CLIMATE CHANGE RISK DISCLOSURE:
A LEGITIMATION TOOL FOR COMPANIES WITH HIGH CARBON RISK EXPOSURE IN THE U.S.

Carolina MOLINARI, BACom, MBA & MRes

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Supervisors: **Professor Fatima Annan-Diab**
Professor Chris Hand

Abstract

As one of the world's top risks, climate change has severely impacted human and natural systems, evidenced by high temperatures, wildfires and floods. High-quality climate change disclosure has the potential to enable stakeholders to act on the information they receive, such as investors directing their capital to more sustainable companies, activists targeting large CO_2 emitters and government tightening regulation. However, quality of climate-related disclosure remains an issue. Environmental disclosure has been studied since 1970s but results are still mixed in terms of the motivations for companies to provide disclosure. In this regard, legitimacy theory indicates that companies under legitimacy threats (e.g. high risk or high media visibility) provide higher levels of disclosure, while voluntary disclosure theory posits that better performers (e.g. better risk managers) would use more disclosure to showcase their superiority, while impression management suggests that companies tend to attribute successes to internal factors (e.g. strategy, management skills) and failures to external factors (e.g. market, regulation). This study applies both theories and employs logistic and OLS regressions, using a sample with 200 U.S. listed companies from high GHG emission industries (e.g. oil & gas, chemicals, and metals & mining). In alignment with legitimacy theory, results evidenced that GHG emissions risk and media visibility positively impact on the likelihood of a company to provide GHG emissions risk disclosure. Results also suggest that when there is increased GHG emissions risk level, companies increase their general disclosure four times more than their specific disclosure, which is potentially associated with a legitimation strategy of diverting stakeholders' attention to the context instead of the company itself, also aligned with attributing their high risk levels to external factors, as suggested in impression management. In addition, media visibility was found to positively influence the extent of specific disclosure, which may be explained by stakeholders' prior knowledge influencing information threshold as in voluntary disclosure theory.

Keywords:

climate change; greenhouse gas; GHG; emissions; disclosure; reporting; legitimacy

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Abbreviations

B	Beta coefficient
CDLI	CDP Carbon Disclosure Leadership Index
CDP	Carbon Disclosure Project
CDSB	Climate Disclosure Standards Board
CEP	Council on Economic Priorities
CO_2	Carbon Dioxide
CPLI	CDP Climate Performance Leadership Index
EPA	U.S. Environmental Protection Agency
ESG	Environment, Social and Governance
GHG	Greenhouse Gas
GHGRP	U.S. GHG Reporting Programme
GRI	Global Reporting Initiative
IPCC	Intergovernmental Panel on Climate Change
OLS	Ordinary Least Square
SEC	U.S. Securities and Exchange Commission
TCFD	Task Force on Climate-Related Financial Disclosures
UN	United Nations
UNFCCC	UN Framework Convention on Climate Change
VIF	Variance Inflation Factor

1 Introduction

Due to its importance and urgency, climate change has been intensely discussed by investors, governments, regulators, academics, NGOs, the media and environmental activists, as recently observed during the United Nations COP26, in Glasgow, when countries around the world reaffirmed their international commitment to limit average global temperature increases by the end of the century to 1.5 degrees Celsius. According to the World Economic Forum (2021), extremely weather, and failure of climate change adaption and mitigation are the two most likely global risks. In a recent report, the Intergovernmental Panel on Climate Change (IPCC, 2021) has confirmed that the average global temperature is already 1.07 degrees higher than during the 1850-1900 period, and the last eight years were the hottest ones in record, emphasising the need for urgent action.

Discussions on climate change include reflecting on why some companies provide more GHG emissions information than others. In this regard, carbon disclosure has attracted increasing attention as a research topic due to evolving regulations, the implementation of emission-trading schemes and the recognition of the significant financial impacts from climate change risks. Reliable and comprehensive climate change disclosure enables stakeholders to act on the information they access, contributing to reduce greenhouse gas (GHG) emissions that produce climate change. Examples include investors directing their capital to more sustainable companies, activists targeting large emitters and encouraging consumer activism, and government tightening regulation.

The relationship between environmental disclosure and legitimacy threats, such as poor environmental performance and high media visibility, has been tested since 1980s. However, studies have delivered mixed results in terms of extent and quality of disclosure. Some studies support that companies under higher pressure from society provide more disclosures (Dobler, Lajili and Zéghal, 2015; Patten, 2002), which is aligned with legitimacy theory. While other studies found that those companies with stronger performance use more disclosures to showcase their superiority (Al-Tuwaijri, Christensen and Hughes, 2004; Clarkson *et al.*, 2008), aligned with voluntary disclosure theory. Studies have also evidenced that companies have often employed impression management strategies to attribute positive outcomes to internal factors and negative ones to external factors (Bettman and Weitz, 1983; Staw, McKechnie and Puffer, 1983; Salancik and Meindl, 1984).

Although environmental disclosure studies are numerous, it is not clear whether better performers disclose higher levels of high-quality disclosure (Clarkson *et al.*, 2008; Hummel and Schlick, 2016) or whether poor performers are the ones disclosing higher levels of quantitative disclosure

(Braam *et al.*, 2016). In addition, mixed results have also been found between environmental performance and climate change disclosure, and between risk and risk disclosure. While researchers keep investigating the determinants of company's environmental and risk disclosures, industry reports have evidenced that companies are still failing to disclose their environmental risks (TCFD, 2019).

Considering the research gap above, this paper aims at contributing to understand whether legitimacy threats (e.g. high GHG emissions risk, weak risk management or high media visibility) and/or superiority aspects (e.g. low GHG emissions risk and strong risk management) are capable to predict the likelihood of a company providing GHG emissions risk disclosure, as well as its volume and quality. In addition, it also investigates whether attribution behaviour, common in impression management strategies, may help explain companies' disclosure decisions. Building on the environmental disclosure and on the risk disclosure literature, this study tests hypotheses based on legitimacy and voluntary disclosure theories and on impression management.

The research design comprises logistic and OLS multiple regressions applied to a sample composed of 200 U.S. listed companies from industries with high GHG emissions exposure (e.g. oil & gas, airlines, chemicals, metals & mining, construction materials and transport). The estimation models test the relationship between GHG emissions risk, risk management and media visibility as potential predictors of the presence of GHG emissions risk disclosure in a company's annual report, and of different measures of GHG emissions risk disclosure: general, specific and total disclosure, and ratio of general or specific to total disclosure.

As a novelty aspect, this study includes a type of disclosure that has often been ignored in the literature: sentences not referencing a company's activities but still related to the context, named as general disclosure by Ingram and Frazier (1980). The intensification of this type of sentence may reveal an attempt to divert stakeholders' attention as a legitimation strategy (Lindblom, 1994) or an impression management behaviour. A second novelty aspect in this research is the proxy for company-specific GHG emissions risk, extracted from a database extensively used in the financial market but still incipient in the academic literature, the MSCI ESG Ratings.

Results evidence that higher GHG emissions risk and higher GHG emissions media visibility increase the likelihood of a company providing GHG emissions risk disclosure in its annual report. This finding is aligned with legitimacy theory, which often predicts increased disclosure to face legitimacy threats. But it is also aligned with voluntary disclosure theory, as higher media visibility would produce better informed stakeholders demanding higher levels of transparency, considering disclosure as a tool to reduce the information gap between the company and the market.

Results also evidenced that GHG emissions risk and risk management can predict the number of words used in general, specific and total GHG emissions risk disclosure, also aligned with predictions from legitimacy theory. In addition, results suggest that higher risk or weaker risk management not only motivate a company to increase its disclosures, but the increase in general disclosure is approximately 4 times bigger than the increase in specific disclosure. This could be understood, firstly, as an intensification of the legitimation strategy based on diverting stakeholders' attention towards the context other than a company's activities, as identified by Lindblom (1994), and secondly, attributing bad news to external factors, as in impression management behaviour (Merkl-Davies and Brennan, 2007). In other words, companies do spend more words providing information about their activities when facing a greater legitimacy threat, but their legitimation effort by providing contextual information is more intense. Moreover, as expected, increased GHG media visibility is associated with an increase in the number of words spent in sentences mentioning a company's activity, which is aligned with both legitimacy theory (high media visibility as a legitimacy threat) and voluntary disclosure theory (shareholder previous knowledge impacting on disclosure threshold).

This research has implications in at least three aspects. Firstly, annual reports readers may become more cautious about company's disclosures, in light of the potential legitimation strategy and impression management behaviour pursued by high risk companies based on diverting stakeholders' attention towards contextual aspects other than a company's activities. Secondly, it may help regulators identify the type of companies that are more prone to deviate from their recommendations on avoiding the intense use of non-specific disclosures, which may motivate specific monitoring actions. Thirdly, the importance of media coverage to enhance disclosure quality is evidenced by the results, which may motivate greater media coverage and enhancements in platforms to make GHG emissions data publicly available, such as the U.S. GHG Reporting Programme (GHGRP) and the Carbon Disclosure Project (CDP).

In terms of structure, this thesis starts with an introductory chapter covering the importance of the research topic, the research questions and contributions, and the approach to the literature review. The second chapter is focused on the academic literature review, discussing the theoretical framework and the empirical studies reviewed. The third chapter is dedicated to reviewing industry reports on climate change disclosure, including the key aspects of regulation from U.S. Stock Exchange Commission (SEC). The conceptual model and hypotheses are presented in chapter 4, which is followed by the research design in chapter 5. Chapter 6 contains the results of the quantitative analysis, discussed in detail in chapter 7. In addition to identifying which hypotheses have been supported and discussing the results, chapter 7 also covers thesis contributions, implications, limitations and conclusion.

