which are relevant for startups are taken as the starting point in the development of the startup ESG framework. The metrics of the other frameworks are subsequently mapped upon these risk categories, as shown in table Table B.1. It is worth noting that the World Economic Forum uses four risk pillars. Namely, 'Principles of Governance', 'Planet', 'People' and 'Prosperity'. While the first three pillars can be easily linked to the standard Environmental, Social and Governance themes, the last pillar does not have its own ESG theme. Therefore the relevant risk categories from the prosperity pillar are divided over and mapped onto the E, S and G themes.

The ESG Data Convergence Initiative, as its name already indicates, is another initiative that aims to converge the numerous ESG standards towards a common standard. This initiative has its roots in and is focused on the private capital market where data is scarce in comparison to the public market. It is a collaborative initiative between LPs and GPs. This makes it an interesting standard on which to further build the startup ESG framework.

Invest Europe is the trade association of Europe's private capital providers, working together with GPs and LPs in the European Private Equity, Venture Capital and infrastructure investment sectors. Invest Europe has published an ESG reporting template for their member firms which they have based on the ESG Data Convergence Initiative, but also on a two-phased survey among their member GPs and LPs. This indicates that this standard is likely to see a support base in the European private capital sector.

ESG_VC is an organisation specifically aimed at enabling ESG reporting and due diligence in the startup and venture capital context. While it is not as widely recognized as the previously mentioned organisations, the fact that it is specifically focused on the startup and VC context makes their standard an interesting one to include.

B Lab is a non-profit organisation that governs the B Corporation, or B Corp, certification. This certificate signals that a firm "meet[s] the highest standards of verified social and environmental performance, public transparency, and legal accountability to balance profit and purpose." (B Lab Global, 2021) B Corp differs from ESG rating agencies in that they do not provide ratings for all companies but only certify the ones that meet their standards. To obtain a B Corp certificate companies have to go through a rigorous assessment process of which filling out a publicly available assessment form is the first step. Because also startups can pursue a B Corp status, and because ESG and B Corp scoring criteria generally align, the relevant indicators from this assessment are also considered for

[3] See: https://www.weforum.org/reports/measuring-stakeholder-capitalism-towards-common-metrics-and-consistent-reporting-of-sustainable-value-creation/

[4] See: https://www.esgdc.org/

[5] See: https://www.investeurope.eu/invest-europe-esg-reporting-guidelines/

[6] See: https://www.esgvc.co.uk/

[7] See: https://www.bcorporation.net/

this study's ESG framework.

In the following subsections I will draw from the selected frameworks to hypothesise how environmental, social and governance risk management can be assessed in startups. The outline of these subsections and how they fit in the risk management measurement section is presented in Figure 4.1. All relevant metrics of the different frameworks are mapped onto the relevant World Economic Forum risk categories. However, a metric is only included in the ESG model when at least two of the selected frameworks have included the metric. This ensures that the ESG framework is parsimonious, but it also heeds to the calls for more converged ESG metrics. The full list of included metrics and the sources can be found in Table B.1 in Appendix B.

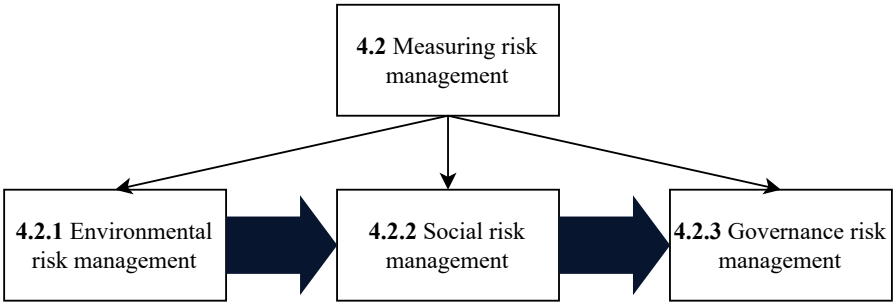

Figure 4.1: Outline of the measuring risk management section

4.2.1 Environmental risk management

Environmental risk is the first of the three ESG themes. The relevant World Economic Forum risk categories within this theme are *climate change, nature loss, fresh water availability* and *resource availability*.

Climate change

According to the World Economic Forum (2020), mitigating climate change is paramount in ensuring the advancement of human societies. This means that greenhouse gas emissions should be measured and minimised. It thus comes as no surprise that every one of the selected frameworks implements some sort of greenhouse gas emissions metric. Yet, it seems unlikely that a large proportion of startups measures their greenhouse gas emissions, let alone benchmark their emissions with their peers. Therefore, to measure climate change impact in startups, two basic greenhouse gas emissions metrics (E1 and E2, see Table B.1) are included which are derived from the frameworks that focus on startups and the private capital market: ESG_VC, B Lab and Invest Europe. Another important metric which all of the frameworks include and which can be mapped onto the climate change category is the amount of renewable energy consumption, as a proportion of the total energy consumption (E3).

Nature loss

While environmental risk management predominantly focused on carbon emissions in the past, nature loss, or biodiversity loss, is becoming an increasingly important topic. The World Economic Forum (2022) recognized it as one of the top three most severe risks threatening societies and the planet. "Over half of the world's total GDP is moderately or highly dependent on nature and the services it provides" (World Economic Forum, 2020, p. 27). To measure the impact of a startup's activities on nature loss one metric is used (E4), which is included by the World Economic Forum and Invest Europe. This metric addresses whether a startup's operations negatively affect biodiversity-

sensitive areas, where biodiversity-sensitive areas are specified by the European Commission as Natura 2000 areas[8].

Fresh water availability

Fresh water availability, or water stress, is another risk category defined by the World Economic Forum whereupon one metric (E5) can be mapped that is included by Invest Europe and B Lab. To assess whether a startup has operations in water stressed areas the World Resources Institute's Aqueduct Water Risk Atlas[9], a "publicly available and credible tool" (Global Reporting Initiative, 2018, p. 10), is used.

Resource availability

To achieve a sustainable future the circularity of non-renewable resources should be increased (World Economic Forum, 2020). One relevant metric included by ESG_VC and B lab is used for this category (E6).

Environmental impact

The ESG framework this study proposes aims to measure the unmanaged ESG risk in a startup. However, four metrics are proposed that do not measure ESG risk but rather the degree of impact a startup aims to make. These metrics do not weigh in the ESG risk rating of a startup. Instead, a separate Impact metric is constructed based on these metrics. The reason for the inclusion of these metrics and the resulting Impact score is that it enables an interesting juxtaposing of the impact of startups' ESG scores on their valuations against the influence of their Impact scores on their valuations.

Two environmental impact metrics (E7 and E8) are included. First it is interesting to look at whether the economic activities of a company actually classify as making a substantial contribution to climate mitigation. This can be derived from the EU Taxonomy, the classification system for sustainable economic activities published in 2021 by the European Union[10]. The EU Taxonomy aims to mitigate greenwashing by specifying exactly what can be considered environmentally sustainable. In this light one other metric can be added to this environmental impact category which addresses whether a startups' products or services are structured to restore or preserve the environment, derived from B Lab.

4.2.2 Social risk management

Social risk is the second of the three ESG themes. The relevant World Economic Forum risk categories within this theme are *dignity and equality, health and well-being, skills for the future, employment* and *wealth generation*.

Dignity and equality

Dignity and equality can be considered the most important category in the Social risk theme. Providing equitable opportunities to (potential) employees matters in the light of the Universal Declaration of Human Rights (World Economic Forum, 2020). Managing dignity and equality issues also affects business outcomes, as "companies that maintain high standards in health, safety and labour rights can see higher levels of employee productivity and operational efficiency" (World Economic Forum,

[8] See: https://natura2000.eea.europa.eu/

[9] See: https://www.wri.org/applications/aqueduct/water-risk-atlas/

[10] See: https://ec.europa.eu/sustainable-finance-taxonomy/taxonomy-compass

2020, p. 33). The category can be measured through (i) employee diversity and inclusion, (ii) pay equality, and (iii) wage level. Three metrics (S1, S2 and S3) are adopted from the World Economic Forum, Invest Europe, ESG_VC and B Lab.

Health and well-being

Health and well-being is mentioned as an important category by both the World Economic Forum and Invest Europe. In a startup it can be measured through (i) healthcare coverage and (ii) work-related accidents. Three metrics are included (S4, S5 and S6) which are derived from the total set of included frameworks. With the work-related accident metrics the average individual risk of an employee is defined as the number of work related injuries and fatalities respectively, in the last year divided by the average amount of full-time employees.

Skills for the future

The skills for the future category refers to employee training opportunities, for which both Invest Europe and B Lab include metrics. Training and reskilling employees internally is important so that employees remain relevant in the labour market (World Economic Forum, 2020). One metric is included (S7).

Employment and wealth generation

Businesses fulfil a vital role in society through employment and wealth creation (World Economic Forum, 2020). While it may not directly come across as an ESG topic, this category is included in both the frameworks of the ESG Data Convergence Initiative and Invest Europe. Therefore, two metrics are included (S8 and S9) covering the rate of organic net new hires and the employee turnover rate.

Social value generated

Social value generated measures the social impact and prosperity a company creates for its customers and beneficiaries. It thus also does not weigh in the ESG rating of a startup but in the separate Impact rating. It is a category that comes from the prosperity pillar of the World Economic Forum but is mapped onto the social theme. One metric (S10) that comes from B Lab is mapped onto this category.

4.2.3 Governance risk management

Governance risk is the third and final ESG theme. The relevant World Economic Forum risk categories within this theme are *quality of the governing body, ethical behaviour* and *risk and opportunity oversight*.

Governing purpose

This category covers the final impact metric, as it measures "the extent to which governance drives firms to establish and pursue a positive and sustainable value creation." (World Economic Forum, 2020, pp. 21-22) The indicator (G1) measures whether the corporate mission statement includes a social or environmental commitment. Both the World Economic Forum and B Lab consider this an important category.

Quality of governing body

Quality of the governing body can and should be measured through a variety of metrics (G2 - G6). First it is important to look at both the board of directors and the C-suite. For both the board

and the C-suite it is important to embrace diversity, meaning that women and members from under-represented societal groups should be represented. It is furthermore important to look at the proportion of board members that are independent, i.e. who are not part of the executive team or involved in the day-to-day operations. This is important because independent board members improve the control environment (Knechel & Willekens, 2006).

Ethical behaviour

While only few early-stage ventures may have encoded company policies, having encoded policies on ethics in place is an easy indication of the ethical behaviour of a company. The World Economic Forum, Invest Europe, ESG_VC and B Lab all include metrics on ethics policies. Three relevant metrics are included in the framework (G7, G8 and G9).

Risk and opportunity oversight

Actively identifying and responding to threats and opportunities is an important governance characteristic. Failing to do this introduces great risks for a company. Cybersecurity risk is one of those risks that is becoming more relevant nowadays and which is included in the frameworks from the World Economic Forum, Invest Europe and ESG_VC. One metric is included in the framework (G10).

4.3 The startup ESG framework

The goal of this study is first to create a framework for measuring startups' ESG characteristics. Taking into account the risk structure of ESG, the relevant metrics for measuring ESG risk management performance, and the approach for weighting the ESG themes, a model is proposed and shown in Figure 4.2.

The ESG risk score S_{ESG} of a startup, reflecting the unmanaged ESG risk, can be derived by taking the startup's exposure to ESG risk E_{ESG}, which follows from the EBRD Environmental and Social Risk Categorisation List, and decreasing this exposure in line with the startup's management of ESG risk M_{ESG}. This exposure to ESG risk E_{ESG} can hold a value of '1' for low ESG risk, '2' for medium ESG risk, and '3' for high ESG risk.

$$S_{ESG} = (1 - M_{ESG})E_{ESG} \tag{4.1}$$

The ESG risk management score M_{ESG} in equation 4.1 is a weighted average risk management score over the different ESG themes E, S and G. Here x_i represents the weight of ESG theme i, which follows from the MSCI ESG Industry Materiality Map, and which is subject to the boundary conditions $0 \leq x_i \leq 1$ and $\sum_i x_i = 1$. M_i is the risk management score for ESG theme i.

$$M_{ESG} = \sum_i x_i M_i \tag{4.2}$$

Finally, the risk management score M_i for a certain ESG theme i can be derived by taking the average score of all ESG metrics m_j within ESG theme i. With n_i being the number of ESG metrics in ESG theme i that are taken into account, and m_j being a binary value (holding either '1' when risk management is good and '0' when risk management is bad, according to this metric). Table B.2 in Appendix B shows the multiple choice answers for every metric, and the corresponding scores. When the information required to properly answer a metric is not available, the assessor can answer with "Unknown". In this case this metric will not be scored and is not taken into account in the number of metrics n_i in that particular ESG theme i.

$$M_i = \sum_{j=1}^{n_i} \frac{m_{ij}}{n_i} \tag{4.3}$$

In order to actually score the startups in this study an ESG rating tool is created based on the proposed startup ESG framework. This tool concerns a Microsoft Excel template which can be filled out to come to an ESG score for a startup. To facilitate the replicability of this study, and to enable the use of this framework in future research, the tool can be downloaded for free from:

www.shorturl.at/zKL89

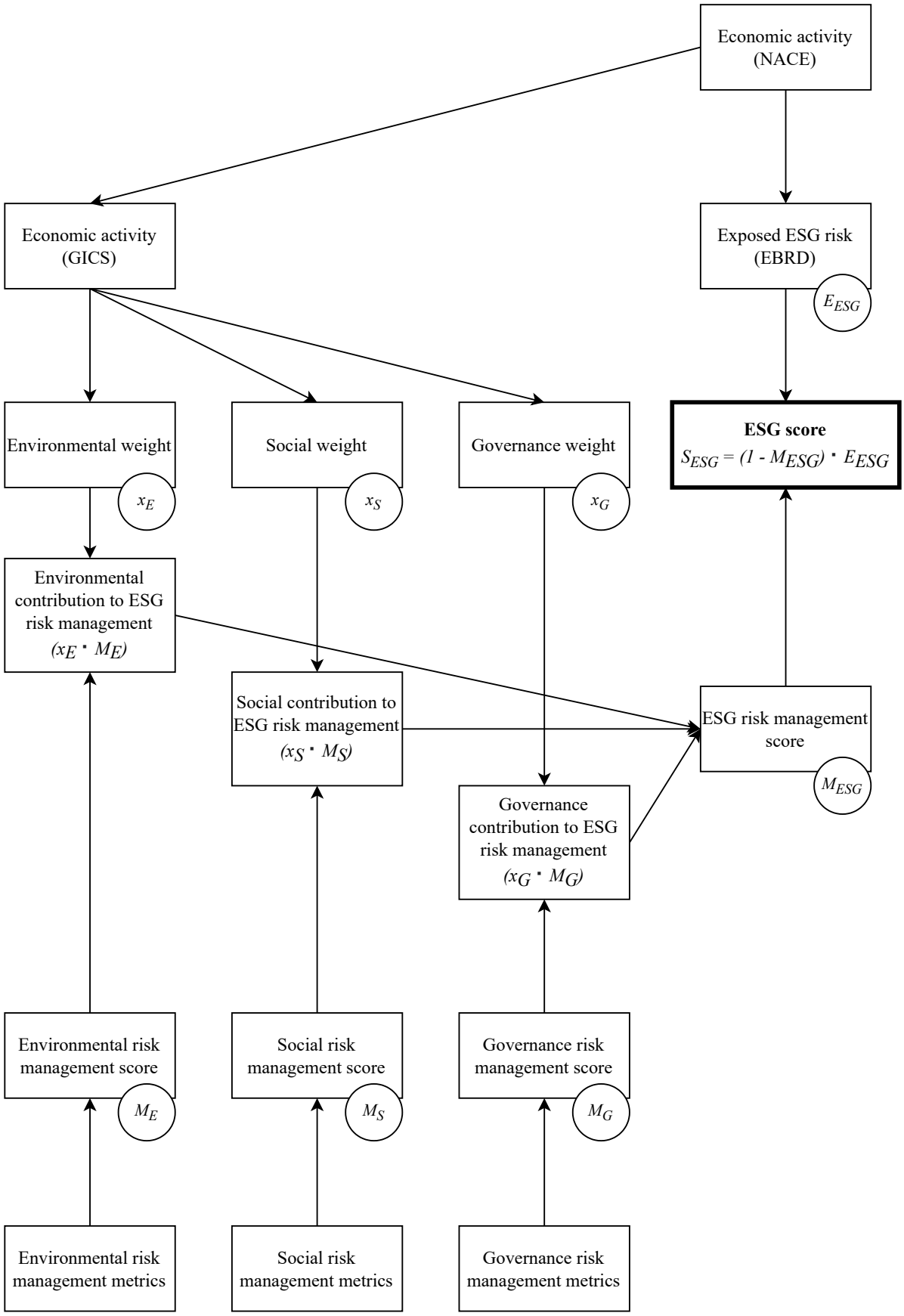

Figure 4.2: A model for quantifying ESG risk in startups

5 Startup data and research methodology

5.1 Sample and data collection

Public data of private companies is relatively scarce in comparison to that of publicly listed companies (Zhang, 2022). The few previous studies that have examined the economic effects of startups' ESG characteristics have all done this in the crowdfunding or token offering setting, exactly because of this reason (Guzmán et al., 2020; Hörisch, 2015; Mansouri & Momtaz, 2022; Vismara, 2019). The startups that try to acquire funding through these markets need to provide relevant information to the public in order to obtain their funding, thereby creating a large public dataset which opens up research possibilities. However, in this study I carry out an empirical investigation in the venture capital setting.

Pitchbook and Crunchbase provide arguably the most complete public databases of startup and funding data, but even these databases largely lack valuation data and do not provide ESG data. Consequently, convenience sampling is used because there is no sampling frame available.