1.1 Background on climate change and GHG emissions

The Intergovernmental Panel on Climate Change (IPCC, 2018) defines climate change as the change in the mean temperature that typically persists for decades or longer, which may be due to natural processes (e.g. volcanic eruptions) or persistent human activity. In a recent report, IPCC (2021, p. 5) argued that “it is unequivocal that human influence has warmed the atmosphere, ocean and land”. This warming effect is produced by an increase in the concentrations of greenhouse gases (GHGs) in the atmosphere. Between 1990 and 2015, the global warming effect increased by 37% due to GHG emissions from human activities, with carbon dioxide accounting for 30% (U.S. Environmental Protection Agency, 2016).

Although the connection between global warming and human activity is still challenged (Busch and Judick, 2021), scientists have proved that “climate change is occurring, is caused largely by human activities, and poses significant risks for – and in many cases is already affecting – a broad range of human and natural systems” (National Research Council, 2010, p. 3). There are plenty of evidence confirming that the climate has changed (2020 was the hottest year on record) and frequency and severity of natural disasters have been exacerbated, such as massive wildfires, droughts, hurricanes and floods, affecting approximately 40 million people in 2018 (UN, 2020).

International initiatives have tackled climate change at a global level, including key agreements led by the United Nations (UN). The first international agreement in this regard was the UN Framework Convention on Climate Change (UNFCCC), signed by 154 states at the 1992 Earth Summit, held in Rio de Janeiro. This was followed by the Kyoto Protocol, to implement the measures under the UNFCCC. The Kyoto Protocol (UNFCCC, 2020a), adopted in 1997 and entered into force in 2005, committed developed countries to reduce their GHG emissions – a reduction of 5% against 1990 emission levels was expected between 2008 and 2012 – and established market mechanisms to support trade of emissions permits. Overall, the sum of emission from the nations committed to Kyoto targets fell significantly, while there was a sharp increase in developing countries, especially in China.

The subsequent Paris Agreement (UNFCCC, 2020b) committed not only developed but also developing countries to tackle climate change. The Paris Agreement entered into force in 2016, with the central aim to avoid global temperature rising 2°C above pre-industrial levels, attempting to limit it to a 1.5°C rise to reduce the impacts. The Agreement has been ratified by 189 parties, requiring all signatories to report regularly on their emissions and implementation efforts.

In addition to the Kyoto Protocol and the Paris Agreement, climate change is also a crucial topic in the UN Sustainable Development Goals, adopted by all UN members in 2015 as part of the 2030 Agenda for Sustainable Development. ‘Goal 13: Take urgent action to combat climate change and its impacts' (UN, 2020) is based on five targets and specific indicators, including strengthening adaptive capacity to climate-related hazards, integrating climate change measures into national planning, and financially supporting developing countries in the context of mitigation actions.

Despite the fact that the U.S. is the second biggest GHG emitting country, only behind China (Global Carbon Atlas, 2020), the U.S. announced in 2017, under Trump's administration, the decision to withdraw from the Paris Agreement, which was reverted by President Joe Biden on his first day in office, in early 2021. Since 2009, the U.S. Environmental Protection Agency (EPA) has acknowledged that GHG emissions "endanger the health and welfare of current and future generations by causing climate change and ocean acidification" (U.S. Environmental Protection Agency, 2020). Impacts of climate change to the environment and human's health have been monitored in the U.S., detecting significant increases for total annual precipitation, sea level and wildfires. EPA has issued fuel economy standards for vehicles and national GHG emissions standards, requiring preconstruction permits from large new stationary sources and implementing regulation to reduce carbon pollution from power plants (electricity generation is the largest source of GHG emissions in the country). In the U.S., at least half of the states have implemented measures to reduce GHG emissions, primarily through emission inventories and 'cap and trade' programmes (setting a limit on emissions and creating a market for emissions allowances), besides also providing incentives for renewable energy generation.

Actions to combat climate change are urgent, corroborated by the fact that CO_2 emissions were projected to grow by 4.8% in 2021, as demand for coal, oil and gas rebounds with the economic recovery from the Covid-19 recession (International Energy Agency, 2021), which was confirmed as global CO_2 emissions had their highest increase in history in 2021 (IEA, 2022). Examples of stakeholders acting on the information they access through GHG disclosures include: 1) investors directing their capital to more sustainable companies or demanding a high-risk premium (which would impact on share price, which in turn would impact on managers' compensation and therefore, could increase the internal effort towards reducing risk); 2) activists targeting large emitters and GHG-related industries (e.g. fossil fuels), to put pressure on institutional investors and to promote public demonstrations to encourage consumer activism; and 3) government tightening regulation and advancing the process of integrating climate change measures into national policies. Initiatives like these combined, built on realistic GHG disclosures, will certainly contribute to reduce GHG emissions that cause climate change.

1.2 Importance of the research topic

> "Inadequacies in GHG emissions disclosures have the potential to mislead investors and hinder progress of country, investor and business initiatives addressing climate change and looking to accelerate the transition to a low carbon economy." (EIT Climate-KIC, 2018)

The importance of climate change as a research topic is unquestionable, as climate change has already negatively impacted us through changes in the temperature, precipitation, droughts and other extreme events, with those most vulnerable being the most impacted. Climate change has significantly impacted organisations in multiple sectors, with expected increased risks due to the intensification of weather impacts and more stringent regulation. Impacts from climate change on corporations include compliance costs with changing regulation, physical effects (e.g. timing and level of precipitation and snowmelt, increased frequency of major storms, availability of water), indirect effects of both regulatory and physical changes (e.g. increased price for insurance, increased cost of inputs, supply disruption due to severe weather), changes in consumers' demand and reputational damage. The 200 biggest global companies declared almost US$1 trillion at risk from climate impacts, with many of these impacts probably occurring within 5 years (CDP, 2019). A report issued by the IPCC (2018) alerted that urgent measures are needed to meet the goals of the Paris Agreement, including transitions in energy, land, transport, building and industrial systems, directly affecting companies' objectives.

Climate change disclosure can accelerate the efforts to reduce emissions in two directions. Firstly, disclosure may drive internal changes towards reducing emissions and improving climate change risk management. These internal changes would be expected as providing GHG emissions disclosure requires systematically collecting and preparing the information to be disclosed, including engaging with stakeholders to understand their expectations and interests (GRI, 2016). Secondly, good quality disclosure conveys meaningful information to stakeholders, who in turn may act on it. Climate risk disclosure is particularly important for investors, companies, governments and regulators, researchers and report users in general, as discussed in the next paragraphs.

For investors, disclosure is essential to support comparisons between companies, promoting more informed assessments of companies' future financial performance. As climate change pose material risks to companies, GHG emissions risk disclosure is crucial in investors' analysis, enabling them to direct their funds towards companies that are more prepared to deal with climate change (and therefore, are less risky). Increasing transparency may contribute to a shift from high to low-carbon assets, although these two investment options are not directly substitutable (Ameli, Kothari and Grubb, 2021). Institutional shareholders have been under scrutiny about what they are doing to tackle climate change (Shukman, 2020), as sustainable institutional ownership has been found to be positively associated with a company's environmental performance (Kordsachia, Focke and Velte, 2021).

For companies, disclosure is an important manner to inform stakeholders about its operations, strategy, risks etc, contributing to protect its legitimacy and helping differentiate a company in the market. Measures to increase transparency of industrial risks contribute to make "polluters internalise the potential harms they might inflict on third parties" (Sinclair-Desgagné and Gozlan, 2003, p. 378), leading to action to enhance risk management, such as accelerating investments in technological innovation and clean energy (Foerster *et al.,* 2017). GHG emissions risk disclosure is particularly important for those companies in environmentally-sensitive sectors, as they have been under intense scrutiny on reducing their carbon emissions and managing climate-related risks. Another factor that makes climate change risk disclosure important is that companies' financial disclosure practices have been the subject of enforcement actions (e.g. by state Attorneys General, shareholders and the SEC) which obviously imply financial, legal and reputational risks (Foerster *et al.,* 2017).

For governments, private sector GHG emissions risk disclosure is important to meet their own disclosure obligations, such as the ones imposed by the Paris Agreement, besides contributing to a more effective integration of climate change measures into national strategies. Legislation and stock exchange regulations on climate change risk disclosure are part of environmental informational regulation, whose main objective is to achieve "higher levels of environmental protection by improving the quality, quantity, and availability of information about environmental harms, benefits, and risks" (Kleindorfer and Orts, 1998, p. 156). Informational regulation provides information to affected stakeholders (e.g. shareholders, employees, regulators and neighbouring communities), usually with the expectation that they will exert pressure on companies, as far as information is at good quality and stakeholders have access to the judicial system (Sinclair-Desgagné and Gozlan, 2003).

For researchers, climate change risk disclosure is important as studies on this topic are rare and they could contribute to clarify the mixed results delivered by studies on environmental disclosure and risk disclosure. Moreover, investigating disclosure enables testing theories, contributing to enhance the knowledge on their application in the social accounting field.