For this research I draw upon a proprietary dataset of pitch decks and firm valuations provided by the Dutch independent VC firm FORWARD.one. As already briefly mentioned, the firm invests in startups that develop innovative hardware technologies. Some of their most notable investments include Mayht, a developer of disruptive transducers, Rocsys, a manufacturer of autonomous charging solutions for electric vehicles, DAB, a company that is pioneering biomanufacturing fermentation technology, and Quantware and Quix Quantum, two companies pioneering in the quantum computing field. The technology categories in the sample cover, in no particular order, sensory data and IoT platform technologies, separation technologies, sensors and trackers, batteries, chargers and energy storage solutions, imaging and machine vision hardware, chips, circuitry and electronics, hardware components for AI and neural net solutions, 3D printing technologies, recycling technologies, advanced materials, research and measuring equipment, robotics, cooling and heating solutions, mechanical components and smart city and smart home technologies. FORWARD.one is furthermore specialised in Business-to-Business propositions and works with a geographical scope covering the Netherlands, Germany and the Nordics. Their investments - or 'ticket sizes' - typically range from EUR 0.5 million to EUR 5.0 million focussing mainly on early-stage companies that have some initial traction such as a working prototype or pilot projects. The firm aims to help their portfolio companies' founders grow their companies from 5 to 50+ employees.

The dataset consists of pitch decks and valuation data of 47 startups in the period 2017 - 2022[1], covering the portfolio companies in fund I (11 startups) and fund II to date (8 startups), but also 1 case currently in the investment pipeline and 27 cases whereby the startup got offered a term sheet but the deal did not close. We can divide these 27 cases over two categories. The first category exists out of startups whereby the deal did not go through because additional investment risks came up during the due diligence process (18 startups). In these cases FORWARD.one decided not to invest. The other category exists out of startups whereby the deal did not go through because the startup got

[1] For the startups in the sample additional available documentation, such as websites and social media pages, are explored.

offered a competing term sheet and chose the competing bid. In these cases FORWARD.one wanted to invest but missed the deal. This segment is also referred to as the 'Anti-Portfolio' (9 startups).

The sample of startups can be divided over four quadrants, based on whether FORWARD.one included ESG considerations or not, and based on whether the startup was positively or negatively assessed by the firm (i.e. VC-backed or not). Because FORWARD.one did want to invest in the 9 startups making up the anti-portfolio, these startups are also considered to be VC-backed. The quadrant overview showing this categorisation is presented in Figure 5.1.

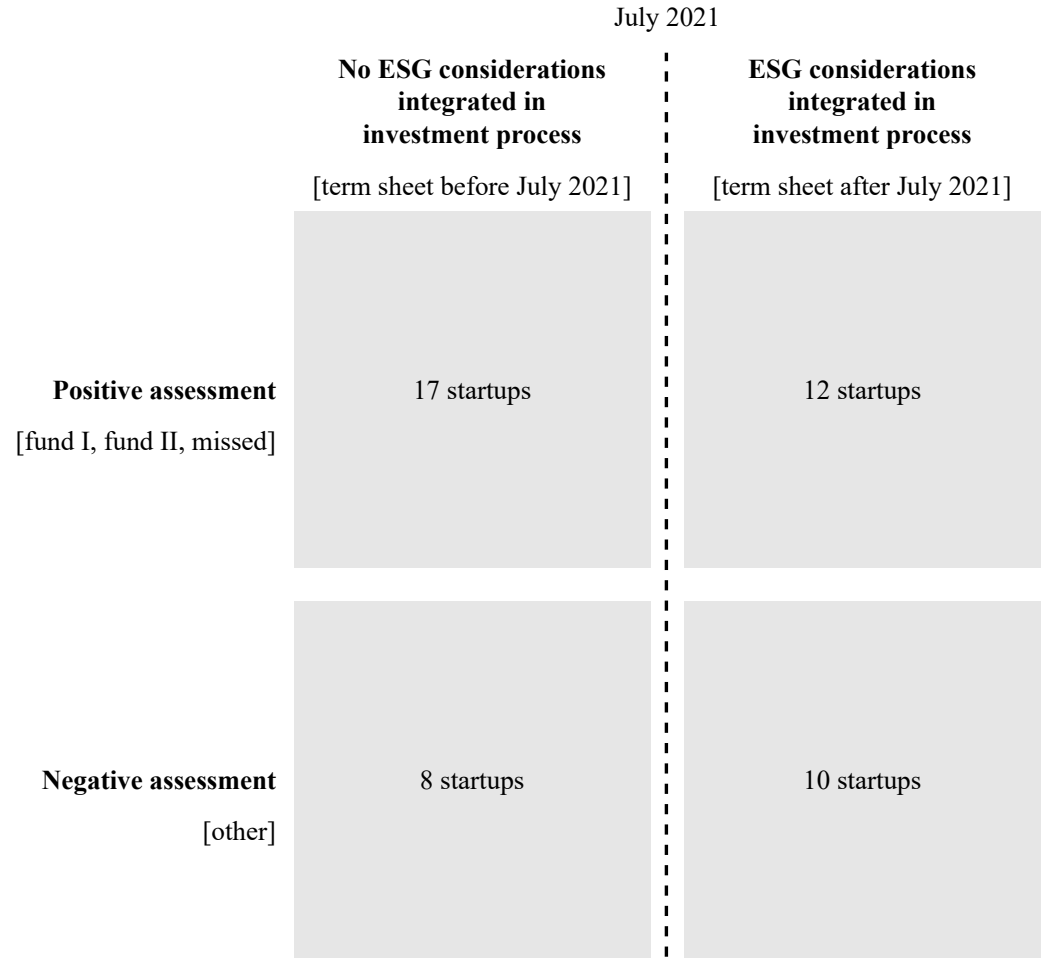

Figure 5.1: Categorisation of the startups for means comparison

5.2 Measurements

5.2.1 Dependent variable

The variable of interest in this study is the financial valuation of a startup. Here there exists the possibility to either look at the pre-money valuation or the post-money valuation. The difference is that the post-money valuation refers to the valuation of the startup with the new capital of the financing round included, whereas the pre-money valuation refers to the valuation of the startup before it receives the new capital. I use the *pre-money valuation* as the dependent variable (DV) in this study because this is the standard in the entrepreneurial finance literature (e.g. Gompers, 1995; Miloud et al., 2012).

5.2.2 Independent variable

The startups in the sample are scored on their ESG characteristics by operationalising the proposed ESG framework. The resulting *ESG risk score* is the independent variable (IV) in this research. It is worth noting one more time that this ESG score reflects the unmanaged ESG risk in a startup. Therefore, a low ESG score is desirable and a negative covariance with the dependent variable is expected. The construction of this variable is explained in detail in chapter 4.

In order to examine the structural break in the data and test hypotheses H_{1b} and H_{2b} a dummy variable is added named *ESG DD included* and an interaction term is created for *ESG risk score* and *ESG DD included*. Hereby *ESG DD included* is '1' when the firm had implemented ESG considerations in the due diligence process at the time the startup was assessed (i.e. when a term sheet was offered after July 2021), and '0' when the firm had not implemented such considerations (i.e. when a term sheet was offered before July 2021).

Previous studies in the SE domain that have examined the economic effects of startups' ESG characteristics in the crowdfunding setting have used rather ad-hoc approaches to quantify ESG characteristics (e.g. Guzmán et al., 2020; Hörisch, 2015; Vismara, 2019). Mansouri and Momtaz (2022) propose a more structured and less subjective method in their paper whereby they use a machine learning algorithm to count ESG-related terms in startups' disclosed documentation. Although they perform manual sanity checks to confirm the validity of their results, their ratings are entirely based on language rather than on an analysis of actual operations. The ESG framework proposed in this research takes a different angle and aims to base the ratings on an analysis of startups' operations. Although the word counting method is not a widely recognized valid instrument, it is a method that can be used to cross-check the results in this study. This should give an indication of the convergent validity of the measures in the framework this thesis proposes.

It is good to note that an ESG score is always derived based on how an organisation is seen to be performing, i.e. how its ESG-related behaviour is reported. There is a gap between real operations and perceived operations. If a startup has solid governance policies in place, but these policies are not established in its documentation, this will not be reflected in its ESG score.

5.2.3 Control variables

Control variables (CVs) which are included in the analysis mainly come from the venture capital and entrepreneurial finance literature. When venture capitalists invest in the pre-revenue stage conventional valuation methods which rely on cash flows fall short. Therefore, venture capitalists look beyond these traditional valuation methods and often base the valuation of the company on more strategic indicators such as the quality of the founders and the attractiveness of the industry, as well as the development stage of the company (Mansouri & Momtaz, 2022; Miloud et al., 2012).

Researchers from different domains as well as venture capitalists themselves have long argued that the founding team is the most important asset of any new venture and that the quality of this founding team is positively related to the valuation of a startup (e.g. Aspelund et al., 2005; Gimeno et al., 1997; Macmillan et al., 1985; Tyebjee & Bruno, 1984). The quality of the founders is a multi-faceted construct. A considerable amount of studies have argued that different forms of experience, such as industrial experience (Gimeno et al., 1997; Siegel et al., 1993), top management experience (Gimeno et al., 1997) and previous startup experience (Larson & Starr, 1993; Muzyka et al., 1996) add to the founder quality. The *Industrial experience* of the founders is an important indicator, because it shows that the founders possess knowledge about the intricacies of the industry and its processes and are likely to have a network that can potentially include important advisors and clients (Miloud et al., 2012). *Management experience* is another indicator because in the case that the startup becomes a success, the founders will have to lead an increasingly expanding team (Miloud et al., 2012). Previous top management experience furthermore shows that the founders have

knowledge about organisational structures and strategies required to grow the startup into a mature firm (Gimeno et al., 1997; Miloud et al., 2012). Both these numbers are hand-collected from the startup's founders' LinkedIn profiles. Furthermore, previous *Startup experience* is also considered a plus because this provides founders with valuable learnings, especially if this startup was successfully exited, and equips the entrepreneurs with a set of valuable entrepreneurial skills (Larson & Starr, 1993; Miloud et al., 2012; Muzyka et al., 1996). Finally, *Management team size* is also included as a control variable because it is argued that a larger founding team can use a greater amount of human capital to succeed in building a business (Eisenhardt & Schoonhoven, 1990; Miloud et al., 2012).[2]

The attractiveness of the industry can be indicated by the market size (Miloud et al., 2012). This market size must be sufficiently large so that the startup can scale big while obtaining a realistic market share. Venture capital investors make a profit on their investment when the startup is sold, either through an acquisition or through an initial public offering (IPO). In these transactions, the price of the company is often based on an annual sales or EBITDA multiple. For VC firms to make a decent return on investment, the sales must therefore be able to realistically grow to a sufficiently high level. Hence, it follows that it is important that the market the startup aims to penetrate is sufficiently large. There exists the possibility to either look at the Total Addressable Market (TAM), the Serviceable Addressable Market (SAM), or the Serviceable Obtainable Market (SOM). Whereby the TAM refers to the global market size, the SAM to the part of the market that is serviceable with the current product, and the SOM to the share of the SAM that is realistically obtainable considering direct and indirect competition. Here it must be noted that market size estimations are often not precise, but they are used because they give a rough indication. And because there exists great variation in how startups calculate their SAM and SOM based on their TAM, the Total Addressable Market is used as the market size indicator in this study.

Finally, the development stage also has an important impact on the valuation of a startup (e.g. do the founders just have an idea, a working prototype, already some paying customers, or are they already progressing towards large scale production, etc.) (Miloud et al., 2012). This construct is difficult to measure however. I use the *Number of employees* as a proxy because, although not a perfect reflection of the development stage, the team grows as a startup progresses (Mansouri & Momtaz, 2022). For example, a small founding team might hire additional engineers to build the prototype, to subsequently hire a sales person or team for setting up pilot projects and further expand the team when production is scaled up.[3] Table 5.1 summarises all the variables, their measurements and expected signs.

[2]The completeness of the founding team, or in other words the *Team balance* between technical and commercial know-how is also mentioned in the literature as an indicator for the quality of the founders (see for example Hall & Hofer, 1993; Miloud et al., 2012; Roure & Keeley, 1990). Because of the high-tech focus of FORWARD.one it is found that each startup in the sample has at least one technical co-founder. The dummy variable indicating team balance thus reflects the presence or lack of a commercial co-founder in this case. But since the data shows no effect of this presence of a commercial co-founder on the valuation it is excluded from the analysis.

[3]Additionally the economic sentiment at the time of investment (i.e. in a bull market versus in a bear market) should also be considered, as it is strongly related to VC valuations (Mansouri & Momtaz, 2022; Miloud et al., 2012). I use the generally accepted definition of a bear market as a decline of 20% or more from a previously high close of a major stock index. For this major stock index I use the S&P 500 Index, as this index is often referred to as the best representation of the global economy. The bear market ends when the lowest point is reached after this initial decline of 20%. The bull market starts from this lowest point reached and runs through the next market high. However, because of the relatively young age of FORWARD.one it is found that there is only little variance in the data when it comes to economic sentiment (43 entries were assessed in a bull market and only 4 entries in a bear market). Therefore, this control variable is excluded from the analysis.

Table 5.1: Summary of variables, their measurements and expected signs

Variable	Sign	Measurement
Dependent variable		
Pre-money valuation		Pre-money valuation of the startup (in EUR thousand)
Independent variable		
ESG risk score (H_{2a})	−	ESG risk score resulting from the proposed ESG framework
ESG DD included		Dummy variable with '1' indicating the fund considered ESG during the due diligence process and '0' indicating the fund did not consider ESG during the due diligence process
Interaction term (H_{2b})	−	Interaction term for ESG risk score and ESG DD included
Control variables		
Industrial experience	+	The sum of the number of years the founders worked in the startup's industry
Management experience	+	The sum of the number of years the founders worked in top management positions
Startup experience	+	Dummy variable with '1' indicating previous startup experience and '0' for no previous startup experience
Management team size	+	The number of top management positions filled
TAM (market size)	+	The total addressable market of the startup (in EUR billion)
Number of employees	+	The number of employees

5.3 Descriptive statistics

Table 5.2 reports the descriptive statistics for the raw data. The table shows that the *Pre-money valuation* follows a highly skewed distribution ranging from EUR 1.25 million to EUR 27.50 million with a median valuation of EUR 5.00 million.

The *ESG risk score* can have a value between 0.000 and 3.000 in theory, but the minimum and maximum found in the sample are 0.350 and 2.000 respectively. The average *ESG risk score* is 0.947 and for 46.8% of the startups ESG considerations were made during the investment process.

The founding teams on average count 3 co-founders that have a combined industrial experience of 28 years and have worked in top management positions for a combined 26 years. 68.1% of the teams had at least one co-founder with previous startup experience. The market size follows a highly skewed distribution ranging from EUR 100 million to EUR 464 billion with a median *Total Addressable Market* of EUR 5.3 billion. The distribution of the number of employees that the startups had at the time of fundraising also is highly skewed, ranging from 0 to 73, with a median of 6 employees.

5.4 Empirical methodology

This study aims to determine whether ESG characteristics have an impact on startup valuations in the VC context, but first it is empirically checked whether ESG risk does matter to venture capitalists. This is done through multiple one-tailed independent sample t-tests which examine whether the mean *ESG risk score* differs for various categories in the sample. Based on the discussion so far one expects three things.

First, one would expect the mean *ESG risk score* to be lower for startups that were positively

Table 5.2: Descriptive statistics

	Mode	Median	Mean	Std. Deviation	Minimum	Maximum
Pre-money valuation (in € thousand)	3000.000	5000.000	8140.000	6769.925	1250.000	27500.000
ESG risk score	0.950	0.950	0.947	0.288	0.350	2.000
ESG DD included (dummy)	0.000	0.000	0.468	0.504	0.000	1.000
Interaction term (ESG risk score - ESG DD included)	0.000	0.000	0.423	0.478	0.000	1.270
Industrial exp. (in years)	0.000	17.000	28.191	27.871	0.000	118.000
Management exp. (in years)	0.000	23.000	26.383	25.856	0.000	94.000
Startup exp. (dummy)	1.000	1.000	0.681	0.471	0.000	1.000
Management team size	3.000	3.000	2.894	0.961	1.000	5.000
TAM (in € billion)	2.000	5.300	23.939	73.784	0.100	464.000
Number of employees	5.000	6.000	11.936	13.954	0.000	73.000

This table presents the descriptive statistics of the raw data. See Table 5.1 for variable definitions.

assessed by the firm (i.e. the portfolio and anti-portfolio companies and the case currently in the investment pipeline) than the startups which were negatively assessed by the firm (i.e. those 18 startups whereby FORWARD.one decided not to invest after performing due diligence) - H_{1a}. This indicates whether the ESG risk of a startup has any impact on the *invest* versus *not invest* decision.

Second, one would expect the mean *ESG risk score* to be lower for startups that were assessed after the firm implemented the ESG considerations in its due diligence process, as compared to the startups that were assessed before these considerations were made - H_{1b}. This is because the complete set of startups in the sample have made it to a point in the investment funnel where FORWARD.one came up with a term sheet - meaning that the firm seriously considered investing in the startup. Startups with high ESG risk are thus expected to have been filtered out at this stage in the case that ESG considerations were made, but not before these considerations were made. The result to this t-test indicates whether there is indeed a structural break in the data, caused by the implementation of ESG considerations in the investment process.

Additionally, when dividing the startups over the four sub-samples as depicted in Figure 5.1, one would expect the difference in mean *ESG risk score* for positively versus negatively assessed startups to be more significant after the implementation of ESG considerations than before the implementation of these considerations.

After performing the t-tests to test hypotheses H_{1a} and H_{1b}, a Multiple Linear Regression analysis is performed to identify the relationship between the ESG risk score and the valuation of a startup. Two models are proposed, one examining only the direct effect of *ESG risk score* on *Pre-money valuation* - H_{2a}, and one with the interaction effect included which examines the structural break - H_{2b}. Equation 5.1 provides the first model that is to be estimated in the MLR analysis

$$\begin{aligned} Log(Pre-money\ valuation) = \alpha + \beta_1\,(ESG\ risk\ score) \\ + \beta_{1-k}\,(Vector\ of\ controls) \end{aligned} \tag{5.1}$$

where α is the intercept, β_1 is the regression coefficient of the independent variable and β_{1-k} represents the regression coefficients of the control variables, with k equal to 6.

Equation 5.2 provides the second model that is to be estimated, now with the interaction effect included. Since no change in the intercept of the pre-money valuation is expected purely due to the inclusion of ESG considerations, the dummy *ESG DD included* is not included in the model. Only the

interaction effect *ESG DD included* has with *ESG risk score* is included as a change is expected in the coefficient of *ESG risk score* for startups that had ESG considerations included versus those that did not.

$$Log(Pre-money\ valuation) = \alpha + (\beta_1 + \beta_2\ (ESG\ DD\ included))\ (ESG\ risk\ score) + \beta_{1-k}\ (Vector\ of\ controls) \tag{5.2}$$

Here α is again the intercept, β_1 is the regression coefficient of the independent variable, β_2 is the regression coefficient of the interaction term and β_{1-k} represents the regression coefficients of the control variables, with k equal to 6.

After inspection of the raw data it is concluded that the assumptions of Ordinary Least Squares (OLS) regression are not met and that data transformation is required [4]. Most variables have highly skewed distributions, causing heteroscedasticity and a non-normally distributed error term. Two outliers are removed from the *TAM* variable (TAM = 225 and TAM = 464) and log transformations with base 10 are performed for the dependent variable and all of the continuous control variables. The independent variable *ESG risk score* already follows a normal distribution. After these transformations it is concluded that all of the OLS assumptions are met.

However, because the sample size is only small and the model contains many control variables it is decided to pursue data reduction through Principal Component Analysis. A reduced set of variables can help with obtaining statistically significant results. Three of the control variables are significantly correlated: *Industrial experience*, *Management experience* and *Management team size*[5]. These control variables can be summarised in one dimension because all of their factor loadings on this principal component are > 0.700. As each of these control variables is an indicator of the founder quality construct, this dimension can naturally be interpreted as *Founder quality*. The descriptive statistics for all the variables after data transformation and data reduction can be found in Table C.5 in Appendix C.

[4] See Appendix C for a full documentation of the procedures gone through to diagnose violations of the OLS assumptions and the data preparation that is performed to overcome these problems

[5] See Table C.4 in Appendix C for the correlation table

6 Empirical results

6.1 Main statistical results

Figure 6.1 presents the measures of central tendency and the standard deviation for each of the four sub-samples and Table 6.1 presents the results of the one-tailed independent sample t-tests. The mean *ESG risk score* of positively assessed startups (mean ESG risk score = 0.908) is indeed lower than the mean *ESG risk score* of the negatively assessed startups (mean ESG risk score = 1.010) when not considering the structural break, consistent with the prediction. This difference in means is statistically significant on the 10% level ($p = 0.053$). Therefore we can conclude from this test that in general (i.e. when not considering the structural break) the ESG risk of a startup does have an impact on the *invest* versus *not invest* decision.

It can also be observed that the mean *ESG risk score* of the startups that were assessed and thus made it to a term sheet did go down after implementation of the ESG considerations, again consistent with the prediction. This can be observed both for startups that were positively assessed as well as for startups that were negatively assessed, indicating that startups with high ESG risk indeed get filtered out before a term sheet is presented. However, the t-test results indicate that this difference in means (mean ESG risk score = 0.986 for startups assessed before implementation of ESG considerations; mean ESG risk score = 0.903 for startups assessed after implementation of ESG considerations) is not statistically significant ($p = 0.163$). Therefore we cannot conclude whether the implementation of ESG considerations indeed causes a structural break in the data.

Finally, the results show that positively assessed startups had lower ESG risk than negatively assessed startups, already before the ESG considerations were implemented. One can suggest based on this observation that ESG risk might have already been considered in the subconscious before these considerations were made explicit. However, the results show that this difference in means was insignificant before the implementation of ESG considerations ($p = 0.239$) while the difference *is* significant on a 10% level after the implementation of the ESG considerations ($p = 0.090$). This indicates that there is indeed a structural break in the data and that after the implementation of ESG considerations the ESG risk of a startup *does* have an impact on the *invest* versus *not invest* decision, while it remains unclear whether this impact was already present before the implementation of ESG considerations.

The correlation matrix in Table 6.2 discloses the bivariate correlation between the variables in the MLR model. The matrix reports that the bivariate correlation between the DV and *Number of employees* is significant on the 0.1% level. The bivariate correlation between the DV and *Founder quality* is significant on the 1% level. The bivariate correlation between the DV and *ESG risk score* is significant on the 10% level. All significant bivariate correlations between the DV and the other variables furthermore have the expected signs. Not surprisingly *Startup experience* correlates with *Founder quality*, as previous startup experience is also an indicator of the founder quality construct. Interestingly however, *Startup experience* does not correlate with the DV but does correlate with *ESG risk score*. Nevertheless, no severe multicollinearity is found in the model (Condition Index = 14.482 and all variance inflation factor values are < 5.0). Furthermore, no significant bivariate correlation is

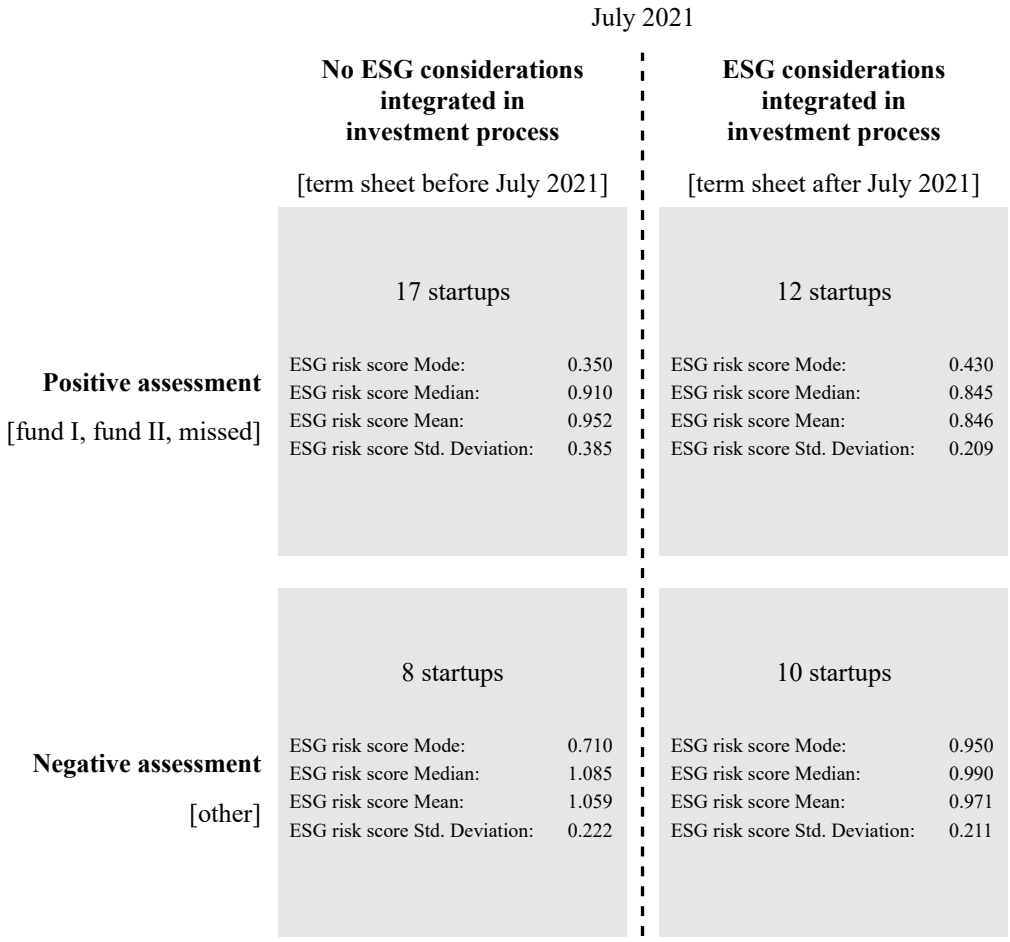

Figure 6.1: Means comparison with categorisation based on the inclusion of ESG DD and the final assessment of the firm

found between the DV and *TAM*.

Table 6.3 reports the results for different MLR models. Model 1 is the baseline model and only contains the control variables. Model 2 contains the control variables as well as the independent variable and tests the direct effect of *ESG risk score* on the dependent variable - H_{2a}. In Model 3 also the interaction term is included to test the interaction effect of *ESG risk score* and *ESG DD included* on the dependent variable - H_{2b}. Finally, in Model 4 the dummy *Startup experience* is excluded from the analysis.

Model 1 shows that the signs of both the *Startup experience* coefficient and the *TAM* coefficient are flipped. One would expect founders with previous startup experience to be of higher quality because of their previous learnings which therefore should have a positive effect on their startup's valuation. Also, a larger market size can potentially lead to a larger exit which therefore should have a positive effect on the startup's valuation. Both these regression coefficients are highly insignificant however, which comes as no surprise because both variables had no significant bivariate correlation with the dependent variable. *Founder quality* and *Number of employees* obtain statistically significant regression coefficients on the 1% and 0.1% level respectively, with the predicted signs. The standardised regression coefficients indicate that the *Number of employees* has a slightly larger impact on the valuation of a startup than the *Founder quality* does. Because both *Pre-money valuation* and *Number of employees* are log-transformed the coefficient can be interpreted as their elasticity. For every 1% increase in the *Number of employees*, the *Pre-money valuation* increases by 0.296%. The *Founder quality* coefficient is a little bit more difficult to interpret because *Founder quality* is a principal

Table 6.1: Difference in ESG risk score means and standard deviations for different sub-samples

		Sub-sample I		Sub-sample II		Test for difference (one-tailed)				
	Test	**Mean**	**SD**	**Mean**	**SD**	**Means**[a]	**SD**	**Statistic**[b]	**df**	***p***
Positive vs. negative[c]	Mann-Whitney	0.908	0.323	1.010	0.214	−0.118		186.500		0.053
With vs. without ESG considerations[d]	Student	0.903	0.215	0.986	0.340	−0.084	0.084	−0.992	45	0.163
Positive vs. negative (without ESG considerations)[c]	Student	0.952	0.385	1.059	0.222	−0.106	0.147	−0.723	23	0.239
Positive vs. negative (with ESG considerations)[c]	Student	0.846	0.209	0.971	0.211	−0.125	0.090	−1.391	20	0.090

Note. One-tailed independent sample t-tests.
Note. The Mann-Whitney U test is used as the non-parametric equivalent of the Student's t-test for testing whether the positively assessed startups' mean ESG risk score is lower than the mean ESG risk score of the negatively assessed startups when not considering the structural break, because the Shapiro-Wilk test indicates that the ESG risk score of the sub-sample of positively assessed startups does not follow a normal distribution.
[a] For the Mann-Whitney U test, the mean difference reports the Hodges-Lehmann estimate.
[b] The statistic reports the W value for the Mann-Whitney U test and the t value for the Student's t-test.
[c] The alternative hypothesis specifies that the mean ESG risk score is lower for positively assessed startups than for negatively assessed startups.
[d] The alternative hypothesis specifies that the mean ESG risk score is lower for startups that were assessed with ESG considerations implemented than for startups that were assessed without the implementation of these considerations.

component representing multiple log-transformed predictors. However, every one unit increase in the *Founder quality* factor score causes a 6.396% increase in the *Pre-money valuation*.

When the IV is added in Model 2 it can be seen that the coefficient has a negative sign, consistent with the prediction, and that the coefficient is statistically significant at the 10% level. For every one full point increase in *ESG risk score*, the *Pre-money valuation* decreases by 28.917%. The inclusion of the IV does furthermore not change the rest of the model materially.

Before examining the effect of the interaction term in Model 3, the interaction term is inspected in isolation from the rest of the model. Figure 6.2 shows the interaction plot. As consistent with expectations the regression lines for the two sub-samples are not parallel. The regression line is steeper for the sub-sample that had ESG considerations implemented in the investment process, meaning that the effect of the *ESG risk score* on the *Pre-money valuation* is larger when these considerations are implemented. When we now inspect the Model 3 summary we can see that both the coefficient of determination and the adjusted coefficient of determination are increased from Model 2 - the model without the interaction term - suggesting that the interaction term does contribute to the explanatory power of the model. However, when we inspect the model itself we can see that the regression coefficient of the interaction term is insignificant, causing confusion about the interpretation. There are seemingly two explanations for this. First, the small sample size might be a problem in obtaining a statistically significant result. With the interaction term the already small sample is effectively split into two sub-samples. These sub-samples might simply be too small to obtain a statistically significant result. Second, looking back on the means comparison we saw that, although the t-test result was insignificant, it seemed as if the firm already considered ESG risk to some extent before making these considerations explicit. This can also explain why the direct effect of *ESG risk score* on *Pre-money valuation* is significant but the interaction through *ESG DD included* is not.

In Model 4 *Startup experience* is excluded because of its significant correlation with *ESG risk score* and *Founder quality*. Although the variable was highly insignificant, excluding it from the model decreases the adjusted coefficient of determination. It can be observed that excluding *Startup experience* decreases the impact of both *ESG risk score* and *Founder quality* on the DV (the absolute

Table 6.2: Bivariate correlation matrix of the variables in the MLR model

Variable	10Log(Pre-money)	ESG risk score	Founder quality	Startup exp.	10Log(TAM)	10Log (Number of employees)
1. 10Log(pre-money)	–					
2. ESG risk score	−0.251*	–				
3. Founder quality	0.427**	−0.057	–			
4. Startup exp.	0.025	−0.291*	0.301*	–		
5. 10Log(TAM)	−0.031	−0.187	−0.117	−0.022	–	
6. 10Log(Number of employees)	0.479***	−0.142	0.147	−0.040	0.184	–

The correlation coefficients shown are Pearson's r. ***, **, and * denote statistical significance at the 0.1%, 1% and 10% levels, respectively. See Table 5.1 for definitions of the raw variables and section 5.4 for a description of the applied data transformations and data reduction.

standardised regression coefficient of ESG risk score decreases from 0.247 to 0.205; the standardised regression coefficient of Founder quality decreases from 0.354 to 0.311) and increases the p-values of both regression coefficients (the p-value of ESG risk score increases from $p = 0.057$ to $p = 0.097$; the p-value of Founder quality increases from $p = 0.008$ to $p = 0.014$). This final model thus gives a better idea about the direct effects of those two variables on the DV.

One final but important remark remains for the main statistical results. There is one data point (with ESG risk score = 2.00) that could be perceived as an outlier when looking at the distribution plot.[1] While this data point does drive the results of the analysis, it is not excluded from the dataset. When this instance is removed the IV becomes highly insignificant in the MLR model with a p-value of 0.440. It is reasoned however that this entry is not an outlier but that the gap between this entry and the other data is rather a result of the small sample size. The entry is no mistake but a valid observation. It furthermore lays along the regression line when examining the relationship between *ESG risk score* and the DV and also when considering the interaction term, as can be seen in Figure 6.2.