Finally, for annual report users in general, increasing their knowledge on GHG emissions risk disclosure and its relationships with GHG emissions risk and media visibility will enable a deeper interpretation of disclosure, promoting a more informed assessment. Considering climate change risk disclosure as an emergent research topic, its intrinsic discretion level and importance in corporate evaluation and risk reduction, and its evolving regulation, this research may be of interest of academics, managers, investors, governments, regulators and users of financial reports in general. Since good quality GHG emissions risk disclosure triggers actions from multiple stakeholders, as discussed above, it ultimately contributes to combat climate change and to promote a more sustainable development.

1.3 Research aims, questions and objectives

Considering the relevance of climate change risk disclosure and the scarce literature on this topic, the overall aim of this study is to advance understanding on determinants of GHG emissions risk disclosure, by investigating its potential relationship with GHG emissions risk, risk management and media visibility. This research is also aimed at advancing understanding of the application of legitimacy and voluntary disclosure theories and impression management to the practice of environmental and risk disclosure.

The research questions are presented below:

1. At a company level, is GHG emissions risk disclosure determined by GHG emissions risk?
2. At a company level, is GHG emissions risk disclosure determined by GHG emissions risk management?
3. At a company level, is GHG emissions risk disclosure determined by GHG emissions media visibility?
4. Can legitimacy and voluntary disclosure theories and impression management behaviour explain the potential relationship between GHG emissions risk, risk management and media visibility as determinants of GHG emissions risk disclosure?

The following objectives have been set for this study to answer the questions above:

- Conduct a literature review on GHG emissions risk disclosure and how socio-political and economic theories (mainly legitimacy and voluntary disclosure theory) have been used to explain its potential determinants. GHG emissions risk disclosure is part of climate change risk disclosure, which in turn is part of both risk disclosure and environmental disclosure, the latter offering more abundant literature. The review should also include studies exploring the potential relationships between determinants – particularly risk and media visibility – and risk disclosure, and between these determinants and environmental disclosure. The literature review should also encompass how quality of environmental disclosure and risk disclosure has been measured;

- Conduct a review of industry reports focused on the current practice of corporate climate change disclosure, globally and in the U.S., and on the initiatives to foster it;
- Test the potential relationship between GHG emissions risk, risk management and media visibility as determinants of different types of GHG emissions risk disclosure, including general and specific disclosure;
- Interpret results in light of the theoretical framework and empirical literature review.

Hypotheses have been elaborated to test the potential relationships listed above.

1.4 Thesis contributions

According to Dobler, Lajili and Zéghal (2014), further empirical research on environmental risk is welcome, including exploring distinct dimensions of environmental risk disclosure in broader samples and beyond industry-level assessments. Clarkson *et al.* (2008) argue that further research is necessary to explain environmental disclosure practice, including focusing on more specific environmental aspects and moving beyond the level of disclosure, to encompass specific types of disclosure. For Chithambo and Tauringana (2014), further understanding of company-specific determinants of GHG disclosure is needed, as it can help inform regulation to foster corporate transparency and accountability. This study responds to these calls, aiming at advancing understanding of environmental disclosure by investigating different types of disclosure focusing on a specific environmental topic, namely GHG emissions risk. To the best of the author's knowledge, no academic paper has explored the potential relationships between GHG emissions risk, risk management and media visibility, and GHG emissions risk disclosure.

As it will be discussed in the next sub-sections, this research is intended to promote theoretical, empirical and industry contributions. In terms of theoretical contribution, in addition to impression management, the conceptual model applies legitimacy theory and voluntary disclosure theory in an integrated way, which has been observed in the disclosure literature only at environmental level (Tadros and Magnan, 2019) and at sustainability level (Hummel and Schlick, 2016). The theoretical contribution is also related to associating Lindblom's (1994) legitimation strategies with general and specific disclosures, which was not observed in the literature.

In terms of empirical contribution, this study includes two measures of disclosure which are rarely employed in the environmental disclosure literature: disclosure not referencing a company's activities or situation, and ratio of general or specific disclosure to total disclosure. Moreover, a more objective approach to measure disclosure is adopted, calculated based on companies' risk factors only, instead of collecting information from the whole extension of annual reports, as often seen in the literature. Also, an innovative measure of GHG emissions risk will be employed.

In terms of industry contributions, understanding whether and how risk, risk management and media visibility determine GHG emissions risk disclosure may help report users interpret annual reports, motivate companies to enhance their disclosures and inform regulators to drive companies towards improving quality of disclosure.

1.4.1 Theoretical contribution

The theoretical contribution will be addressed by the findings from the research question "4. Can legitimacy and voluntary disclosure theories and impression management explain the potential relationships between GHG emissions risk, risk management and media visibility as determinants of GHG emissions risk disclosure?"

Disclosure studies often test competing hypotheses based on legitimacy and voluntary disclosure theories to predict the relationship between environmental performance and disclosure (e.g. Wedari, Jubb and Moradi-Motlagh, 2021). This research builds on recent environmental disclosure studies reconciling the application of legitimacy theory and voluntary disclosure theory (Hummel and Schlick, 2016; Tadros and Magnan, 2019), supplemented by impression management. The novelty of the proposed conceptual model refers to the application of both theories in a complementary manner to a more specific level of environmental disclosure than observed in the current literature. The selection of determinants that enable interpretation from the lenses of both theories (e.g. weak risk management could be considered a legitimacy threat, while strong risk management could be a superiority aspect) will facilitate employing both theories in the conceptual framework.

The second theoretical contribution is related to associating general and specific disclosure with Lindblom's (1994) legitimation strategies, which is discussed in Section 2.4.1. This will help understand the motivations driving the discretion on the volume and type of disclosure provided, which are expected to be evidenced by the results.

1.4.2 Empirical contribution

The empirical contribution will be addressed by the findings from research questions 1, 2 and 3, which are related to whether, at a company level, GHG emissions risk disclosure is determined by GHG emissions risk, risk management and media visibility. Academic papers on the determinants of climate change risk disclosure are still scarce, and no paper has been identified testing the relationship between GHG emissions risk and GHG emissions risk disclosure. Expanding to environmental risk and environmental disclosure, only one study was found employing a company-specific measure of environmental risk (Dobler, Lajili and Zéghal, 2015), yielding results aligned with legitimacy theory. Studies testing the relationship between environmental performance (which could also be a legitimacy threat or a superiority aspect) and disclosure have delivered mixed results (as summarised in Section 2.5.1).

This study measures different types of GHG emissions risk disclosure and two of them are quite rare in the literature: disclosure not referencing a company's activities or situation – named here as general disclosure following Ingram and Frazier (1980) – and ratio of general or specific disclosure to total disclosure. Measuring disclosure not referencing a company's activities or situation is different to most of the studies in the field of environmental and risk disclosure, which usually ignore disclosures not referencing a company's activities – Ingram and Frazier (1980) and Hrasky (2012) are the only two exceptions identified. Employing a ratio of disclosure to total disclosure will enable investigating the dynamics between the types of disclosure that compose total disclosure. This type of proportion measure was only observed in one environmental disclosure paper, measuring ratio of soft disclosure (i.e. lacking substantiation) to total disclosure (Clarkson *et al.*, 2008).

Comparing with previous empirical papers, risk disclosure will be measured based on companies' risk factors only. This approach is more objective than the one often used in environmental disclosure studies (Clarkson, Overell and Chapple, 2011) and risk disclosure studies (Linsley and Shrives, 2006) that require collecting information from the whole extension of annual reports. Focusing on a specific chapter of the annual report reduces subjectivity in terms of what should actually be considered risk disclosure, and enables working with bigger samples (some annual reports submitted to SEC contain more than 200 pages, which would hinder textual analysis).

In addition, this research employs a new determinant for GHG disclosure: GHG emissions risk, using an innovative company-specific measure, also including its underlying measure of risk management. Collecting data from MSCI ESG Ratings, a renowned database extensively used in the financial market, enabled overcoming the difficult to access company-specific environmental risk measures due to the proprietary costs involved, avoiding relying on company's disclosures only (Dobler, Lajili and Zéghal, 2015) or using non-company-specific risk exposure measures (Bewley and Li, 2000; Li, Richardson and Thornton, 1997).

1.4.3 Industry contribution

Industry contributions will also be addressed by the findings from the first three research questions, the same questions that will support the empirical contributions: 'At a company level, is GHG emissions risk disclosure determined by GHG emissions risk, risk management and media visibility?' Theory and practice have suggested that several factors have motivated companies to provide different levels of disclosure. In this regard, this study will help companies, regulators and users of annual reports understand some corporate characteristics (e.g. risk level) and contextual characteristics (e.g. media visibility) that may be related to managers' discretion on GHG emissions risk disclosure. This may help companies to enhance their current level of disclosure, advancing their understanding on the motivations for disclosure. For regulators and voluntary standard setters, understanding factors that explain GHG emissions risk disclosure may help them close the gap between those companies that provide good quality disclosure and the vast number of companies that still fail to do so, informing new regulation and/or efforts towards compliance with the existing ones. In addition, this study may also help report users interpret annual reports, enabling more informed decisions as they will be in a better position to assess a company's risk profile based on its disclosures.

1.5 Approach to the literature review

The academic literature review for this study has been conducted following two approaches: keyword searches using iCat, and snowballing technique, complemented by recent papers identified using Google Scholar alerts. For industry reports, snowballing technique from the academic literature, Google search and Google alerts were the main tools.