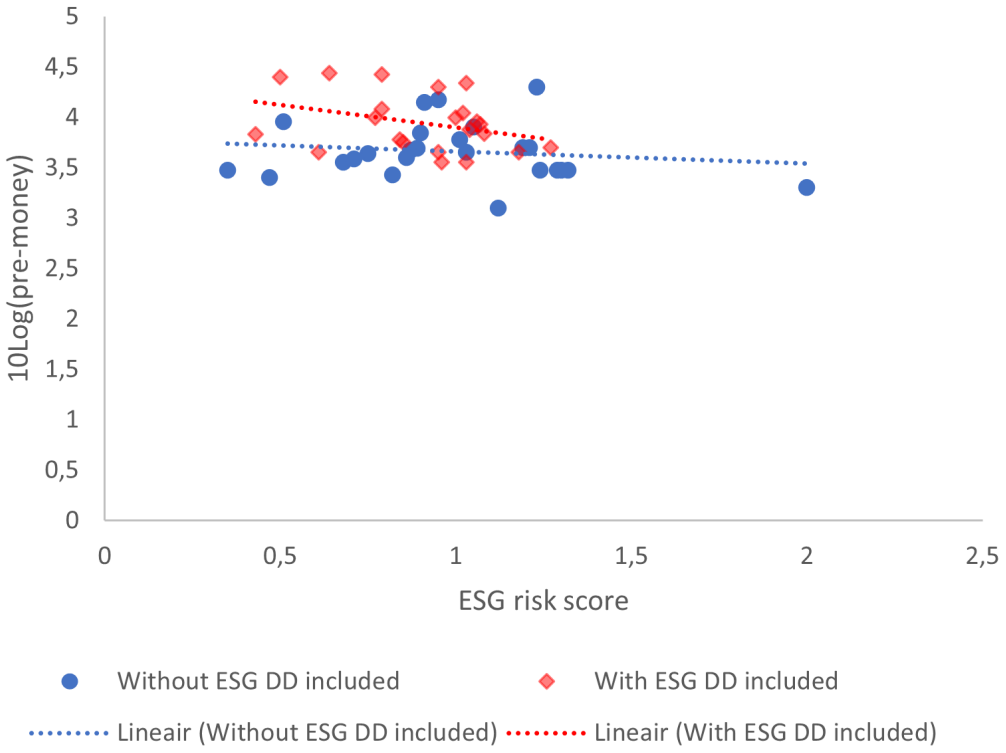

Figure 6.2: Interaction plot showing that the effect of ESG risk score on Pre-money valuation depends on ESG DD included

6.2 Post-hoc analyses

6.2.1 Relative importance of environmental, social and governance factors and the framework structure

To check whether the results are driven by a specific ESG theme a MLR analysis is run with the three separate E, S and G scores as well as the control variables. When all of the ESG variables are included in the model the variables do get the expected signs, but all of them are highly insignificant (E p-value = 0.908; S p-value = 0.716; G p-value = 0.149). When only including one of the ESG variables at the

[1] See Figure C.3 in Appendix C

Table 6.3: The effect of ESG risk score on log transformed pre-money valuation

	Model 1: Control variables		**Model 2: Direct effect of ESG**		**Model 3: Interaction effect**		**Model 4: Excluding Startup exp.**	
Intercept	3.595		3.906		3.901		3.781	
Std. Error	(0.116)		(0.205)		(0.201)		(0.170)	
ESG risk score			−0.254	*	−0.268	*	−0.222	*
Std. Error			(0.140)		(0.137)		(0.131)	
Standardised			(−0.233)		(−0.247)		(−0.205)	
Interaction term (ESG risk score - ESG DD included)					0.136		0.137	
Std. Error					(0.082)		(0.082)	
Standardised					(0.207)		(0.209)	
Founder quality	0.062	**	0.063	**	0.058	**	0.051	*
Std. Error	(0.022)		(0.021)		(0.021)		(0.020)	
Standardised	(0.377)		(0.386)		(0.354)		(0.311)	
Startup exp. (1)	−0.048		−0.097		−0.095			
Std. Error	(0.086)		(0.088)		(0.086)			
10Log(TAM)	−0.039		−0.061		−0.064		−0.062	
Std. Error	(0.072)		(0.071)		(0.070)		(0.070)	
Standardised	(−0.068)		(−0.106)		(−0.112)		(−0.109)	
10Log(Number of employees)	0.296	***	0.275	**	0.234	*	0.245	**
Std. Error	(0.087)		(0.085)		(0.087)		(0.087)	
Standardised	(0.433)		(0.403)		(0.342)		(0.360)	
R^2	0.369		0.416		0.454		0.437	
Adjusted R^2	0.309		0.345		0.372		0.368	
RMSE	0.260		0.254		0.248		0.249	
F-statistic	6.139	***	5.840	***	5.536	***	6.364	***
No. observations	45							

This table presents the coefficient estimates of four multiple linear regression models and their model summaries. The dependent variable is the log transformed pre-money valuation of a startup. Standard Errors and Standardised regression coefficients (β) are reported in parentheses. ***, **, and * denote statistical significance at the 0.1%, 1% and 10% levels, respectively.

same time only the governance risk score becomes significant at the 10% level. This can possibly be explained through the larger amount of variance in the governance risk score. One can thus conclude that the results are not driven through just one dimension, but the governance dimension is seemingly the most important one.

It is furthermore checked what the impact is of the structure of the ESG framework. More specifically, what the impact is of the two-dimensional risk model and what the impact is of the industry weights. A MLR analysis is performed with the ESG risk management score M_{ESG}, which refers to the ESG risk management practices of a startup without considering the level of ESG risk a startup is exposed to through its specific economic activities. This effectively represents a one-dimensional ESG risk model. The coefficient does get the expected sign but is highly insignificant (p-value = 0.253). It can thus be concluded that the two-dimensional risk model is a better representation of how venture capitalists perceive ESG risk.

Finally, a MLR analysis is performed with the three separate ESG risk management scores M_E, M_S and M_G. This excludes the weights for the different ESG themes and makes them equally important, no matter the economic activity that the startup performs. Again, the separate coefficients do get the expected signs but none of them is significant (M_E p-value = 0.841; M_S p-value = 0.433; M_G p-value = 0.128). These results are consistent with the sentiment in the literature that not every theme is found to be equally important.

6.2.2 The effect of impact scores

In this thesis I have looked at ESG and its impact on startup valuation from the risk perspective, as in line with the practice of responsible investing. The practice of impact investing on the other hand looks at ESG through the opportunity lens. Where responsible investing is concerned with the operations of a company and how it is managed, impact investing is concerned with the mission of a company and how it creates positive non-financial externalities. It is thus interesting to see whether the impact of a startup also affects its valuation in the venture capital setting[2]. All of the startups in the sample were assessed on four impact indicators (indicators E7, E8, S10 and G1, see Table B.1 in Appendix B), covering the positive externalities and the mission of the startup. These impact indicators were not taken into account in the construction of the ESG score of the startup, but a separate impact score is constructed based on these indicators.

A MLR analysis is performed with *Impact score*, an interaction term of *Impact score* and *ESG DD included* and the control variables. Both the direct effect of *Impact score* on *Pre-money valuation* and the interaction effect are highly insignificant (Impact score p-value = 0.999; Interaction effect p-value = 0.205). The means comparison - shown in Figure B.10 in Appendix B - furthermore shows that the mean *Impact score* went down after implementation of the ESG considerations - while a high score is desirable in the case of the impact score[3]. And most notably, the mean *Impact score* of startups that were assessed positively is lower than the mean *Impact score* of the negatively assessed startups. This shows that positive non-financial externalities do not have an impact on the valuation of a startup and the investment decision in the context of purely financially driven (i.e. non-impact) VC's.

6.2.3 Cross-check of the results

In order to assess the convergent validity of the framework the sample of startups are also rated on their ESG characteristics with the word counting method of Mansouri and Momtaz (2022). Mansouri and Momtaz (2022) have created an ESG-specific dictionary in the startup context and have trained a

[2]It is important to consider that while there exist numerous impact VC's, FORWARD.one is no such impact fund.

[3]The impact score is calculated as the average score on the four impact indicators, which can all hold a binary value, i.e. either '0' or '1' for no impact or impact respectively. The impact score S_I is thus subject to the boundary condition $0 \leq S_I \leq 1$ whereby a score of 1 represents the maximum amount of impact.

text mining model to measure the normalised prevalence of ESG cues in startups' disclosed documentation. They have made their application publicly available[4]. For each startup in the sample their word counting application is used to come to another ESG score. Here it is important to note that the ESG score obtained through this word counting method should be a reflection of ESG *performance*, rather than ESG *risk*. Therefore a high ESG score is desirable and a negative correlation is expected with the ESG score obtained through the ESG framework proposed in this study. To prevent confusion I will refer to the ESG score obtained through Mansouri and Momtaz's word counting method as *ESG score MM*.

Table 6.4 reports the bivariate correlation between the two ESG scores and the impact score. While no significant bivariate correlation is found between *ESG risk score* and *ESG score MM*, *ESG score MM* is correlated to *Impact score* on a 10% significance level. Again the statistical analyses are performed and, as with the *Impact score*, *ESG score MM* is not statistically significant in the MLR model (p-value = 0.916). Furthermore, *ESG score MM* shows the same pattern in the means comparison as the *Impact score* (see Figure B.11 in Appendix B): the mean ESG performance decreases after implementation of ESG considerations and the mean score of startups that were assessed positively is lower than the mean score of the startups which were assessed negatively. This leads to the conclusion that the word counting method is rather a reflection of the impact a startup makes than the responsibility of its operations and, as we have seen, there is no relationship between such an impact score and startup valuations and investment decisions within the context of purely financially driven VC's.

Table 6.4: Bivariate correlation matrix of the different ESG and impact scores

Variable	ESG risk score	ESG score MM	Impact score
1. ESG risk score	–		
2. ESG score MM	0.103	–	
3. I score	0.055	0.352*	–

The correlation coefficients shown are Pearson's r. ***, **, and * denote statistical significance at the 0.1%, 1% and 10% levels, respectively.

[4] See https://www.sustainableentrepreneurship.org/

7 Discussion and conclusions

7.1 Discussion of main results

This thesis serves as an attempt to establish the initial empirical linkage between ESG factors and startup valuation by venture capitalists. To do so this study first assesses the status quo of ESG frameworks and related literature, to then answer sub-questions 1 and 2 based on this theoretical background and propose the startup ESG framework. The study then employs independent sample t-tests to examine whether the amount of ESG risk in a startup, measured through this startup ESG framework, has an impact on the investment decisions made by venture capitalists. The study subsequently employs a Multiple Linear Regression analysis to test whether a higher ESG risk score leads to a lower financial valuation.

Examining a sample of 47 startups that have been assessed by the Dutch venture capital firm FORWARD.one in the period 2017 - 2022, I find support for two of the four proposed hypotheses. The results of the independent sample t-tests indicate that the ESG risk of a startup does have an impact on the investment decision of venture capitalists. The startups that were positively assessed by the firm (i.e. those startups wherein the firm invested or wanted to invest) had on average an estimated 0.118 point lower *ESG risk score* than the startups that were negatively assessed. This result is significant on the 10% level and corresponds to a 12.46% change in *ESG risk score* (with a sample mean ESG risk score of 0.947). Hence, hypothesis H_{1a}, which specifies that ESG risk scores are lower for VC-backed startups as compared to non-backed startups, is accepted, answering sub-question 3.

Second, and most notably, I find support for hypothesis H_{2a} that specifies that there exists a negative relationship between startups' ESG risk scores and their financial valuations. For every one full point increase in *ESG risk score*, the *Pre-money valuation* decreases by 28.917%. This direct effect is also statistically significant on the 10% level. This finding answers sub-question 4.

Here it must be noted that although the statistical results are consistent with the existing literature on the economic effects of firms' ESG characteristics in the public market context (e.g. Friede et al., 2015; Gillan et al., 2021) and the crowdfunding context (Guzmán et al., 2020; Mansouri & Momtaz, 2022; Vismara, 2019), this study does not attempt to establish a causal mechanism. Yet, it is likely that the findings are the result of the institutional LPs pushing the GPs to adopt responsible investing approaches.

In both analyses - the independent sample t-tests and the MLR analysis - a structural break in the data is examined that is caused by the sudden implementation of explicit ESG considerations in the investment process by the focal venture capital firm. Both analyses give insignificant results. There is no statistically significant difference in mean *ESG risk score* of startups assessed before and after the implementation of the explicit ESG considerations. Therefore, hypothesis H_{1b}, which specifies that the ESG risk scores are lower for startups that were assessed after the implementation of ESG considerations as compared to startups assessed before the implementation of such considerations, is rejected. Similarly, there is no statistically significant interaction effect through the inclusion of ESG considerations. Therefore hypothesis H_{2b}, which specifies the existence of this interaction effect, is also rejected. This can be interpreted in two ways. The first interpretation says that FORWARD.one

already considered ESG risk subconsciously before implementing these considerations explicitly. This can explain why the direct effect of *ESG risk score* on *Pre-money valuation* is significant but the interaction through *ESG DD included* is not. The second interpretation says that the sample size is forming a problem in obtaining statistically significant results, and that in reality there might actually be a structural break in the data. Based on the analysis of this sample however, both hypotheses H_{1b} and H_{2b} are rejected. Either way, it is evident that the ESG risk in a startup does affect both the investment decision of the venture capitalist as well as the startup's financial valuation by the venture capitalist, clearly answering the main research question.

It is furthermore noteworthy that there exists no bivariate correlation between *ESG risk score* and *number of employees*, the proxy measurement for the development stage of the startups. This is important because it rules out the explanation that further developed startups with more employees have spent more effort on their sustainability performance, and that the effect of ESG risk on the financial valuation is explained through the development stage.

This study also performs the same analyses with an *Impact score* instead of the *ESG risk score* as the explanatory variable. Both analyses give insignificant results. We can conclude from this that purely financially driven (i.e. non-impact) VC firms are not interested in startups' positive externalities relating to the environment and society, as in line with the results of Zhang (2022). These firms are only interested in the environmental, social and governance risk in a startup, i.e. its ESG-related negative externalities. This finding is consistent with the literature and anecdotal evidence which suggests that institutional investors are increasingly incorporating the practice of responsible investing and are pushing their asset managers - among which venture capital GPs - to follow suit (Botsari & Lang, 2020; Florman & MacKay, 2012; Lloyd & Schraven, 2020; Wiek & Villegas, 2022), while no such claims are made for the practice of impact investing. Naturally, this result may not be generalisable to the impact investor context.

We can also conclude that the two-dimensional risk model is a better representation of how venture capitalists experience ESG risk than the one-dimensional risk model. This is indicated by the result that the *ESG risk score* is statistically significant in the MLR models but the ESG risk management score M_{ESG} in the post-hoc analysis is not. Furthermore, basing the weights of the ESG themes on the dynamic optimization approach with industry specific ESG weights gives better results than using equal weights for the ESG themes. This indicates that indeed not every theme is found to be equally important and that this relative importance can indeed depend on the industry a startup operates in. These findings strengthen the conclusion that sub-question 2 is well answered, namely that the proposed startup ESG framework performs well in determining a startup's ESG risk rating.

7.2 Theoretical contributions and practical implications

The present study contributes to the still emergent literature around the role of ESG in entrepreneurial finance. It attempts to address multiple gaps in the literature and in doing so makes important contributions. First, measurement issues of ESG in the startup context have been an important impediment for both researchers and investors in the entrepreneurial finance domain. Zhang (2022) has therefore called for the development of new measures for startups' ESG characteristics to facilitate responsible investing in the venture capital industry. The startup ESG framework proposed in this study takes relevant indicators from multiple existing ESG frameworks and produces a quantitative ESG risk score that can be used to evaluate and benchmark startups on their sustainability performance. One major strength of this framework is that it can evaluate a startup on its ESG performance purely based on its pitch deck and publicly available documentation. The more information the assessor has on the startup the more accurate the ESG risk score will be, but with limited data available this framework can already come up with an indicating score. Researchers can use this framework in

further studies to quantify startups' sustainability performance. Investors can use this framework during the due diligence process to assess the startups in their deal flow but also during their fund lifetime to monitor the sustainability performance of portfolio companies over time. Thereby the startup ESG framework can help GPs to abide to the expectations of their institutional LPs to adopt more meaningful approaches to responsible investing. A second major strength to this framework is that it is transparent. Entrepreneurs can use it to assess their own startups and discover how they can improve their sustainability performance and consequently their ESG risk scores.

Second, the results show that ESG risk in startups does have a significant relationship with startups' financial valuations by venture capitalists and the outcomes of these venture capitalists' investment decisions. Hence we can extend the findings of previous studies in the crowdfunding and token offering settings (Guzmán et al., 2020; Mansouri & Momtaz, 2022; Vismara, 2019) to the venture capital setting. This means that also those entrepreneurs that seek funding from venture capitalists have an economic incentive to work on their sustainability performance. However, this study finds that sustainability performance is only valued to the extent that it concerns ESG risk management, i.e. minimising ESG-related negative externalities. The creation of ESG-related positive externalities is not valued by purely financially driven venture capitalists.

The finding that the creation of ESG-related positive externalities is not valued by purely financially driven venture capitalists does not come as a surprise. Zhang (2022) already found in her research results that US venture capital investors expect startups that aim for environmental and social impact to be of lower quality as compared to other startups. Presumably this is because ESG-rents are perceived to come at the direct cost of financial rents (Giuli & Kostovetsky, 2014). However, this study does neither find a positive nor a negative relationship between *Impact score* and *Pre-money valuation*. The VC investors in this study seem indifferent against the environmental and social impact aim of startups. As a consequence, impact startups that want to raise funding from purely financially driven venture capitalists should still have a solid business case. This makes sense because purely financially driven funds have the fiduciary duty to maximise profits and not to maximise impact. Considering the ESG-related risks is part of this fiduciary duty because these risks can have financially material consequences. And impact startups which aim to contribute to solving the societal challenges of the current time can be funded, but only as long as there is the prospect of making a profitable exit.

Let us take for example a startup that develops batteries for electrical vehicles. Besides aiming for profits this startup also aims to generate ESG-related positive externalities, actively trying to contribute to solving one of today's societal challenges, and can be classified as an impact startup. The institutional investor has the fiduciary duty to maximise profits. Thus, as long as this impact venture has a solid business case the investor can invest. But that decision is made based in the first place on the solid business case and not on the impact the startup aims to make. However, even though this startup actively aims to solve a societal challenge (i.e. creates positive ESG-related externalities), it might be operated in a non-sustainable way so that it also creates ESG-related negative externalities. For instance, its operations might lead to biodiversity loss through nickel mining. This ESG-related negative externality can result in financially material environmental disaster. And therefore, the institutional investor has the fiduciary duty to consider this risk when making an investment.

Ergo, the market takes care of allocating capital to startups that operate sustainably, but is not by itself able to fund all organisations that actively aim to contribute to solving today's societal challenges. Intergovernmental policy initiatives such as the European Green Deal have enabled viable business cases for impact startups, through giving a strong directional signal to the market about the necessity and future demand for certain products and technologies. Thereby these initiatives have also opened up broader funding possibilities to these impact startups in the private market. But dedicated impact funds with an impact or philanthropy mandate, as well as government subsidies,

are essential funding mechanisms for the remaining impact startups that, because of a weak business case, find themselves unable to raise funding from purely financially driven investors.

Nevertheless, as Mansouri and Momtaz (2022) indicate, the fact that there exists an economic incentive for entrepreneurs to focus on sustainability performance means that the Schumpeterian logic of 'creative destruction' might also apply to the notion of sustainable entrepreneurship (Schumpeter, 1934, 1942). The results indicate that although ESG performance might impose costly restrictions upon entrepreneurs, "the demand for ESG creates entrepreneurial opportunity" whereby sustainable businesses might replace unsustainable businesses (Mansouri & Momtaz, 2022, p. 29). Startups furthermore have a distinct advantage over mature firms according to the Climate Change and Sustainability Services department at accountancy and consultancy firm Ernst & Young. Because startups are small and still building the company, entrepreneurs can incorporate ESG values and practices into their company culture right from the beginning whereas mature firms have to go through costly and lengthy restructuring processes (Kite-Powell, 2022).