Firstly, papers found on iCat containing the following keywords have been reviewed: greenhouse gases (or GHG or carbon), risk and disclosure (or reporting). As this search produced limited results, the list of keywords has been expanded to identify papers on climate change risk disclosure, climate change disclosure, environmental risk disclosure, environmental disclosure and risk disclosure, particularly the ones exploring relationships with potential determinants. iCat searches in more than 73,000 electronic journals, including 19 of the 20 journals that published more articles on climate change accounting & reporting between 1999-2018 (Gulluscio *et al.*, 2020). iCat also encompasses eight amongst the ten journals with most publications on environmental accounting between 1973 and 2011 (Schaltegger, Gibassier and Zvezdov, 2013). Using a search engine such as iCat helps overcome the challenge of a substantial part of studies on environmental accounting being published outside mainstream accounting journals (Schaltegger, Gibassier and Zvezdov, 2013), as it searches materials from several disciplines. ABS Academic Journal Guide and Google Scholar were also consulted to identify other journals on sustainability accounting and to, where possible, prioritise publications ranked as three or more stars.

Secondly, snowballing technique has been employed to identify relevant papers cited on the ones found through the searches on iCat. This technique was particularly important as systematic literature reviews were included in the search results. Theoretical papers were also identified mainly from applying snowballing technique, exploring the theories supporting the empirical papers on the determinants of environmental and risk disclosure.

The two approaches above have been complemented by using Google Scholar alerts, on a weekly basis, to identify recent papers using the keywords searched on iCat, ensuring the literature review remains up to date. Based on the papers identified via Google Scholar alerts, other relevant papers were also identified through snowballing. Key papers on the determinants of environmental disclosure and risk disclosure, discussed in Sections 2.5.1 and 2.5.2, are summarised in a table in Appendix 9.1.

Industry reports were mainly identified by visiting specific websites hosted by voluntary initiatives towards enhancing climate change disclosures (e.g. the Carbon Disclosure Project - CDP and the Task Force on Climate-Related Financial Disclosures - TCFD), by consultancies (e.g. KPMG, EY) and stock exchanges, mainly the U.S. Stock Exchange Commission (SEC). These websites were found using Google search and snowballing technique when they were mentioned in academic papers (e.g. CDP data are often used in academic research). Google alerts also helped identifying reports and surveys recently released.

1.6 Structure of the thesis

This thesis is divided into seven main chapters. The first chapter is the introduction of the thesis, encompassing contextual information on climate change, the importance of the research topic, the research questions and thesis contributions, split into theoretical, empirical and industry contributions, in addition to the approach adopted for the literature review.

The second chapter corresponds to the literature review. It starts discussing disclosure in general and then focusing on climate change disclosure, followed by a section on the other main concepts in the thesis (namely, GHG emissions risk, media visibility and risk disclosure). This chapter also presents the theoretical framework adopted (a combination of legitimacy and voluntary disclosure theories, complemented by impression management theory) and the empirical literature review, exploring determinants of environmental disclosure and risk disclosure. The second chapter finishes with a summary of the main gaps in the literature.

Chapter three is focused on industry reports tackling climate change disclosure. It contains sections on the related regulation applicable to U.S. listed companies and multi-stakeholder initiatives, such as CDP and TCFD (complemented by Appendix 9.2). These are followed by a section reviewing studies on the current practice of climate change disclosure. Similarly to the previous one, the third chapter finishes with a summary of the industry gaps.

The fourth chapter presents the conceptual model and the hypotheses, building on the theoretical framework, the empirical literature review and the industry reports review. Hypotheses are split in sub-sections that correspond to the measures of GHG emissions risk disclosure adopted: presence of disclosure, general, specific and total disclosure, and ratio of general or specific disclosure to total disclosure, in addition to a discussion on the control variables.

The fifth chapter presents the research design adopted to test the hypotheses set in the previous chapter. The chapter discusses the research strategy, data collection method, sample size and description, the dependent and independent variables in the model and the analysis techniques employed. A section on validity and reliability is also included in this chapter.

Chapter six presents the results of the quantitative analyses. It includes descriptive statistics, correlations and results of the logistic regressions and the ordinary least square (OLS) regressions, as well as demonstrating how assumptions have been met. This chapter also contains a section on sensitivity analysis, presenting the results of running logistic and linear regressions with two alternative measures of GHG emissions media visibility.

The seventh and final chapter is dedicated to discussing the results and concluding the thesis. In this chapter, the theoretical, empirical and industry contributions are discussed now in light of the results, as well as the implications, limitations and directions for future research, closed by the conclusion. References are listed in chapter eight, followed by the appendices in chapter 9. In the appendices, the literature review summary table (9.1), the coding guide (9.4) and full SPSS reports on the results of the main analysis (9.7 and 9.8) and the sensitivity analysis (9.9) are available.

2 Literature review

This chapter starts with an update of disclosure in general, followed by a discussion on climate change disclosure context and landscape, where the concept of GHG emissions risk disclosure is delimited. Two other key concepts in this research are explored, including how they have been measured in the literature: GHG emissions risk and GHG media visibility. Concepts, or constructs, are categories to organise observations and ideas with common features, and they are key elements of the body of theory constructed by previous scientists (Bryman and Bell, 2003). The concepts discussed here derived from the definition of Greenhouse Gas (GHG) emissions, as below.

GHG emissions refer to the emissions of the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). GHG emissions may be split in scope 1 emissions (from sources that are owned or controlled by the company), scope 2 emissions (from the generation of purchased electricity consumed by the company) and scope 3 emissions (other indirect GHG emissions) (The Greenhouse Gas Protocol, 2015). As carbon dioxide is predominant amongst the GHGs, CO_2 emissions are also used in empirical studies as a measure of GHG emissions.

At the heart of this chapter, there is a discussion on the theories underpinning this research, focusing on legitimacy theory, voluntary disclosure theory and impression management. Building on the concepts and the theories, previous studies are reviewed, divided into those testing determinants of environmental disclosure and those testing determinants of risk disclosure. The chapter is concluded with the gaps in the literature.

2.1 Disclosure in general

Disclosure is “the act of making something known or the fact that is made known” (Cambridge Dictionary, 2022). When this concept is applied to corporations, disclosure “is the act of making its customers, investors, and any people involved in doing business with the company aware of pertinent information” (Wayman, 2021). From this definition, the subjectivity involved in disclosure becomes visible, as “pertinent” may mean different things for different stakeholders, which leads to the notion of materiality, discussed in section 3.1.

Disclosure may be split into financial (e.g. balance sheet, forecasts etc) and non-financial, often defined as CSR disclosure, or Environmental, Social and Corporate Governance (ESG) disclosure or sustainability disclosure. Disclosure could also be split into voluntary or mandatory disclosure. Mandatory disclosure occurs when there is an obligation to disclose information according to regulation, usually specifying who is entitled to disclose, the threshold that defines whether a piece of information must be disclosed or not, the frequency of disclosure and the required channel to share the information, often also specifying the structure of the report. An example of mandated disclosure is the Form 10-K annual report, filed by U.S. public companies, following a sequence of sections defined by the Securities and Exchange Commission (SEC). In contrast, voluntary disclosure is the act of sharing information not imposed by regulation, or that extrapolates regulation requirements, which occurs primarily on corporate websites, in sustainability reports and through responses to questionnaires. Research has demonstrated that companies required to report GHG emission information have reduced their emissions (Downar *et al.*, 2021; Jouvenot and Krueger, 2019; Muller, Liang and Yang, 2021), evidencing that regulation motivates companies to adopt more sustainable practices.

Depoers, Jeajean and Jérôme (2016) compared GHG emission disclosure in corporate reports, such as annual report, and CDP issued by French listed companies and found that, on average, companies disclose lower GHG figures in the corporate reports than in the CDP, building on the argument that discretion is higher in corporate reports as the content of GHG reporting is not standardised as opposed to the structured questionnaire used by CDP. Considering disclosure in mandated annual reports, the voluntary or the mandated approach of company's disclosure (i.e. managers' discretionary level) seems to be more related to the topics disclosed under the condition of materiality and the section within the annual report to disclose them – i.e. for mandatory disclosure: Management Discussion and Analysis (MD&A) and notes; for voluntary disclosure: CEO's letter (Hughes, Anderson and Golden, 2001) – than to the disclosure channel itself.

Looking at voluntary disclosure channels, Dragomir (2012) studied sustainability reports issued by the five largest oil & gas companies over 10 years and identified "unexplained figures and methodological inconsistencies" (p. 223), such as insufficient comparability between successive reports and reduced information on estimation methodologies, suggesting that "EU regulatory system has its own share of anomalies and loose procedures" (Dragomir, 2012, p. 234). Inconsistencies were also identified in GHG disclosure by cities responding to CDP questionnaires, such as time gap between calculating and disclosing emissions (outdated information) and incomparability (Parvez, Hazelton and Guthrie, 2019).

As illustrated by the studies mentioned above, there is evidence of discretion in voluntary and mandatory environmental disclosure (Peters and Romi, 2013), for this reason, voluntary disclosure theory has also been employed in studies analysing disclosures in mandated channels (such as listed companies annual reports), as illustrated in the empirical literature review summary table, in Appendix 9.1. Discretion is also present in risk disclosure, in mandated and in voluntary reports. Even in countries with specific regulation requiring companies to disclose their material risks, managers may still define which risks to disclose and how to communicate them, as the content may vary in terms of number of words used, proportion of qualitative and quantitative information, specificity, order, tone of voice and other characteristics. In summary, there is room for discretion in both voluntary disclosure and mandated disclosure channels, which makes voluntary disclosure theory applicable to both cases.