Putting these findings in the light of recent newspaper headlines criticising ESG (e.g. McCaughey, 2022; Tricks, 2022) shows once more the importance of the legislative initiatives that are currently put into place to tackle greenwashing (e.g. the EU Taxonomy). Namely, asset managers of mutual funds have more knowledge about their funds than investors. This creates information asymmetry that opportunistic asset managers can exploit (Candelon et al., 2021). By providing investors with unsubstantiated or misleading information such as a misleading name for a financial product, asset managers can influence the perceptions of investors. The notion of 'greenwashing' is concerned with such cases where asset managers make certain financial products appear as socially responsible (Candelon et al., 2021). Due to the high demand for responsible investments such cases have increasingly come to light and at the same time asset managers in the public market setting have started to charge higher management fees for these ESG funds. This has put the concept of ESG into a bad light and is hurting its intentions. Without regulations this trend might continue into the venture capital asset class because the results of this study show that there is also a high demand for sustainable entrepreneurial ventures.

7.3 Limitations and avenues for further research

This study took a quantitative approach to understanding the impact of startups' ESG characteristics on their financial valuations in the venture capital setting. Where previous studies have so far presumably focused on the crowd-funding and token offering setting due to the lack of publicly available data from the venture capital industry, the Dutch VC firm FORWARD.one provided access to confidential data regarding their deal flow and investments, enabling this quantitative study in the VC context. This research was however subject to multiple limitations inherent to this approach.

Subjectivity in ESG ratings. In order to measure and quantify startups' ESG characteristics this thesis proposes a new ESG framework that is applicable to startups. While the framework itself is kept as simple as possible, for example by using multiple choice answers, filling in the framework does require the judgement of the assessor. For instance, the assessor must judge which NACE category best describes a startup's economic activities. Due to the use of a two-dimensional risk model, differences in this judgement can quickly lead to diverging ESG risk scores. Also, since the rating is done based on startups' disclosed documentation, the results remain contingent upon subjective interpretation of these documents by the assessor. In general, while the proposed startup ESG framework does help analyse the ESG risk in startups based on their perceived operations, the resulting ESG risk scores are bound to subjectivity and potential maturation effects, which limits the generalisability of the results. This furthermore limits the comparability of results across subsequent ESG studies in the entrepreneurial finance setting that use this framework. However, future studies can partly overcome this concern by using a panel of assessors, which decreases subjectivity in the

scoring.

Robustness of the framework. The proposed ESG framework takes the World Economic Forum risk categories and systematically maps the relevant ESG indicators of the other included frameworks upon these categories. This study aimed to propose a framework that is comprehensive but parsimonious. In the light of rating divergence, further research can be done on how robust the resulting ESG risk scores are to the inclusion of additional or other indicators.

Unobserved heterogeneity. Another concern relates to the encoding of information. Because venture capitalists and founders have extensive communication during the investment process which is not all formally encoded, there exists the risk of omitted variable bias (Zhang, 2022) - or unobserved heterogeneity. In this case a variable is not included in the model that has an important effect on the valuation of the startup. If this variable is confounding both the IV and the DV there can exist an endogeneity problem in the model. This study does not diagnose or control for these unobserved heterogeneity concerns, forming a rather large limitation to the study. For instance, Mansouri and Momtaz (2022) found in their study in the token offering setting that unobserved heterogeneity inflated the ESG valuation premium found in their OLS results. Further research can use a two-stage approach (such as Two-Stage Least Squares) in addition to the MLR analysis to diagnose and control for endogeneity.

Sample size. This study used a sample of 47 startups to establish the initial empirical linkage between ESG factors and startup valuation by venture capitalists. We have seen that although the direct effect of *ESG risk score* on *Pre-money valuation* was statistically significant on the 10% level, the small sample size limited us in making sound conclusions about some parts of the analysis. Some scholars would furthermore argue that a 10% chance of making a type I error is too high to make strong conclusions. Further research can use a larger sample size to increase the generalisability of the results. If gathering enough data is problematic other studies can also use conjoint analysis as an alternative research method. In this case researchers can come up with as many hypothetical startups as needed and have venture capitalists put hypothetical valuations to them. This gives insight into how important ESG attributes are in comparison to conventional valuation drivers (i.e. founder quality, market attractiveness and development stage of the startup). However, a downside would be that the study results are based on hypothetical propositions and valuations.

Contextual limitations. Because I rely on the data of a Dutch VC it is important to consider the implicit conditions that have an effect on the results. The extent to which ESG risk is considered in investment decisions, and the motivations behind this might vary based on the geographic location of the investor. For example, Amel-Zadeh and Serafeim (2017) find that the feeling of ethical responsibility is more likely to be considered by European investors as a rationale to incorporate ESG considerations than by their US counterparts. Of course sustainability-oriented legislation for the financial markets also varies per regulator, not to mention the social norms that might vary per culture. The results of this study can therefore not be generalised across borders without considering these contextual factors. It would be interesting to see whether similar studies in different geopolitical areas give rise to the same results.

Financial performance. I have argued that venture capital GPs are pushed by their institutional LPs to incorporate ESG considerations in their investment processes, possibly because of the new regulations and social norm pressure. While the literature and anecdotal evidence supporting this claim can explain the results found in this study, there might also exist other reasons for venture capitalists to incorporate ESG considerations. For instance, although conflicting results are found in the literature, Friede et al. (2015) have shown that the majority of the studies in the public market setting have found a positive relationship between firms' ESG characteristics and financial performance. As a result responsible investing might be considered as a strategy to increase fund performance. It remains to be seen however if this positive relationship between ESG characteristics and firms' financial performance also holds in the venture capital setting. For example, Mansouri and Momtaz

(2022) have found in the token offering setting that startups with better ESG characteristics financially underperformed in the one-year period after funding in comparison to their peers with worse ESG characteristics. Whereas venture capitalists invest for longer periods of usually five to up to ten years (Bocken, 2015), the relationship between startups' ESG characteristics and short-term financial performance might not be extremely interesting. Yet, in order to be able to paint a clearer picture about the economic attractiveness of a responsible investment strategy for venture capitalists, further research might use this startup ESG framework to examine the relationship between startups' ESG characteristics and long-term financial performance, or the impact of ESG risk on the rate of successful exits.

7.4 Concluding remarks

This thesis aimed to (i) examine the relationship between startups' ESG characteristics and their financial valuations in the venture capital setting, and (ii) to propose an ESG framework that is applicable to startups. The study shows that the amount of ESG risk in a startup is negatively correlated to its financial valuation, meaning that venture capitalists do value startups' ESG risk management, i.e. the decreasing of ESG-related negative externalities. This means that also those entrepreneurs that seek funding from venture capitalists have an economic incentive to work on their sustainability performance. The creation of ESG-related positive externalities is however not valued by purely financially driven venture capitalists. I argue that this is mainly driven by the push of institutional limited partners who are themselves subject to new sustainability-related legislation and social norm pressure. In order to measure and quantify the ESG performance of startups this study proposes a startup ESG framework (which is publicly available) based on relevant indicators from multiple existing ESG frameworks. This enables the evaluation and benchmarking of startups on their sustainability performance. The proposed framework and the empirical findings contribute to the still emergent literature around the role of ESG in entrepreneurial finance markets (e.g. Mansouri & Momtaz, 2022; Zhang, 2022). Several promising avenues for further research are suggested.

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Appendix A: Background information

A.1 Venture Capital

The venture capital industry is an opaque industry but has gained the attention of a considerable amount of scholars in recent years. Venture capitalists have an influential role as they often do not only provide financing but also coaching to the entrepreneur, providing the entrepreneur with their experience and network (Bocken, 2015; Jeong et al., 2020). They invest for the long term with investment horizons of up to ten years, making their relationships with the founders of their portfolio companies extremely important (Bocken, 2015). According to Bocken (2015, p. 2) "Venture capitalists may be viewed as the 'gatekeeper' to the emergence of new businesses, as their role is to select venture ideas presented to them by entrepreneurs." The goal of the venture capital fund is to help scale the startup into a large and profitable business and subsequently make a successful exit through a merger, acquisition, or initial public offering (Bocken, 2015).

A VC firm exists out of one or multiple funds and a management firm. The investors which provide liquidity to the funds are the Limited Partners (LPs) while the fund management is performed by the General Partners (GPs) and employees. In general the management firm receives a 1-3% management fee over the assets under management and, through carried interest, shares in the excess returns. This structure is shown in figure Figure A.1.

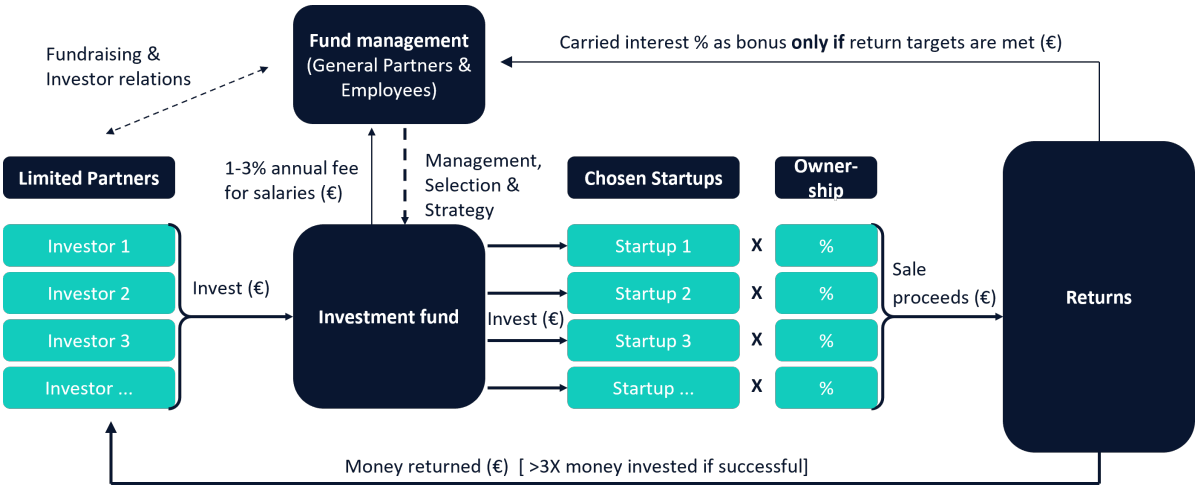

Figure A.1: Venture capital governance structure and business model (figure adapted from FORWARD.one)

Still little is known about ESG preferences and practices in the venture capital industry. Zhang (2022) provides some of the first empirical findings in her experimental study. Bocken (2015) investigates VC's motivations for getting involved with SE through interviews with SE focused VC's. She found that the motivations which were most frequently mentioned were practical idealism and disagreement with the status quo. Lin (2022) and Xue et al. (2019) prescribe some responsible

investment practices for VC's. "In the pre-investment stage of VC, attention should be given to effective ESG due diligence" (Xue et al., 2019, p. 2). In the post-investment stage VC's should actively engage with portfolio companies and make use of their corporate governance rights to make sure that startups meet their ESG-related promises (Lin, 2022). In the exit stage it is wise to set up a dedicated sustainability board (Lin, 2022). Furthermore, as VC's often invest in investment syndicates to reduce risks, it is good practice to share ESG information in the VC syndicate (Xue et al., 2019).

Some additional best practices can be found in anecdotal evidence. For example, Florman and MacKay (2012) propose that venture capital firms should consider the following success factors when planning their responsible investment strategies: ambition, suitability to stakeholders, leadership, defining an ESG policy or policies, defining a governance framework, internal engagement, integration into core business, engagement with portfolio companies, measurement, and reporting. It is furthermore important to first decide on the values and principles which should form the basis of the responsible investment strategy, so that companies in the investment pipeline can be assessed against these values and principles. This can be seen as a form of negative screening. Both Florman and MacKay (2012) and Lloyd and Schraven (2020) highlight that limited partners such as pension funds and other institutional investors are increasingly expecting venture capital firms to adopt more meaningful approaches to responsible investing. This is of course partly due to the new legislation initiatives such as the SFDR which require these institutional investors to disclose whether and how they integrate sustainability risk in their investment process (AFM, 2021).

Appendix B: Figures and tables

B.1 ESG framework

Table B.1: ESG metrics and their sources mapped onto the World Economic Forum risk categories

Risk category	Metric	Measured as	Sources
		Environmental theme	
Climate change	Greenhouse gas emissions	E1: Does the company measure its carbon footprint?	ESG_VC, B Lab
		E2: Does the company have greenhouse gas emissions reduction target(s) in place?	Invest Europe, ESG_VC
	Renewable energy consumption	E3: What proportion of the total energy consumption comes from a renewable energy source?	ESG Data Convergence Initiative, Invest Europe, ESG_VC, B Lab
Nature loss	Land use and ecological sensitivity	E4: Does the company have sites/operations located in or near to biodiversity-sensitive (Natura 2000) areas where activities of the company negatively affect those areas?	World Economic Forum, Invest Europe
Fresh water availability	Water consumption and withdrawal in water-stressed areas	E5: Does the company withdraw material amounts of water in regions with high or extremely high baseline water stress - as defined by the WRI Aqueduct water risk atlas?	Invest Europe, B Lab
Resource availability	Resource circularity	E6: Does the company have policies in place to reduce or reuse hard to recycle waste?	ESG_VC, B Lab
Environmental impact	Environmentally sustainable economic activity	E7: Are the company's products or services structured to restore or preserve the environment?	B Lab
		E8: Are the economic activities the company performs, and the way in which the company performs these activities, classified as, and meeting the criteria for making a substantial contribution to climate mitigation according to the EU Taxonomy?	
		Social theme	
Dignity and equality	Employee diversity and inclusion	S1: What proportion of the employees are female?	Invest Europe, ESG_VC
	Pay equality	S2: What is the gender pay gap?	Invest Europe, ESG_VC
	Wage level	S3: What proportion of employees are paid the living wage?	ESG_VC, B Lab
Health and well-being	Healthcare coverage	S4: What proportion of workers receive healthcare coverage either through a government plan or paid by the company?	ESG_VC, B Lab

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Table B.1 – continued from previous page

Risk category	Metric	Measured as	Sources
	Work-related accidents	S5: What is the average individual risk of injury?	World Economic Forum, ESG Data Convergence Initiative, Invest Europe
		S6: What is the average individual risk of fatality?	World Economic Forum, ESG Data Convergence Initiative, Invest Europe
Skills for the future	Training provided	S7: Does the company provide training opportunities to employees?	World Economic Forum, Invest Europe, B Lab
Employment and wealth generation	Absolute number and rate of employment	S8: What was the proportion of organic net new hires in the last year?	ESG Data Convergence Initiative, Invest Europe
		S9: What was the employee turnover in the last year?	ESG Data Convergence Initiative, Invest Europe
Social value generated	Social value generated	S10: Does the company's product or service address a social or economic problem for the customers and/or beneficiaries?	B Lab
		Governance theme	
Governing purpose	Purpose mission statement	G1: Does the corporate mission statement include a social or environmental commitment?	World Economic Forum, B Lab
Quality of governing board	Governance body composition	G2: What proportion of the board members are independent?	World Economic Forum, Invest Europe, ESG_VC
		G3: What proportion of the board members are female?	World Economic Forum, ESG Data Convergence Initiative, Invest Europe, ESG_VC
		G4: What proportion of the board members come from under-represented groups?	World Economic Forum, ESG Data Convergence Initiative, Invest Europe, ESG_VC
		G5: What proportion of the C-suite are female?	ESG Data Convergence Initiative, ESG_VC, B Lab
		G6: What proportion of the C-suite come from under-represented groups?	ESG Data Convergence Initiative, ESG_VC, B Lab
Ethical behaviour	Anti-corruption initiatives	G7: Does the company have policies in place on anti-corruption and anti-bribery?	Invest Europe, ESG_VC
	Code of conduct	G8: Does the company have a code of conduct in place?	Invest Europe, ESG_VC, B Lab
		G9: Does the company have a whistle-blower policy in place?	Invest Europe, ESG_VC, B Lab
Risk and opportunity oversight	Cyber security risks	G10: Does the company have a program in place to protect against cybersecurity risks?	Invest Europe, ESG_VC

Table B.2: Answer options and corresponding scores to the ESG metrics

Measure	Answers	Score
	Environmental theme	
	Continued on next page	

Table B.2 – continued from previous page

Measure	Answers	Score
E1: Does the company measure its carbon footprint?	Unknown	XXX
	No	0
	Yes	1
E2: Does the company have greenhouse gas emissions reduction target(s) in place?	Unknown	XXX
	No	0
	Yes	1
E3: What proportion of the total energy consumption comes from a renewable energy source?	Unknown	XXX
	< 40%	0
	≥ 40%	1
E4: Does the company have sites/operations located in or near to biodiversity-sensitive (Natura 2000) areas where activities of the company negatively affect those areas?	No	1
	Yes	0
E5: Does the company withdraw material amounts of water in regions with high or extremely high baseline water stress - as defined by the WRI Aqueduct water risk atlas?	Unknown	XXX
	No	1
	Yes	0
E6: Does the company have policies in place to reduce or reuse hard to recycle waste?	Unknown	XXX
	No	0
	Yes	1
E7: Are the company's products or services structured to restore or preserve the environment?	No	0
	Yes	1
E8: Are the economic activities the company performs, and the way in which the company performs these activities, classified as, and meeting the criteria for making a substantial contribution to climate mitigation according to the EU Taxonomy?	No	0
	Yes	1
Social theme		
S1: What proportion of the employees are female?	Unknown	XXX
	< 40%	0
	≥ 40%	1
S2: What is the gender pay gap?	Unknown	XXX
	< 5%	1
	≥ 5%	0
S3: What proportion of employees are paid the living wage?	Unknown	XXX
	≤ 99%	0
	100%	1
S4: What proportion of workers receive healthcare coverage either through a government plan or paid by the company?	Unknown	XXX
	< 90%	0
	≥ 90%	1
S5: What is the average individual risk of injury?	Unknown	XXX
	≤ 5%	1
	> 5%	0
S6: What is the average individual risk of fatality?	Unknown	XXX
	0%	1
	≥ 1%	0
S7: Does the company provide training opportunities to employees?	Unknown	XXX
	No	0
	Yes	1
S8: What was the proportion of organic net new hires in the last year?	Unknown	XXX
	< 30%	0