Adams (2002) identified three groups of factors impacting on sustainability disclosure: corporate characteristics (such as performance, size and industry), contextual factors (country, political context, media pressure etc) and internal organisational factors (process-related factors, such as corporate structure, governance procedures, risk management and stakeholder involvement; and attitude-related factors, such as culture, views on reporting regulation, perceived costs and benefits of reporting). These factors influencing sustainability disclosure are presented in the next chart.

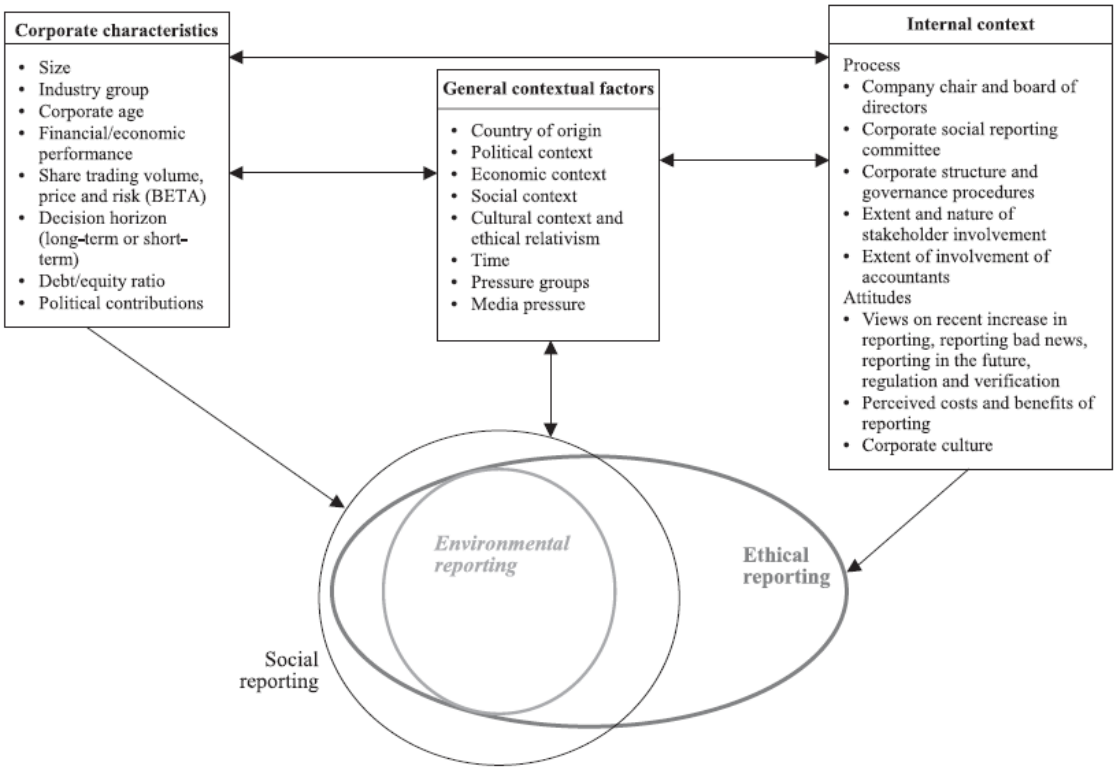

Figure 2.1: Influences on sustainability report (Adams, 2022, p. 246)

Beretta and Bozzolan (2004, p. 269) defined risk disclosure as "the communication of information concerning firms' strategies, characteristics, operations, and other external factors that have the potential to affect expected results". Linsley and Shrives (2006) adopted a wider view, considering risk disclosure if the reader is informed about any opportunity or threat, not only potential but also that has already impacted the company, and the corresponding management measures.

Risk has been investigated as a potential predictor of disclosure due to various reasons, such as: higher risk companies suffer greater pressure from stakeholders, demanding extra information to enable them to assess company's risk profile; risk is also related to cost of capital, so higher risk companies share information as a tentative to reduce their cost of capital by informing stakeholders about their risk management competency; higher risk industries are usually highly regulated and companies playing in these industries are required to provided more information; voluntary providing disclosures may also be a way to prevent enhanced disclosure regulation; good risk managers may want to showcase their ability to differentiate themselves to the other players in the industry, especially in high-risk industries. Several papers have been identified using risk as a predictor of environmental disclosure and of risk disclosure, discussed in section '2.5.1 Determinants of environmental disclosure' and in section '2.4.2 Determinants of risk disclosure'.

2.2 Climate change disclosure context and landscape

Global CO_2 emissions had their highest increase in history in 2021, after pandemic Covid-19 crisis, associated with increased use of coal to address energy demand (IEA, 2022). Discussion on enhancing climate change disclosure regulation has been intense, as revealed by SEC's recent proposal aligned with TCFD recommendations, discussed in section 3.1. There has been an increasing number of papers on climate change disclosure, particularly in 2015 – associated with the signature of the Paris Agreement – and in 2008 and 2012 – linked with the Kyoto Protocol's first commitment period, in the midst of the "uncertainty about the competitive effects of the Protocol and (upcoming) regulatory measures" (Kolk and Pinkse, 2005, p. 6). Industry reports have also been published investigating how companies have reported their CO_2 emissions and risks, mainly published by consultancies and NGOs, which are discussed in section 3.3.

Borghei (2021) has recently published a comprehensive systematic review of the carbon disclosure literature since 1981, which guides the content of this section. In her review, six key research fields were identified, which will be explored in the next paragraphs: strategic climate response; determinants of carbon disclosure; carbon accounting; assurance of carbon disclosure; quality of carbon disclosure; and consequences of carbon disclosure. The context of climate change disclosure literature discussed here is complemented by the grey literature reviewed in chapter 3, particularly in section 3.3 on the current state of climate-related disclosure.

Firstly, the strategic climate response research field in the carbon disclosure literature encompasses studies touching how businesses have responded to climate change concerns, especially driven by the Kyoto Protocol. Kolk and Pinkse (2005) developed a framework showcasing businesses' strategic options to address climate change, under two dimensions: the main aim and the form of organisation (degree of interaction, internally or externally). In their framework, the aim, or strategic intent, was divided into Innovation (product or process-oriented improvements) or Compensation (e.g. buying emission reductions from emissions trading schemes). The other dimension, the degree of interaction, is divided into three levels: the individual company (internal), companies' own supply chain (vertical), and interaction with companies outside the supply chain (horizontal), as shown in the image below:

		Main Aim	
		Innovation	**Compensation**
Organization	**Internal (company)**	Process Improvement (1)	Internal Transfer of Emission Reductions (2)
	Vertical (supply chain)	Product Development (3)	Supply-Chain Measures (4)
	Horizontal (beyond the supply chain)	New Product/Market Combinations (5)	Acquisition of Emission Credits (6)

Figure 2.2: Strategic Options for Climate Change (Kolk and Pinkse, 2005, p. 8)

Assessing how the biggest companies in the world have addressed climate change based on the combination of the six options above, Kolk and Pinkse (2005) identified that most of them, in 2002, fell in two groups, called Cautious Planners and Emergent Planners. The Cautious Planners "can be characterised as preparing for action, with not much activity in the different areas" (Kolk and Pinkse, 2005, p. 12). While the Emergent Planners "have set a process in motion to develop a more comprehensive climate strategy in coming years [...] but they are only in an early stage with regard to implementing organisational change to realise this objective" (Kolk and Pinkse, 2005, p. 12). Unfortunately these business' good intentions identified in 2002 regarding climate change did not reach the expected objective, as we still see many companies emitting huge amounts of carbon. This first research field identified in carbon disclosure literature, also includes factors influencing climate response – such as companies providing minimum disclosure to avoid scrutiny (Stanny, 2013) and the desire to reduce carbon emissions for legitimation purposes (Hopwood, 2009), aiming at reflecting society's expectations.

The second research field in Borghei's (2021) climate change literature was focused on the determinants of carbon disclosure, where this research sits, marked by inconsistent results. Determinants cover the 'motivations' (related to the interest to make a profit), 'drivers' (related to broader societal climate concerns, such as regulation, investor pressure, size, industry, carbon performance, media visibility and governance mechanisms, further investigated in section 2.5.1) and 'barriers' to voluntary carbon disclosure (associated with uncertainty about the marketplace and climate policies).

The third research field in carbon disclosure literature is focused on carbon accounting. Acknowledging that there is no consensus on its meaning, Ascui and Lovell (2011) proposed a new definition for carbon accounting, taking into consideration perspectives from several stakeholders. For example, "the natural sciences view of carbon accounting as a matter of physical measurement, estimation or calculation and attribution of greenhouse gas fluxes through the biophysical environment" (Ascui and Lovell, 2011, p. 983). While for politicians, carbon accounting carries extra components related to the economic consequences of carbon emissions, monitoring and reporting at the national level. In parallel, for accountants, carbon accounting also touches the market-enabling rules involved in turning GHG emissions and reductions into tradable commodities, while for companies it is also associated with social responsibility reporting. Their proposed definition is below, offering "a summary of the spectrum of activities that carbon accounting can involve across the different frames of reference" (Ascui and Lovell, 2011, p. 980).

estimation calculation measurement monitoring reporting validation verification auditing	of	carbon carbon dioxide greenhouse gas	emissions to the atmosphere removals from the atmosphere emission rights emission obligations emission reductions legal or financial instruments linked to the above trades/transactions of any of the above impacts on climate change impacts from climate change	at	global national sub-national regional civic organisational corporate project installation event product supply chain	level, for	mandatory voluntary	research compliance reporting disclosure benchmarking auditing information marketing or other	purposes

Figure 2.3: Acui and Lovell (2011, p. 980) proposed definition of carbon accounting

The fourth research field identified by Borghei (2021) in her carbon disclosure literature is associated with assurance of carbon disclosure. The author argues that "no separate international financial reporting standards are available to guide the reporting procedure of climate risks and opportunities" (Borghei, 2021, p. 9), despite attempts from standard-setters such as the Financial Accounting Standards Board (FASB) and the International Financial Reporting Interpretations Committee (IFRIC). In this research field, the subjectivity of the notion of materiality is also challenged, allowing companies to decide whether to disclose climate-related risks or not. Materiality is also discussed in section 3.1.

The next research field identified in the carbon disclosure literature was quality of carbon disclosure, where the gap between investors' information demand and companies' disclosures becomes evident, hindering comparisons between companies (Sullivan and Gouldson, 2012). The discussion on quality of carbon disclosure is also touched in sub-section 2.2.1, where different measures for disclosure quality are presented, and in section 2.5.1, focused on the determinants of environmental disclosure. This research field also include the impact of disclosure guidance, such as the ratification of the Kyoto Protocol enhancing reliability of carbon disclosure (Freedman, M. and Jaggi, 2011).

The last research field identified in carbon disclosure literature was focused on the consequences of carbon disclosure on companies' performance and share price. Ziegler, Busch and Hoffmann (2011) found a positive relationship between carbon disclosure and share price for companies in the energy sector in the U.S., while this relationship was negative for Korean companies (Lee, S., Park and Klassen, 2015). This research field also includes analysing the impact of carbon disclosure on a company's valuation, with results indicating that "the markets penalise all firms for their carbon emissions, but a further penalty is imposed on firms that do not disclose emissions information" (Matsumura, Prakash and Vera-Muñoz, 2014, pp. 695-6).

Borghei (2021) concludes her systematic review raising three findings. Firstly, "the fragmented conceptualisations of carbon disclosure (including a variety of measures, theories and frameworks)" (Borghei, 2021, p. 14), as the various research fields presented above demonstrate. Secondly, the inconsistent results delivered by empirical studies, largely due to using different proxies for disclosure and emissions, which is also raised as a research gap in section 2.6. Thirdly, and more importantly, that carbon disclosure should be more focused on climate-related risks, to clarify how a company impacts on the climate and vice-versa.

2.2.1 GHG emissions risk disclosure

GHG emissions risk disclosure is part of environmental disclosure as well as part of risk disclosure, encompassing risk exposure, associated risk management measures and potential consequences of GHG emissions, including risks from GHG emissions regulation. No previous paper has been identified specifically measuring GHG emissions risk disclosure, however this kind of disclosure is often contained in climate change risk disclosure, in GHG emissions disclosure (also named carbon emission disclosure), in overall environmental disclosure and in risk disclosure in general. Measurements of these related constructs are discussed in the next paragraphs.

Moving one step above, climate change risk disclosure encompasses, in addition to GHG emissions risk, other risks resulting from climate change, such as physical risks. Measures of climate change risk disclosure have been quite rare in the extant literature, with three main approaches identified: 1) sentence count after identifying climate change risk disclosure using key phrase search in annual reports (Kouloukoui *et al.,* 2018; Kouloukoui, Sant'Anna *et al.,* 2019), 2) counting the amount of climate change risks in annual reports (Doran and Quinn, 2008) and in CDP questionnaires (Elijido-Ten, 2017), and 3) assessing disclosure dimensions such as coverage (whether the material risks for a company's sector are disclosed) and accessibility of climate change information within the report (Foerster *et al.,* 2017). Truant, Corazza and Scagnelli (2017) measured sustainability risk disclosure using a self-created content analysis index, which encompasses whether a company has reported risks and opportunities posed by climate change, classified as physical, regulatory, or other, the associated impact and financial implications, and the risk management measures and related cost.

Taking a step further, GHG emissions disclosure encompasses GHG emissions, emission reduction initiatives and targets, GHG regulation, risks and opportunities. GHG emissions disclosure, as well as climate change disclosure, have been measured mainly based on CDP questionnaires or using content analysis indices usually containing a specific qualitative item on risk (Borghei, Leung and Guthrie, 2016; Chithambo and Tauringana, 2014; Cotter and Najah, 2012; Freedman and Jaggi, 2011; Hollindale *et al.,* 2019; Liu and Yang, 2018; Prado-Lorenzo *et al.,* 2009; Wedari, Jubb and Moradi-Motlagh, 2021). Examples of measures based on CDP climate change questionnaire include: CDP disclosure score (Luo and Tang, 2014; Peters and Romi, 2014; Qian and Schaltegger, 2017), whether a company has provided responses to CDP climate change questionnaire (Dawkins and Fraas, 2011) and whether a company disclosed emissions in the CDP questionnaire (Stanny, 2013). Other approaches also identified in the literature include level of alignment with TCFD recommendations (Demaria, Rigot and Borie, 2019), symbolic versus behavioural management approach (Hrasky, 2012), and completeness with regard to the scope, type and reporting boundary (Liesen *et al.*, 2015).

Looking from a broader perspective, environmental disclosure encompasses aspects of environmental risk, which in more recent papers often refers to information on GHG emissions risk. Two examples illustrate the presence of risk disclosure in environmental disclosure:

Wiseman's (1982) content analysis index includes items such as potential litigation, discussion of regulation and company concern for the environment; Clarkson *et al.*'s (2008) index includes an overview of the environmental impact of the industry and existence of emergency plans, which composes a risk mitigation measure.

Different dimensions of environmental disclosure have been measured since 1980s, which could be grouped into: 1) measures to quantify the level of disclosure (also named amount or extent of environmental disclosure), 2) measures derived from content analysis, and 3) measures of language and tone of disclosure. The measures in the first group are used to count number of pages (Gibson and O'Donovan, 2007; Guthrie and Parker, 1989), lines (Patten, 2002; Wiseman, 1982), sentences (Ingram and Frazier, 1980; Mallin, Michelon and Raggi, 2012; Wiseman, 1982; de Villiers, Charl and van Staden, 2006) and words (Deegan and Gordon, 1996) dedicated to environmental disclosures.

The second group, environmental disclosure measures obtained using content analysis indices, look for specific environmental topics (in recent studies, often based on GRI). In some environmental disclosure indices, items are divided into "soft" (unverifiable claims) or "hard" (objective, quantitative measures) (Clarkson *et al.*, 2008). Although it is argued that the adoption of weighted or unweighted content analysis indices does not substantially impact on the results (Gray, R., Kouhy and Lavers, 1995), some indices employ a weighted system to assess the quality of the disclosure provided for each item, usually varying from merely descriptive qualitative statements to company-specific quantitative (or monetary) information, as exemplified in the table below:

Table 2.1: Categories assessing quality of environmental disclosure

Author/date	Levels of specificity in environmental disclosure content analysis indices	
Ingram and Frazier (1980)	Evidence	• Monetary • Nonmonetary but still quantitative • Qualitative (these three first levels for factual information concerning company's activities) • Declarative: a statement of opinion or unsupported declaration concerning company's activities • None: information not concerning company's activities
	Specificity	• Specific: a statement referencing a company's own activities or situation • General: a statement not referencing a firm's own activities or situation
Wiseman (1982)	Degree of specificity	• Item described in monetary or quantitative terms • Item presented with company specific information in non-quantitative terms • Item mentioned only in general terms
Hughes, Sander and Reier (2000)	Weighted sentence data	• Quantitative: environmental impact clearly defined in monetary terms or actual physical quantities • Descriptive: environmental impact noted but not quantified
Hughes, Anderson and Golden (2001)	Differences in the information contained in the narrative	• Quantitative: environmental impact clearly defined in monetary terms or actual physical quantities • Descriptive: impact is clearly evident • Vague: disclosures limited to passing comments of effects within discussions of other topics • Immaterial: statement of issues as immaterial to company's financial conditions and results
Al-Tuwaijri, Christensen and Hughes (2004)	Quality of disclosure	• Quantitative disclosure • Qualitative specific: non-quantitative but specific information • Qualitative non-specific: general qualitative disclosures, but still company-specific information
de Villiers and van Staden (2006)	Type of environmental disclosure	• Specific items: quantify environmental information, provide financial information and monitor performance against previously set objectives. Specific items indicate the extent of company's environmental impacts and if they are decreasing or increasing. • General items: information not attempting to quantify environmental aspects.
Gibson and O'Donovan (2007)	Categories of environmental information	• Financial: included in the financial statements, including notes to the accounts (e.g. provision for future clean up costs) • Quantifiable non-financial: included in the annual report but not part of the financial statements (e.g. graphs or tables indicating air emissions) • Descriptive: narrative and pictorial forms of disclosure (e.g. often textual references in directors' report or in the environmental sections of the report)
Fontana *et al.* (2015)	Completeness of information released	• Detailed information: expressed in a clear, complete and systematic way • Generic information: "Information is given imprecisely, is not complete in relation to the reference items and does not allow for systematic comprehension of the phenomenon." (p. 46) • No data: no qualitative or quantitative information in relation to the items
Hummel and Schlick (2016)	Reporting quality of GRI indicators	• High-quality disclosure: disclosure of numerical data on a company-wide level fulfilling or exceeding GRI minimum requirements • Low-quality disclosure • Nondisclosure

A third group of environmental disclosure measures identified in the literature is related to assessing disclosure language and tone of voice. In this regard, Cho, Roberts and Patten (2010) assessed optimism and certainty level of environmental disclosure.