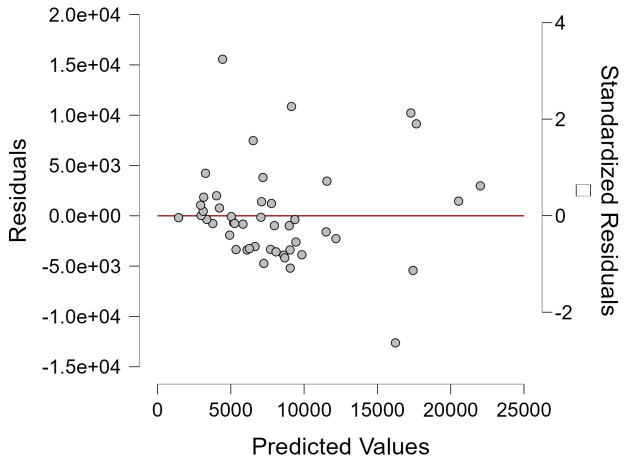
Continued on next page

Table B.2 – continued from previous page

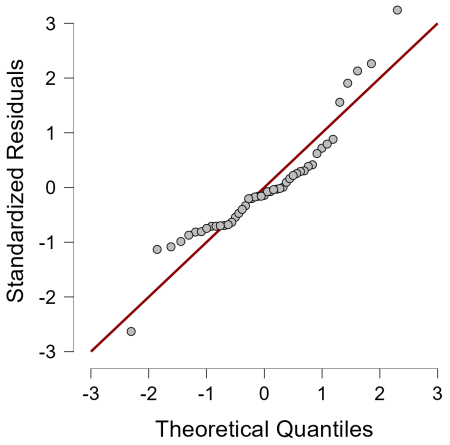
Measure	Answers	Score
	≥ 30%	1
S9: What was the employee turnover in the last year?	Unknown	XXX
	≤ 10%	1
	> 10%	0
S10: Does the company's product or service address a social or economic problem for the customers and/or beneficiaries?	No	0
	Yes	1
Governance theme		
G1: Does the corporate mission statement include a social or environmental commitment?	No	0
	Yes	1
G2: What proportion of the board members are independent?	Unknown	XXX
	< 33%	0
	≥ 33%	1
G3: What proportion of the board members are female?	Unknown	XXX
	< 40%	0
	≥ 40%	1
G4: What proportion of the board members come from under-represented groups?	Unknown	XXX
	< 30%	0
	≥ 30%	1
G5: What proportion of the C-suite are female?	Unknown	XXX
	< 40%	0
	≥ 40%	1
G6: What proportion of the C-suite come from under-represented groups?	Unknown	XXX
	< 30%	0
	≥ 30%	1
G7: Does the company have policies in place on anti-corruption and anti-bribery?	Unknown	XXX
	No	0
	Yes	1
G8: Does the company have a code of conduct in place?	Unknown	XXX
	No	0
	Yes	1
G9: Does the company have a whistle-blower policy in place?	Unknown	XXX
	No	0
	Yes	1
G10: Does the company have a program in place to protect against cybersecurity risks?	Unknown	XXX
	No	0
	Yes	1

B.2 Data analysis

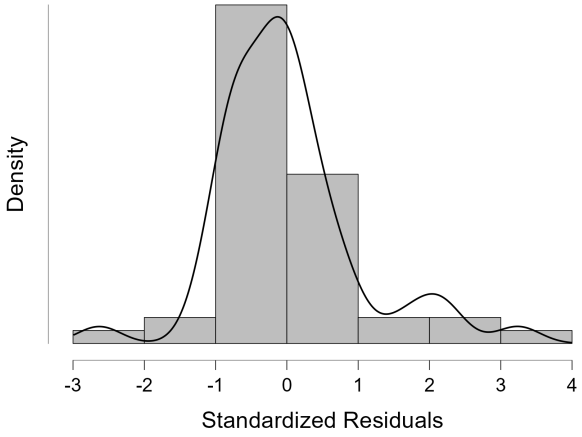
Figure B.1 shows plots of the error term in the MLR with the raw data.



(a) Residuals scatter plot for linear regression with raw data



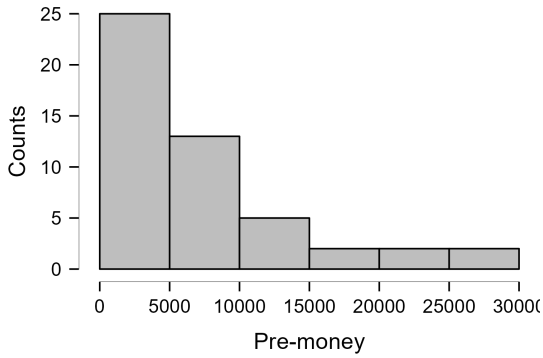
(b) Q-Q plot standardized residuals for linear regression with raw data



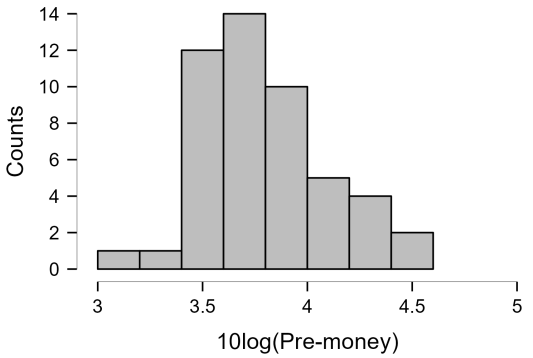
(c) Standardized residuals histogram for linear regression with raw data

Figure B.1: Inspection of the raw data residuals

Figure B.2 and Figure B.3 show the distribution plot and the Q-Q plot for the dependent variable before and after log transformation.

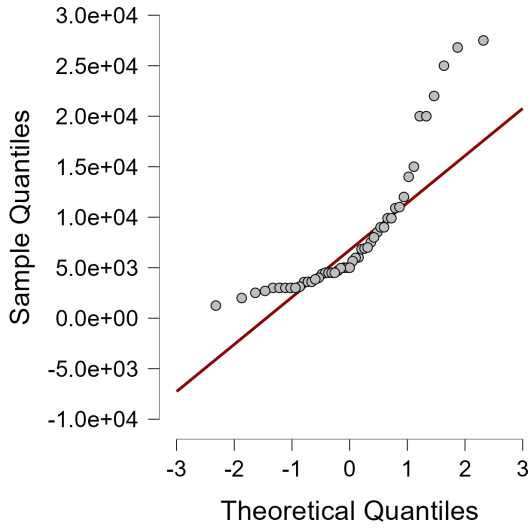


(a) The raw data follows an exponential distribution

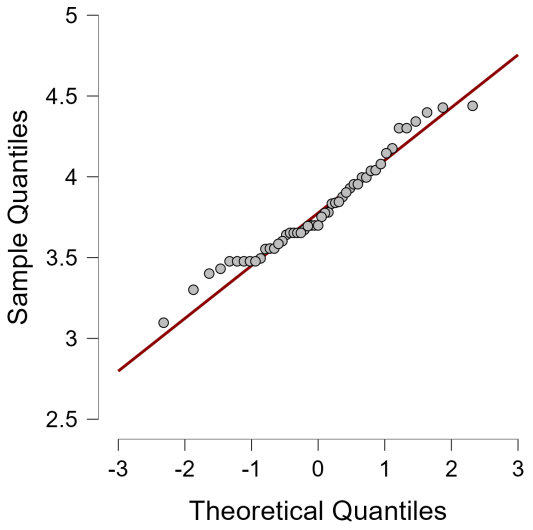


(b) The log-transformed data follows a normal-distribution

Figure B.2: Distribution plots of the raw and the log-transformed dependent variable



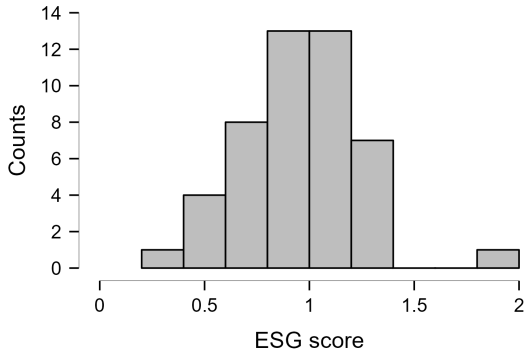
(a) The raw data follows an exponential distribution



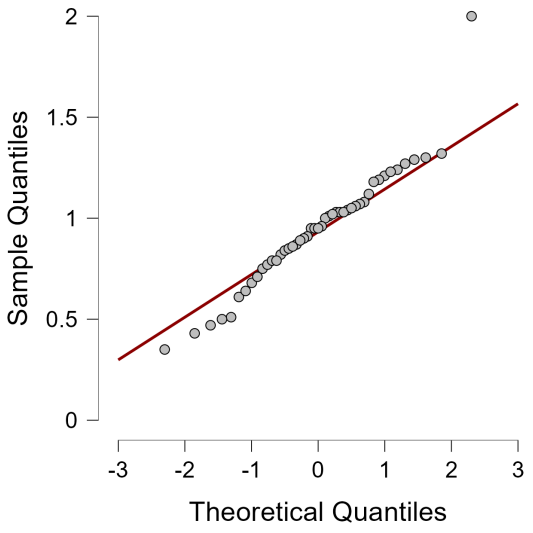
(b) The log-transformed data follows a normal-distribution

Figure B.3: Q-Q plots plots of the raw and the log-transformed dependent variable

Figure B.4 shows the distribution plot and the Q-Q plot for the independent variable. One outlier can be spotted with *ESG risk score* = 2.00.



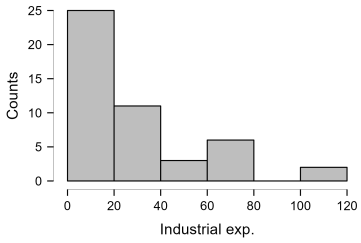
(a) Distribution plot of the independent variable ESG score shows a normal distribution



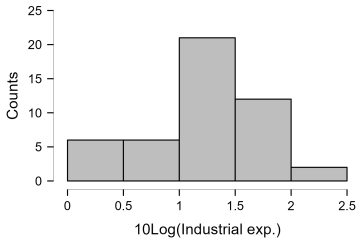
(b) Q-Q plot of the independent variable ESG score shows a normal distribution

Figure B.4: Distribution plot and Q-Q plot of the independent variable

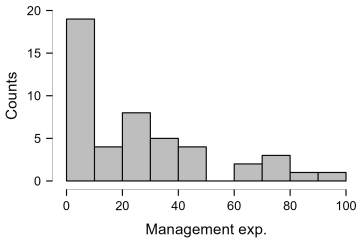
Figure B.5 shows the distribution plots for all of the continuous control variables before and after transformation.



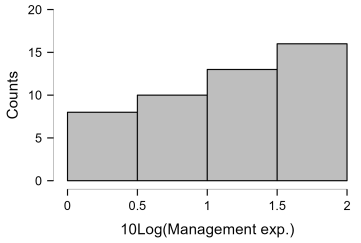
(a) Distribution plot for raw control variable Industrial experience



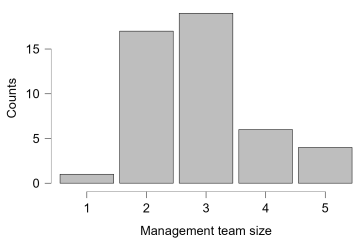
(b) Distribution plot for log-transformed control variable Industrial experience



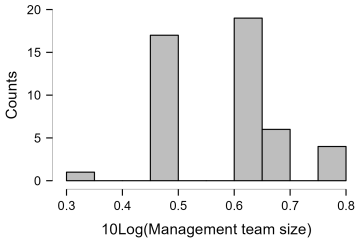
(c) Distribution plot for raw control variable Management experience



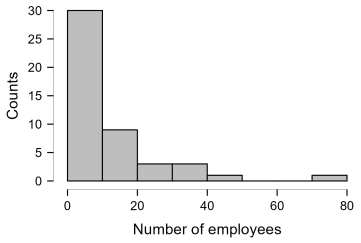
(d) Distribution plot for log-transformed control variable Management experience



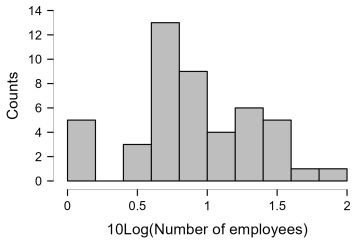
(e) Distribution plot for raw control variable Management team size



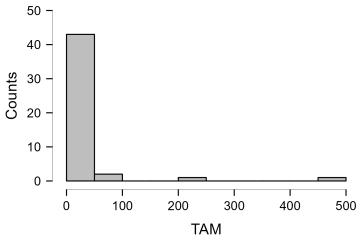
(f) Distribution plot for log-transformed control variable Management team size



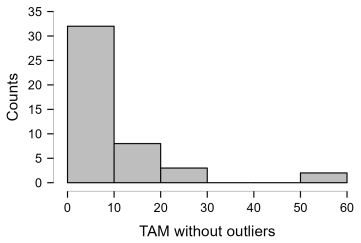
(g) Distribution plot for raw control variable Number of employees



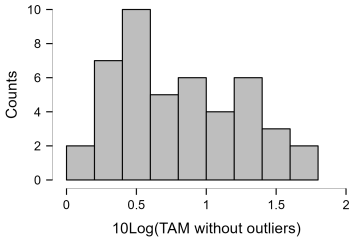
(h) Distribution plot for log-transformed control variable Number of employees



(i) Distribution plot for raw control variable TAM



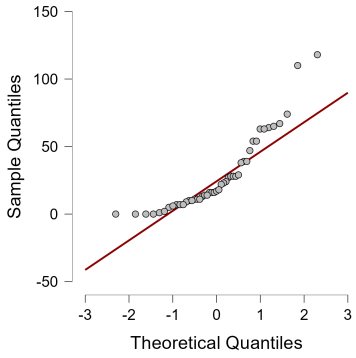
(j) Distribution plot for control variable TAM with two outliers removed



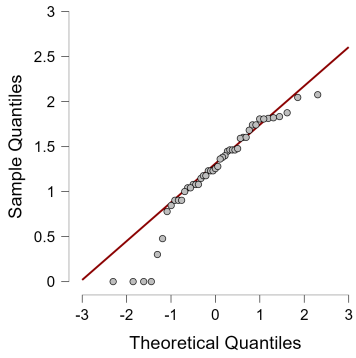
(k) Distribution plot for control variable TAM with two outliers removed and subsequently log-transformed

Figure B.5: Distribution plots of the continuous control variables before and after transformation

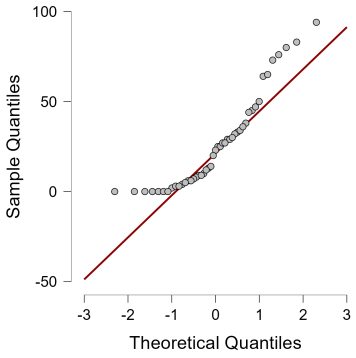
Figure B.6 shows the Q-Q plots for all of the continuous control variables before and after transformation.



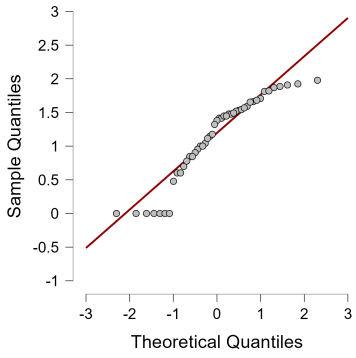
(a) Q-Q plot for raw control variable Industrial experience



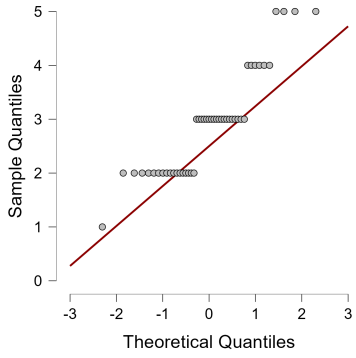
(b) Q-Q plot for log-transformed control variable Industrial experience



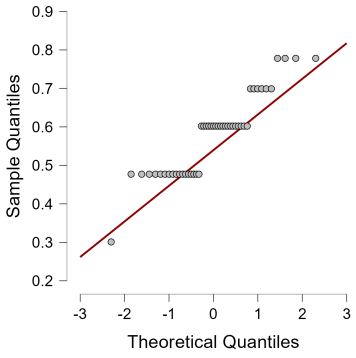
(c) Q-Q plot for raw control variable Management experience



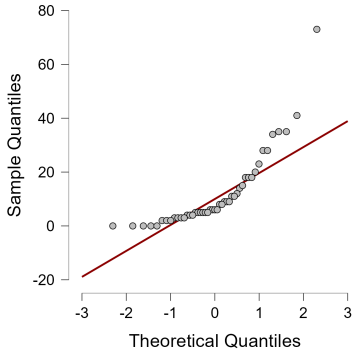
(d) Q-Q plot for log-transformed control variable Management experience



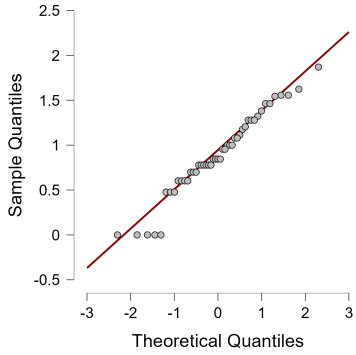
(e) Q-Q plot for raw control variable Management team size



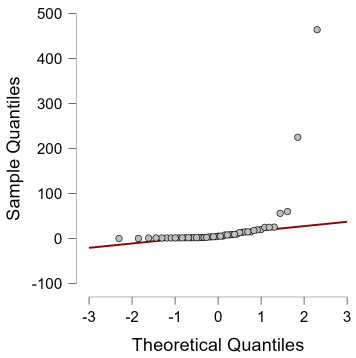
(f) Q-Q plot for log-transformed control variable Management team size



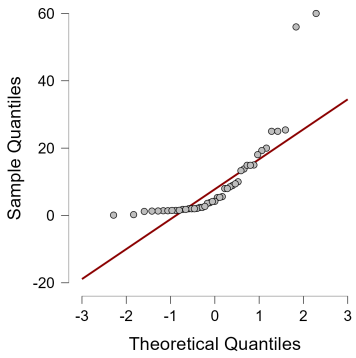
(g) Q-Q plot for raw control variable Number of employees



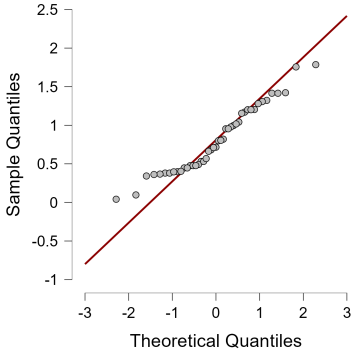
(h) Q-Q plot for log-transformed control variable Number of employees



(i) Q-Q plot for raw control variable TAM



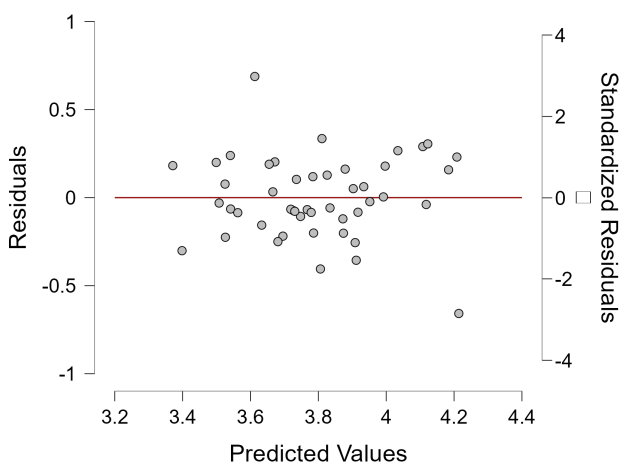
(j) Q-Q plot for control variable TAM with two outliers removed



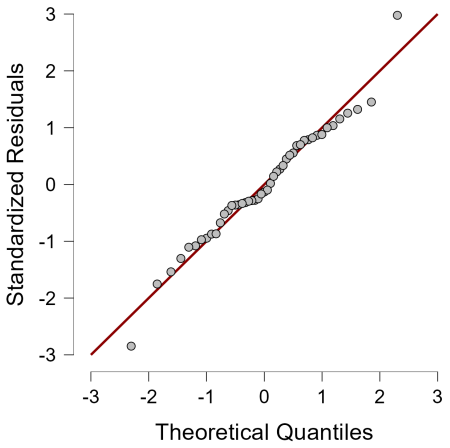
(k) Q-Q plot for control variable TAM with two outliers removed and subsequently log-transformed

Figure B.6: Q-Q plots of the continuous control variables before and after transformation

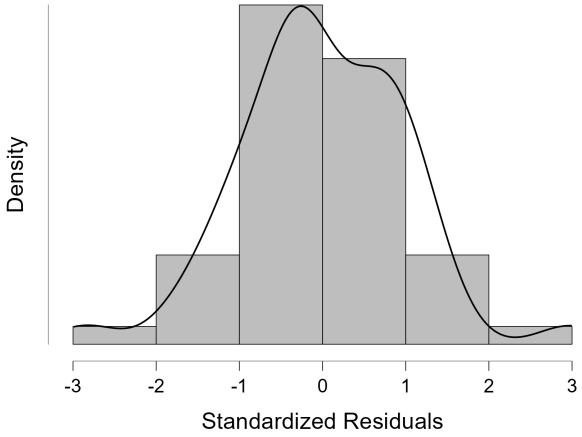
Figure B.7 shows plots of the error term in the MLR with the transformed data.



(a) Residuals scatter plot for linear regression with transformed data



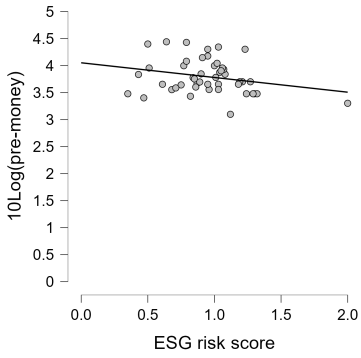
(b) Q-Q plot standardized residuals for linear regression with transformed data



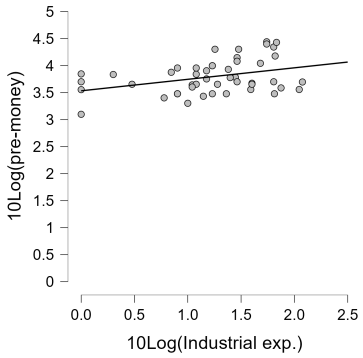
(c) Standardized residuals histogram for linear regression with transformed data

Figure B.7: Inspection of the transformed data residuals

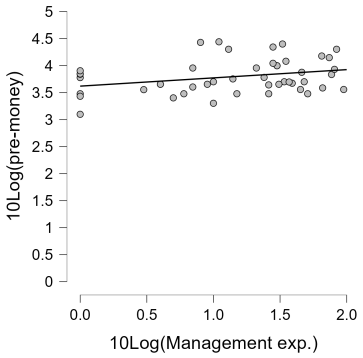
Figure B.8 shows the scatter plots for the independent variable and all of the control variables with the dependent variable after data transformations.



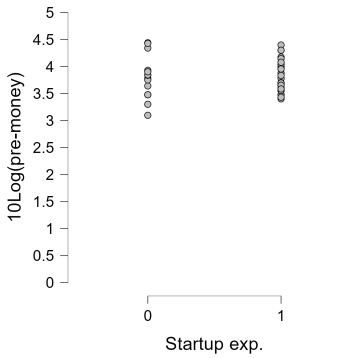
(a) Scatter plot showing the linear relationship between ESG risk score and log-transformed Pre-money valuation



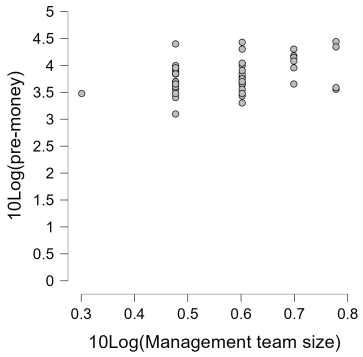
(b) Scatter plot showing the linear relationship between log-transformed Industrial experience and log-transformed Pre-money valuation



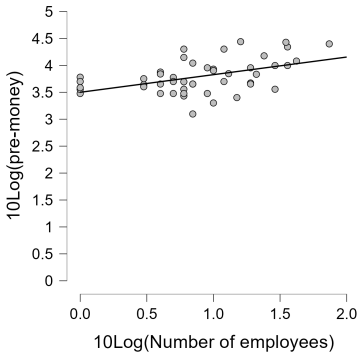
(c) Scatter plot showing the linear relationship between log-transformed Management experience and log-transformed Pre-money valuation



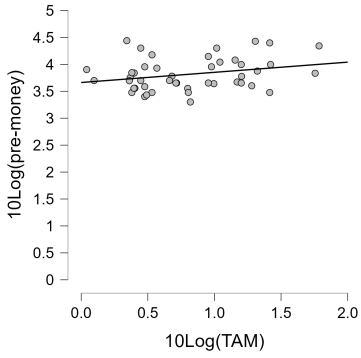
(d) Scatter plot of Startup experience against log-transformed Pre-money valuation



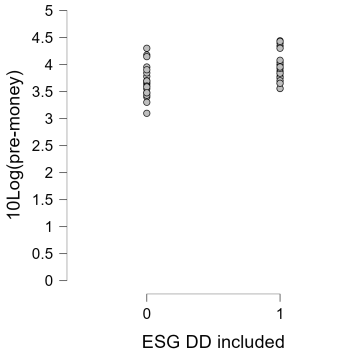
(e) Scatter plot showing the linear relationship between log-transformed Management team size and log-transformed Pre-money valuation



(f) Scatter plot showing the linear relationship between log-transformed Number of employees and log-transformed Pre-money valuation



(g) Scatter plot showing the linear relationship between log-transformed TAM and log-transformed Pre-money valuation



(h) Scatter plot of ESG DD included against log-transformed Pre-money valuation

Figure B.8: Scatter plots of the relationships between the independent variable and the (transformed) control variables with the transformed dependent variable

The means comparisons for the ESG risk score, the Impact score and the ESG score SOTA derived from the word counting method are shown in Figure B.9, Figure B.10 and Figure B.11 respectively. Here it should be noted that for ESG risk score a low score is desirable, for Impact score a high score is desirable and for ESG score SOTA a high score is desirable.

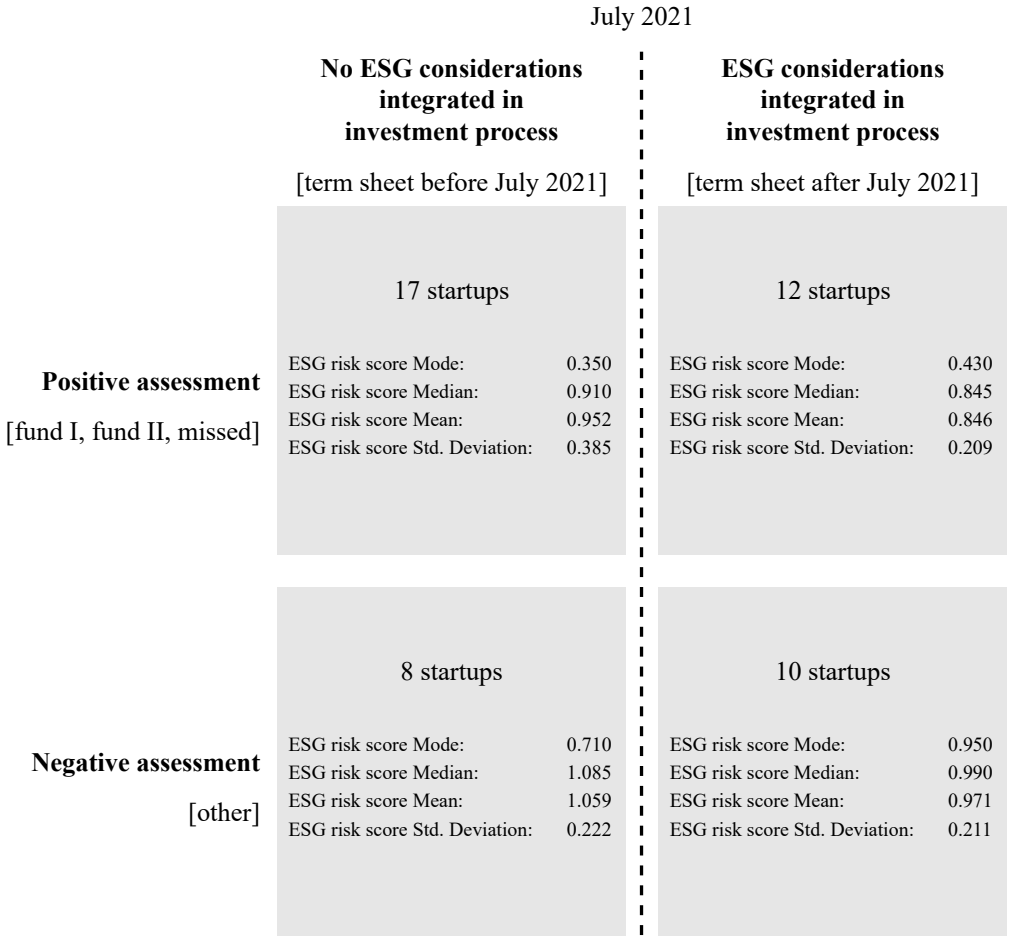


Figure B.9: Means comparison for ESG risk score for which a low score is desirable

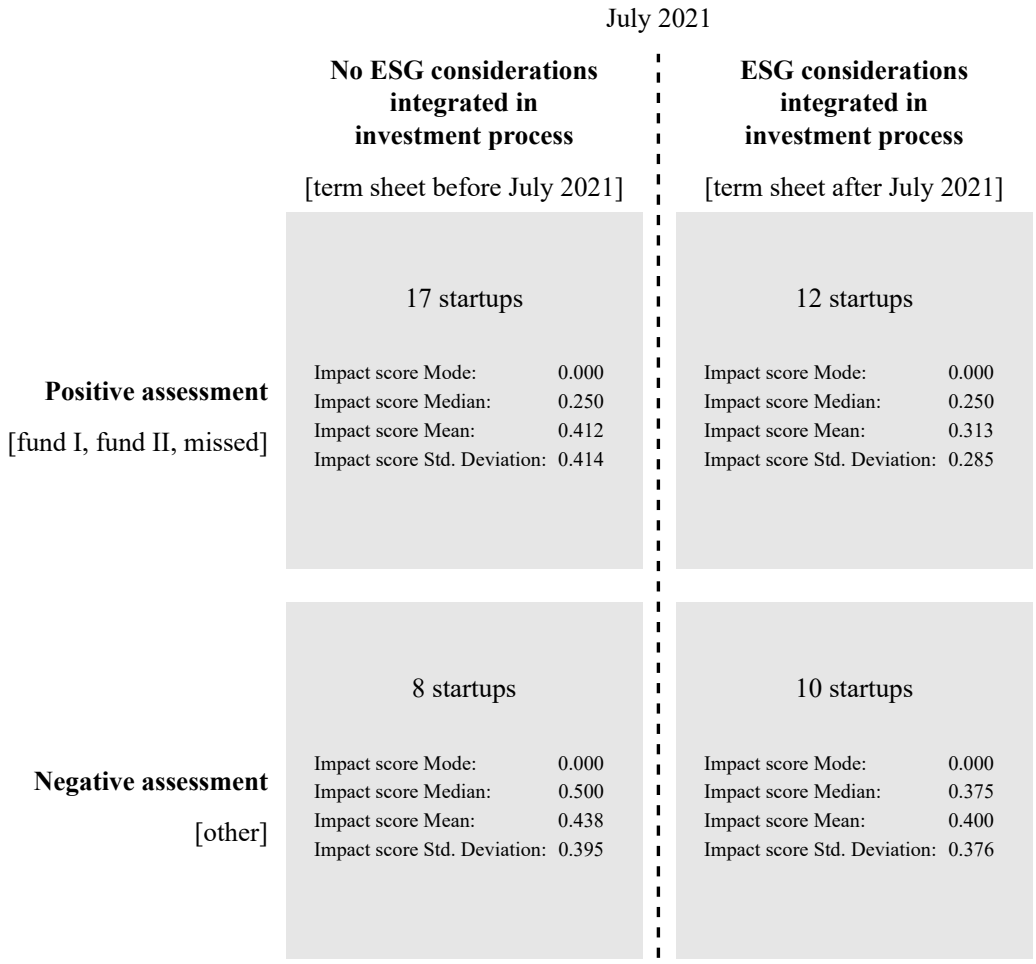


Figure B.10: Means comparison for Impact score for which a high score is desirable

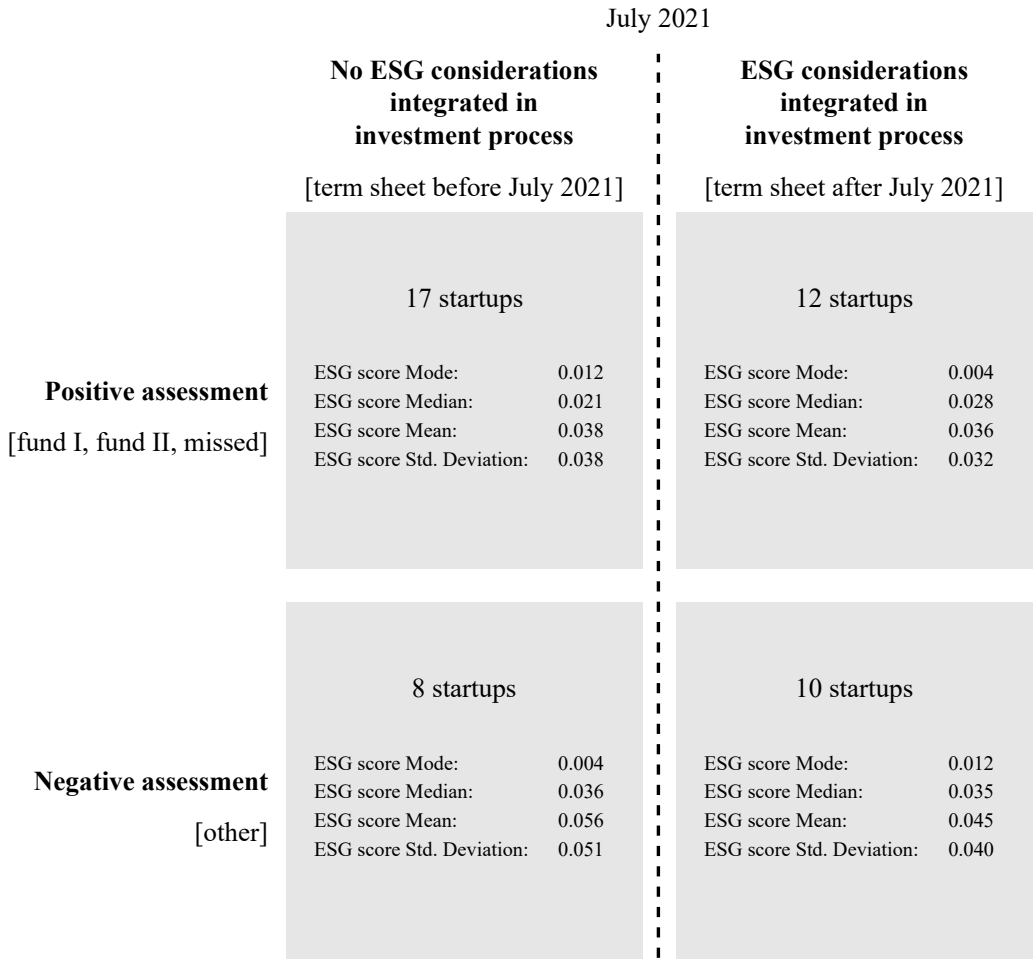


Figure B.11: Means comparison for ESG score MM for which a high score is desirable

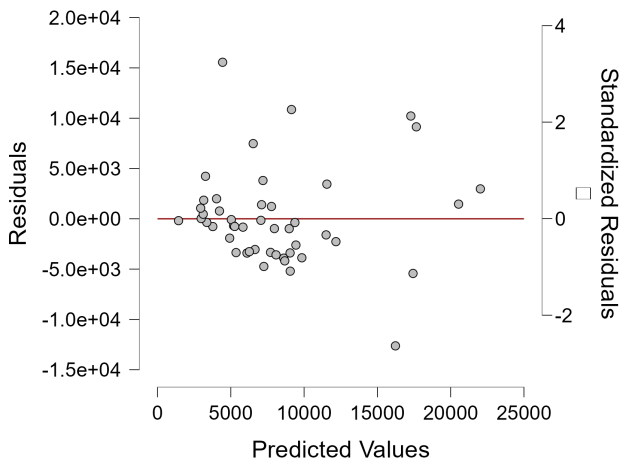
Appendix C: Data preparation

Table C.1 shows the descriptive statistics for the raw data. From inspecting the measures of central tendency it can immediately be seen that most variables seem highly skewed. This is not a problem per se but it does raise suspicion about whether or not the raw data can be used in MLR without violating any of the Ordinary Least Squares (OLS) regression assumptions. To check, a multiple linear regression is performed with the raw data and the error term is inspected. It can be seen in Figure C.1 (a) that the residuals are not distributed symmetrical around the null line and the Q-Q plot of the standardized residuals in Figure C.1 (b) shows no straight line, violating the normality assumption of OLS regression. The decision is therefore made to transform the data.