Focusing on risk disclosure, several authors have measured quantity of disclosures (Abraham and Cox, 2007; Elshandidy, Fraser and Hussainey, 2013; Elzahar and Hussainey, 2012; Linsley and Shrives, 2006; Neri, Elshandidy and Guo, 2018), while disclosure quality has also been investigated. Miihkinen (2013) assessed quality of risk disclosure based on two dimensions: quantity (number of words in risk disclosure) and coverage (the concentration of corporate disclosures across risk topics: strategic, operations, financial and damage risks, and risk management), as risk disclosure is considered more useful if it conveys the overall risk profile of a company.

Abraham and Shrives (2014) developed a model to assess quality of risk disclosure, looking at whether it is updated regularly, reflects actual risk events, and is company-specific (classified into general disclosure, specific industry disclosure or specific company disclosure), finding that managers prefer providing disclosures that are symbolic rather than substantive, and risk disclosure tends to be general and routine. The lack of specificity was noted earlier by Linsley and Shrives (2006), who classified risk disclosures in monetary or non-monetary, while Alex (2016) preferred qualitative or quantitative, and both authors looked at disclosures' timeframe (past, present, future or non-time) and the type of news disclosed (good, bad or neutral). Linsley and Shrives (2006, p. 387) concluded that "it was uncommon to find monetary assessments of risk information, but companies did exhibit a willingness to disclose forward-looking risk information". For Lajili and Zéghal (2005, p. 125), risk disclosures "appears to lack uniformity, clarity, and quantification, thus potentially limiting their usefulness".

As mentioned earlier, disclosure could be classified as voluntary or mandatory disclosures, which could be identified based on the section on the annual report where the disclosures are found (Hughes, Anderson and Golden, 2001), based on mandated risk topics or themes (Elshandidy, Fraser and Hussainey, 2013) or based on accounting rules and stock exchange regulation (Lajili and Zéghal, 2005).

2.3 Other key concepts in this research

2.3.1 GHG emissions risk

Risk is commonly understood as a situation involving exposure to loss, including the probability of converting a source of danger into damage (Kaplan and Garrick, 1981). Different kinds of risks have been categorised based on disciplines, such as economic, environmental, geopolitical, societal and technological risks (World Economic Forum, 2021). Another manner to categorise risks considers their scope, such as external, strategic and operational risks, with environmental risk affecting these three levels (Truant, Corazza and Scagnelli, 2017).

Environmental risks may be classified in broad categories, such as risk from regulations, operations and nature (Dobler, Lajili and Zéghal, 2014), or in a more specific manner, such as compliance risks, liability risks, investment risks, physical risks, indirect risks (such as increasing the costs of energy), reputational risks and risks related to business model. A third manner to classify environmental risks would be based on specific environmental aspects, such as risks related to climate change, energy, water and natural disasters.

Relying on key aspects of risk, such as hazard (or danger), exposure (or vulnerability), likelihood (or probability) and impact (or damage, consequence), the IPCC (2018) defined risk as:

> "The potential for adverse consequences from a climate-related hazard for human and natural systems, resulting from the interactions between the hazard and the vulnerability and exposure of the affected system. Risk integrates the likelihood of exposure to a hazard and the magnitude of its impact." (IPCC, 2018, p. 24).

Dimensions of risk include risk exposure, probability of occurrence, consequence (catastrophic, major, moderate or minor) and risk management (active or not), which could be classified following categories like the ones in the previous brackets or as continuous variables. A measure of risk could be obtained by multiplying the exposure value by the consequence value for each risk, therefore enabling comparisons with other risks or other categories of risk (Dobler, Lajili and Zéghal, 2014).

Companies have assessed their own risks, often supported by consultancies. Risks have also been assessed by independent research companies, based on company's documentation, media screening, assessments from independent experts and interviews with company's representatives. Innovest EcoValue'21™ Ratings (Linsley and Shrives, 2006), KLD environmental concerns ratings (Chatterji, Levine and Toffel, 2009) and GES environmental risk rating (Semenova and Hassell, 2008), both issued by independent companies, have been used in previous studies to proxy for environmental risk. The last two, respectively issued by KLD and GES, were confirmed as tending to be risk-oriented metrics (Semenova, 2010).

GHG emissions is one aspect of climate change, also named carbon emissions, as carbon dioxide represents the vast majority of GHG emissions (80% of U.S. GHG emissions in 2019). The level of a company's GHG emissions risk depends on its exposure to GHG emissions (e.g. industry, production process, number of production units, country/state regulation etc) and its controls in place to manage GHG emissions (e.g. measures to reduce emissions, carbon credits, low-carbon technology etc). Aspects of climate change risks other than GHG emissions include risks related to the transition to a lower-carbon economy (policy risks, technology risk, market risk and reputation risk) and physical risks, such as the impact of extreme temperatures (TCFD, 2017).

Several companies disclose their material (i.e. significant) climate change risks via annual reports and CDP questionnaires, enabling calculating company's risk based on company's disclosure (Dobler, Lajili and Zéghal, 2014). Company's climate change risk disclosures may include where in the value chain the risk occurs (e.g. supply chain, operations, customer), time horizon, likelihood, magnitude of impact, potential financial impact and management method.

Considering the difficulty to access an objective measure of corporate environmental risk, several studies have used related concepts to proxy for company's exposure to environmental risk or carbon risk. These include being a member of a carbon-intensive industry or participating in mandatory environmental/carbon initiatives (Bewley and Li, 2000) and GHG-intensity (Lemma *et al.*, 2019; Lemma *et al.*, 2020). GHG-intensity, or carbon-intensity, refers to the amount of CO_2 or GHG emissions scaled by a specific activity or aspect, such as revenue, energy consumption, employees or total assets, generating a relative measure to facilitate comparisons with companies of different sizes. Carbon-intensity is often referred in the literature as a measure of performance instead of a measure of risk (Braam *et al.*, 2016; Bui, Houqe and Zaman, 2020; Dragomir, Voicu D., 2010; Fontana *et al.*, 2015) and for this reason, papers testing the relationship between carbon-intensity and disclosure are discussed in Section 2.5.1.1 (and not in 2.5.1.2).

2.3.2 GHG media visibility

> "Heightened media attention accentuates the odds of a firm committing to take more action on climate change" (Tavakolifar et al., 2021, p. 127833)

Media visibility reflects the level of media awareness a specific topic, and it has been used as a proxy for society awareness (Tadros and Magnan, 2019) or outsiders' knowledge about a company's activities (Bewley and Li, 2000), for company's exposure to public scrutiny (Al-Tuwaijri, Christensen and Hughes, 2004), for threat to company's legitimacy (Clarkson *et al.*, 2008), for community concerns (Deegan and Rankin, 1996) and for political costs (Gamerschlag, Möller and Verbeeten, 2010). Instead of considering company's media coverage in general, some studies have tested the relationship between disclosure and the number of media articles related to specific topics, such as environment (Aerts and Cormier, 2009; Bewley and Li, 2000; Li, Richardson and Thornton, 1997; Tadros and Magnan, 2019) and climate change (Dawkins and Fraas, 2011).

Media visibility is generally measured by the number of news stories and/or the space (e.g. headline, cover page etc) allocated to a company or a topic. Search for news articles often focuses on printed media (Al-Tuwaijri, Christensen and Hughes, 2004), but may also include articles on wired media (Dawkins and Fraas, 2011). News articles may be classified into positive, neutral or negative news, often consolidated using Janis-Fadner coefficient of imbalance (Aerts and Cormier, 2009).

In addition to media visibility, industry membership has also been used as a proxy for pressure from the public (Liesen *et al.*, 2015), as companies in carbon-intensive sectors would be under higher scrutiny. Several studies have tested the relationship between pressure from specific stakeholder groups – such as shareholders, government, employees and customers – and disclosure. In general, these studies have found that pressure from stakeholder impacts on environmental disclosure (Guenther *et al.*, 2016; Liesen *et al.*, 2015).

2.4 Theoretical framework

Hahn, Reimsbach and Schiemann (2015) identified three main theoretical anchors in the carbon disclosure literature: socio-political theories of disclosure (mainly legitimacy and stakeholder theory), economic theories of (voluntary) disclosure and institutional theory. Gray, Owen and Adams (2009, p. 3) argue that there is a "herding tendency" around legitimacy theory in the social and environmental accounting field, which may be due to the fact that communication is crucial in the legitimation process. Several theories used in environmental accounting have also supported studies in the risk disclosure literature, such as institutional, legitimacy, voluntary disclosure, agency, contingency and signalling theories.

The literature review confirms the tendency around legitimacy theory in environmental disclosure studies (see literature review summary table in Appendix 9.1). More importantly, the studies testing the relationship between environmental disclosure and environmental performance suggest that there is a trend towards employing socio-political and economic theories in conjunction, in an attempt to explain the mixed results (Aragón-Correa, Marcus and Hurtado-Torres, 2016; Clarkson *et al.,* 2008; Dawkins and Fraas, 2011; Hummel and Schlick, 2016; Tadros and Magnan, 2019).