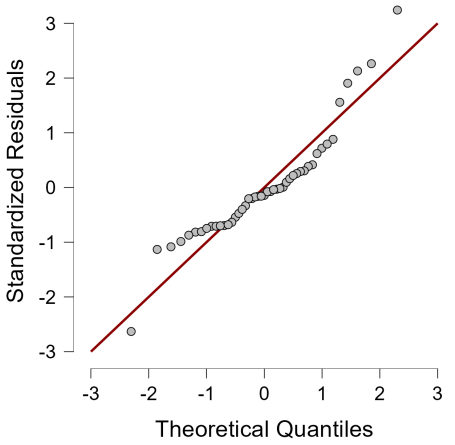
Table C.1: Descriptive statistics

	Mode	**Median**	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
Pre-money valuation (in € thousand)	3000.000	5000.000	8140.000	6769.925	1250.000	27500.000
ESG risk score	0.950	0.950	0.947	0.288	0.350	2.000
ESG DD included (dummy)	0.000	0.000	0.468	0.504	0.000	1.000
Interaction term (ESG risk score - ESG DD included)	0.000	0.000	0.423	0.478	0.000	1.270
Industrial exp. (in years)	0.000	17.000	28.191	27.871	0.000	118.000
Management exp. (in years)	0.000	23.000	26.383	25.856	0.000	94.000
Startup exp. (dummy)	1.000	1.000	0.681	0.471	0.000	1.000
Management team size	3.000	3.000	2.894	0.961	1.000	5.000
TAM (in € billion)	2.000	5.300	23.939	73.784	0.100	464.000
Number of employees	5.000	6.000	11.936	13.954	0.000	73.000

This table presents the descriptive statistics of the raw variables. See Table 5.1 for variable definitions.



(a) Residuals scatter plot for linear regression with raw data

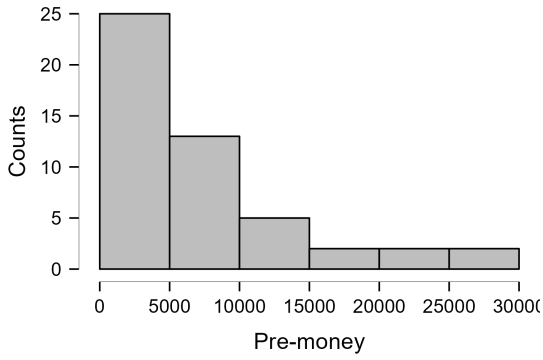


(b) Q-Q plot standardized residuals for linear regression with raw data

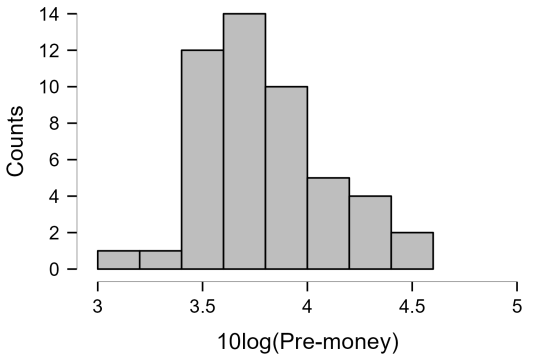
Figure C.1: Inspection of the raw data residuals

C.1 Data transformation

First the dependent variable is examined. The distribution plot in Figure C.2 (a) suggests that the dependent variable follows an exponential distribution. The non-alignment of the measures of central tendency, and the highly significant p-value of the Shapiro-Wilk test shown in Table C.2 both confirm that the distribution is indeed skewed. In order to enhance the analysis a log transformation of the dependent variable is performed with base 10. After the log transformation the dependent variable becomes normally distributed, as can be seen in Figure C.2 (b) and Table C.2. The Q-Q plots show the same result and can be found in Figure B.3 in Appendix B.



(a) The raw data follows an exponential distribution



(b) The log-transformed data follows a normal-distribution

Figure C.2: Distribution plots of the raw and the log-transformed dependent variable

The independent variable *ESG risk score* does already follow a normal distribution and needs not to be transformed. This can be concluded from the aligned measures of central tendency in Table C.1 and the distribution plot in Figure C.3. To be certain a Shapiro-Wilk test is performed which turns out to be significant ($p = 0.027$). This is supposedly the result of the outlier (*ESG risk score* = 2.00). Indeed, after removal of this outlier the Shapiro-Wilk test no longer gives a significant result ($p = 0.202$). However, this outlier is not the result of a mistake but a valid observation. And when inspecting the linear relationship between *ESG risk score* and the DV (Figure C.4 (a)), and the interaction through *ESG DD included* (Figure C.4 (b)), it can be seen that this entry lays along the regression lines. It is therefore concluded that this entry is not an outlier but that the gap between

Table C.2: Descriptive statistics of raw and transformed dependent variable

	Pre-money	**10Log(Pre-money)**
Mode	3000.000	3.477
Median	5000.000	3.699
Mean	8140.000	3.793
Std. Deviation	6769.925	0.313
Skewness	1.661	0.404
Std. Error of Skewness	0.347	0.347
Shapiro-Wilk	0.774	0.964
p-value of Shapiro-Wilk	$< .001$	0.153

This table presents the descriptive statistics including the skewness and Shapiro-Wilk value of the dependent variable before and after log transformation.

this entry and the other entries is simply a result of the small sample size of the study. Therefore it is not excluded from the analysis. It should be noted however that this outlier has a large impact on the results.

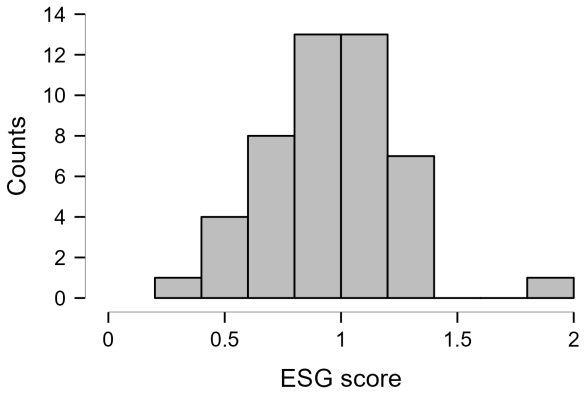
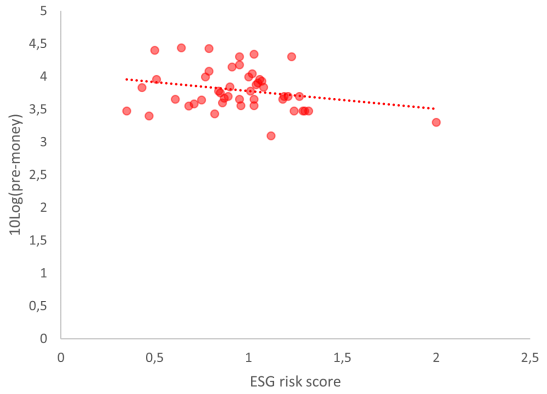
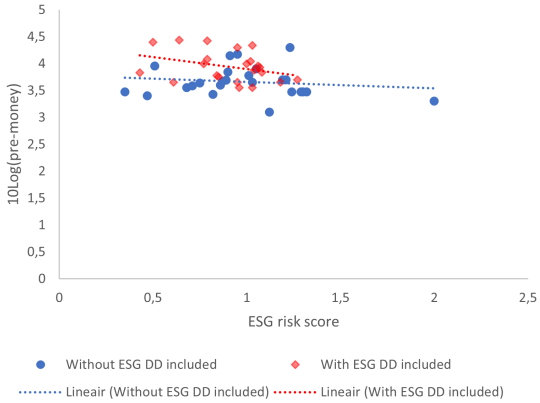


Figure C.3: Distribution plot of the independent variable ESG score shows a normal distribution



(a) Scatter plot of independent variable against the dependent variable



(b) Interaction plot

Figure C.4: Inspection of the "outlier"

The continuous control variables are all highly skewed. The following transformations are

performed:

- **Industrial experience:** Log transformation with base 10;
- **Management experience:** Log transformation with base 10;
- **Management team size:** Log transformation with base 10;
- **Number of employees:** Log transformation with base 10;
- **TAM:** Removal of two outliers (TAM = 225 and TAM = 464), then a log transformation with base 10.

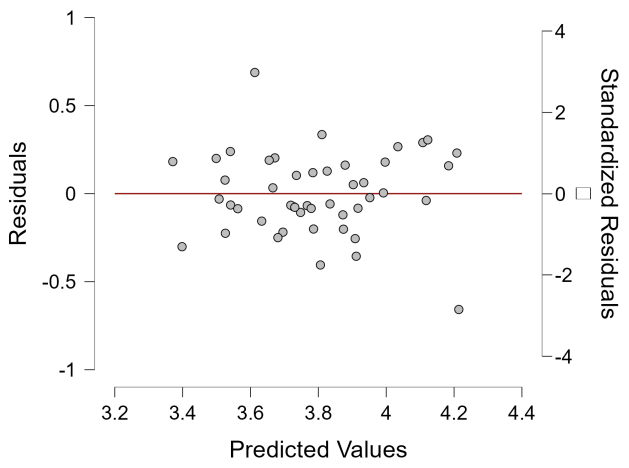
The transformations are successful in creating normal distributions for two of the five variables, *Number of employees* and *TAM*. *Industrial experience*, *Management experience* and *Management team size* remain somewhat skewed. The results are summarized in Table C.3. The distribution plots and Q-Q plots for all of the raw and transformed variables can be found in Appendix B Figure B.5 and Figure B.6 respectively.

Table C.3: Descriptive statistics of raw and transformed control variables

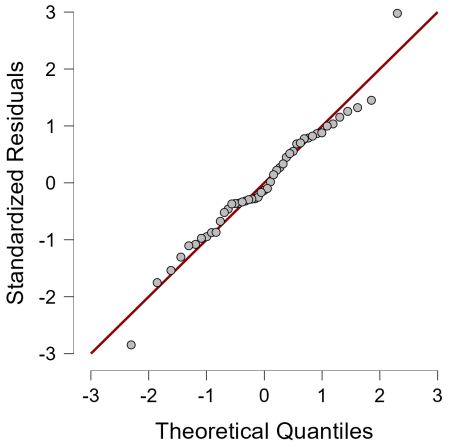
	Mode	**Median**	**Mean**	**Std. Deviation**	**Shapiro-Wilk**	***p*-value Shapiro-Wilk**
Industrial exp.	0.000	17.000	28.191	27.871	0.839	< .001
10Log(Industrial exp.)	0.000	1.255	1.226	0.539	0.923	0.004
Management exp.	0.000	23.000	26.383	25.856	0.874	< .001
10Log(Management exp.)	0.000	1.380	1.143	0.616	0.898	< .001
Management team size	3.000	3.000	2.894	0.961	0.859	< .001
10Log(Management team size)	0.602	0.602	0.578	0.105	0.877	< .001
TAM	2.000	5.300	23.939	73.784	0.311	< .001
TAM without outliers	2.000	4.200	9.692	12.804	0.678	< .001
10Log(TAM without outliers)	0.477	0.716	0.809	0.430	0.951	0.055
Number of employees	5.000	6.000	11.936	13.954	0.747	< .001
10Log(Number of employees)	0.778	0.845	0.897	0.459	0.962	0.131

This table presents the descriptive statistics including the Shapiro-Wilk values of the control variables before and after transformations.

Now that the data is transformed, the data is again inspected to see whether all assumptions of OLS regression are met. One can see in Figure C.5 (a) that the residuals are now much more symmetrically distributed around the null line, and in Figure C.5 (b) that the Q-Q plot now shows a somewhat straight line. One can thus conclude that the error term follows a normal distribution. Furthermore, no funnelling can be observed in the scatter plot, indicating that the assumption of homoscedasticity is also met. To be certain, Levene's Test of Equality of Variances is performed with *ESG DD included* as the grouping variable. This gives an insignificant p-value of 0.684, confirming homoscedasticity of the transformed data. It is also checked that the independent variable and all of the control variables have a linear relationship with the dependent variable. The scatter plots showing these relationships can be found in Appendix B Figure B.8. Finally, all tolerance values are > 0.1 and all Variance Inflation Factor values are < 5.0. Hence no severe multicollinearity is present in the model and all OLS assumptions are met.



(a) Residuals scatter plot for linear regression with transformed data



(b) Q-Q plot standardized residuals for linear regression with transformed data

Figure C.5: Inspection of the transformed data residuals

C.2 Data reduction

Because the sample size is only small and the model contains many control variables it is decided to pursue data reduction through Principal Component Analysis (PCA). A reduced set of variables can help with obtaining statistically significant results. Three of the control variables are significantly correlated, as can be seen in the correlation table (Table C.4): *Industrial experience*, *Management experience* and *Management team size*.

All the three variables *Management experience*, *Industrial experience* and *Management team size* have high component loadings on the principal component (0.831, 0.807 and 0.744 respectively) and can be summarized in one dimension. As each of these control variables is an indicator of the founder quality construct, this dimension can naturally be interpreted as *Founder quality*. The Eigenvalue of this component is 1.894, representing 63.1% of the total variance. The descriptive statistics for all the variables after data transformation and data reduction are presented in Table C.5.

Table C.4: Correlation matrix of the independent variable and control variables

Variable	ESG risk score	10Log (Industrial exp.)	10Log (Management exp.)	10Log (Management team size)	10Log (TAM)	10Log (Number of employees)
1. ESG risk score	–					
2. 10Log(Industrial exp.)	0.008	–				
3. 10Log(Management exp.)	−0.084	0.523***	–			
4. 10Log(Management team size)	−0.061	0.398**	0.442**	–		
5. 10Log(TAM)	−0.187	−0.195	0.013	−0.102	–	
6. 10Log(Number of employees)	−0.142	0.138	0.116	0.095	0.184	–

The correlation coefficients shown are Pearson's r. ***, **, and * denote statistical significance at the 0.1%, 1% and 10% levels, respectively.

Table C.5: Descriptive statistics of variables after data transformation and reduction

	Mode	Median	Mean	Std. Deviation	Minimum	Maximum
10Log(Pre-money)	3.477	3.699	3.792	0.312	3.097	4.439
ESG risk score	0.950	0.950	0.947	0.288	0.350	2.000
ESG DD included (dummy)	0.000	0.000	0.490	0.505	0.000	1.000
Interaction term (ESG risk score - ESG DD included)	0.000	0.000	0.423	0.478	0.000	1.270
Founder quality	−4.122	0.137	0.000	1.895	−4.122	3.792
Startup exp. (dummy)	1.000	1.000	0.688	0.468	0.000	1.000
10Log(TAM)	0.477	0.716	0.809	0.430	0.041	1.785
10Log(Number of employees)	0.778	0.845	0.893	0.455	0.000	1.869

This table presents the descriptive statistics of the variables as used in the MLR analyses, i.e. after data transformation and data reduction. See Table 5.1 for definitions of the raw variables. Two outliers are removed from the *TAM* variable (TAM = 225 and TAM = 464) and log transformations with base 10 are performed for the dependent variable and all of the continuous control variables. PCA is performed resulting in *Industrial experience* (factor loading = 0.807), *Management experience* (factor loading = 0.831) and *Management team size* (factor loading = 0.744) all being summarized by the *Founder quality* dimension.