Legitimacy theory suggests that environmental disclosure is a function of social and political pressure (Gray, Kouhy and Lavers, 1995), while voluntary disclosure theory considers disclosure as a manner to inform shareholders, demonstrate superior capacity and differentiate a company from its competitors (Clarkson *et al.*, 2008). In general, environmental literature distinguishes between companies following a defensive and compliance-driven approach, and those taking proactive strategies to accommodate stakeholders' interests (Buysse and Verbeke, 2003). Reacting to societal pressure, the first group of companies would use environmental disclosure to protect their legitimacy, threatened by unfavourable environmental performance, while the second group would use environmental disclosure to communicate their strong performance, in alignment with voluntary disclosure theory.

Disclosure studies based on legitimacy and voluntary disclosure theories often test competing hypotheses, but this is not the case for Hummel and Schlick (2016) and Tadros and Magnan (2019), using both theories in a complementary manner. Hummel and Schlick (2016) found a negative relationship between sustainability performance and low-quality sustainability disclosures, explained by legitimacy theory, while there was a positive relationship between sustainability performance and high-quality sustainability disclosures, explained by voluntary disclosure theory. Similarly, Tadros (2019) found that both economic and legitimacy factors explain environmental disclosure. Hahn, Reimsbach and Schiemann (2015) give a further step in this reflection on using legitimacy and voluntary disclosure theories in an integrated manner, alerting for a potential merge of their foci if report readers are more professional and companies provide a more balanced report (as both would reduce a company's discretion level):

> "Socio-political theories initially focus on participation in disclosure schemes and on the quantity of disclosures, while economics-based theories are more concerned with the content of disclosures (see, e.g., Clarkson *et al.*, 2008). This follows the underlying assumption that, other than financial investors, disclosure recipients do not scrutinise the given information and that firms would prefer to disclose positive signals, which lead actors to grant legitimacy to any disclosing organisation. However, if nonfinancial recipients of carbon information professionalise their information processing and if firms report more balanced information, both theoretical foci could merge." (Hahn, Reimsbach and Schiemann, 2015, p. 96)

Building on the disclosure studies reconciling the application of legitimacy theory and voluntary disclosure theory, this study is also based on these two theories to explain the relationship between a sub-level of environmental disclosure, named GHG emissions risk disclosure, and its corresponding risk, risk management and media exposure. As this study is also concerned about different types of disclosure, including general and specific disclosure, a third perspective in included in the theoretical framework: impression management, which may help explain different behaviours associated with different types of disclosure.

Using more than one theory to explain managerial behaviour is considered legitimate, as theories work as lenses that "overlap and interact, lenses that occasionally compete and also lenses that can often mutually support each other" (Gray *et al*., 2009, p. 38). Arguing that a multi-theoretic approach may be appropriate, Borghei (2021) posits that:

> "Recognising that no single study on the topic offers the ultimate answer for the determinants and consequences of carbon disclosure, it is plausible that a number of theoretical concepts are components of a pluralistic debate on carbon disclosure. The question is whether these are competing, complementary or simply context-dependent theories for explaining carbon disclosure." (Borghei, 2021, p. 15).

The following sub-sections discuss legitimacy and voluntary disclosure theories and impression management, and their application in the environmental disclosure field.

2.4.1 Legitimacy theory

The socio-political legitimacy theory is one of the most prevalent in the carbon disclosure literature (Hahn, Reimsbach and Schiemann, 2015) and in the broader social and environmental disclosure field (Gray, R., Owen and Adams,2009). This theory originated with Weber's (1922) notion of conformity with social norms and formal laws. Lindblom (1994, p. 2) defined legitimacy as:

> "A condition or status which exists when an entity's value system is congruent with the value system of the larger social system of which the entity is a part. When a disparity, actual or potential, exists between the two value systems, there is a threat to the entity's legitimacy".

In the same direction, Suchman (1995, p. 574) defined legitimacy as:

> "A generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions".

By using the word 'generalised', it is acknowledged that legitimacy transcends specific adverse occurrences. Suchman (1995) explicitly added society's perception of organisational actions to the definition, suggesting that legitimacy is created subjectively, and that an organisation may diverge from the social norms as far as it goes unnoticed.

According to legitimacy theory, there is a social contract between companies and the society, with conditions that change over time, establishing that companies are legitimate if they operate in alignment with society's value system (Deegan, 2002; Guthrie and Parker, 1989). Legitimacy is required for business continuity (Suchman, 1995), as business needs stakeholders' support to operate. For instance, if organisations are perceived operating outside the social norms, governments may tighten regulation or impose fines, employees may organise strikes or not be interested in working for the company, communities may block company's accesses or not respect private property limits, customers may prefer buying from competitors, and suppliers may not meet their commitments. All these potential consequences of legitimacy gaps would certainly impact on company's objectives.

Suchman (1995) classified legitimacy in three broad co-existing types: pragmatic, moral and cognitive legitimacy. Firstly, pragmatic legitimacy involves exchanges with organisation's immediate audiences, evaluating whether organisational activity benefits its stakeholders. Secondly, moral legitimacy is related to whether the organisational activity is 'the right thing to do', promoting welfare to the society, as opposed to the self-interest view of the pragmatic legitimacy. Moral legitimacy includes consequential legitimacy (judging organisations based on what they accomplish), procedural legitimacy (particularly when outcomes are not clear and good practice demonstrates the right efforts), personal legitimacy (based on leaders' charisma) and structural legitimacy (whether organisation's structure represents capacity to perform certain activities). Thirdly, cognitive legitimacy is mainly based on the ability to provide explanations for the organisation and its objectives, and on taken-for-grantedness (organisations are considered able to manage disorder). For Suchman (1995, p. 589), "if organisations gain pragmatic legitimacy by conforming to instrumental demands and moral legitimacy by conforming to altruistic ideals, they gain cognitive legitimacy primarily by conforming to established models or standards" including by mimicking the most prominent organisations in the sector. This strategy of copying best performers in the sector is also analysed under voluntary disclosure theory.

2.4.1.1 *Legitimation strategies*

> "Information […] is a major element that can be employed by the organisation to manage (or manipulate) the stakeholder in order to gain their support and approval, or to distract their opposition or disapproval." (Gray, Rob, Owen and Adams, 1996, p. 46)

Several legitimation strategies have been pursued by organisations, especially when facing legitimacy threats. In this section, the legitimation strategies identified by Suchman (1995), Dowling and Pfeffer (1975), and Lindblom (1994) are presented, all of them supported by communications. As legitimacy theory is built on the notion of perceptions, "any remedial strategies… must be accompanied by disclosures. That is, information is necessary to change perceptions" (Deegan, 2002, p. 296).

Suchman (1995) argues that there are three general challenges in legitimacy management: gaining, maintaining and repairing legitimacy, for which communications, including disclosures, play a pivotal role. Firstly, strategies for gaining legitimacy fall into three general groups: 1) efforts to conform to the expectations of pre-existing stakeholders, 2) efforts to select an environment and stakeholders that will support the organisation, and 3) efforts to manipulate the environment to create new stakeholders and new values. Secondly, strategies for maintaining legitimacy are divided in two groups: 1) perceiving future changes (by enhancing ability to predict stakeholders' reaction and emerging challenges) and 2) protecting past accomplishments (by avoiding events that may encourage stakeholders to review their perception about the organisations, in favour of a consistent and predictable conduct). Thirdly, strategies to repair legitimacy were grouped under three broad prescriptions: 1) formulating a normalising account (to separate the threat from the overall assessment of the organisation, by offering denials, excuses, justifications and explanations), 2) restructuring (by creating watchdogs or distancing from bad influences) and 3) avoiding panic (requiring a light touch and sensitivity to stakeholders' reactions).

For Dowling and Pfeffer (1975), organisations can follow three strategies to become legitimate: 1) they can adapt their operations and goals to conform with the current definition of legitimacy, 2) they can attempt to change the definition of legitimacy to be aligned with their current practices, or 3) they can associate themselves with symbols and institutions recognised by their legitimacy (e.g. politicians, traditional universities). All these legitimation strategies are considered challenging because "as organisations adapt, social definition of legitimacy change" (Dowling and Pfeffer, 1975, p. 134).

For Lindblom (1994), when legitimacy is threatened or when there is a legitimacy gap, an organisation may employ four legitimation strategies, ranging from an active to a more passive conduct. Firstly, an organisation may seek to educate relevant stakeholders about its intentions to improve performance. Secondly, it may seek to change stakeholders' perceptions, without changing performance. Thirdly, the organisation may distract attention and focus on other related issues. Or fourthly, the organisation may seek to change external expectations about its performance. The strategy on diverting stakeholders' attention from the issues of concern is amongst the strategies that have been adopted most by Australian mining companies (Yongvanich and Guthrie, 2007), as well as by UK and Chinese companies to communicate bad news (Lin, 2021).

As Lindblom's (1994) strategies are clear in terms of the approach to communications (i.e. disclosures) adopted, a model is proposed here associating Lindblom's (1994) legitimation strategies with Ingram and Frazier's (1980) disclosure categories, which will help interpret the results from this research. Ingram and Frazier (1980) developed a simple and objective categorisation of disclosure based on specificity, where disclosure mentioning a company's activity or situation is called specific disclosure, while disclosure not mentioning a company's activity or situation is called general disclosure. Considering disclosure specificity as a continuum, the following scheme suggests the type of disclosure that would be prevalent in each of Lindblom's (1994) legitimation strategies. In one extreme, when a company seeks to educate stakeholders about its performance, it will mainly rely on sentences mentioning its activities (specific disclosure). In contrast, when a company intends to distract attention and focus on other related issues, it will mainly rely on sentences not mentioning its activities (general disclosure).

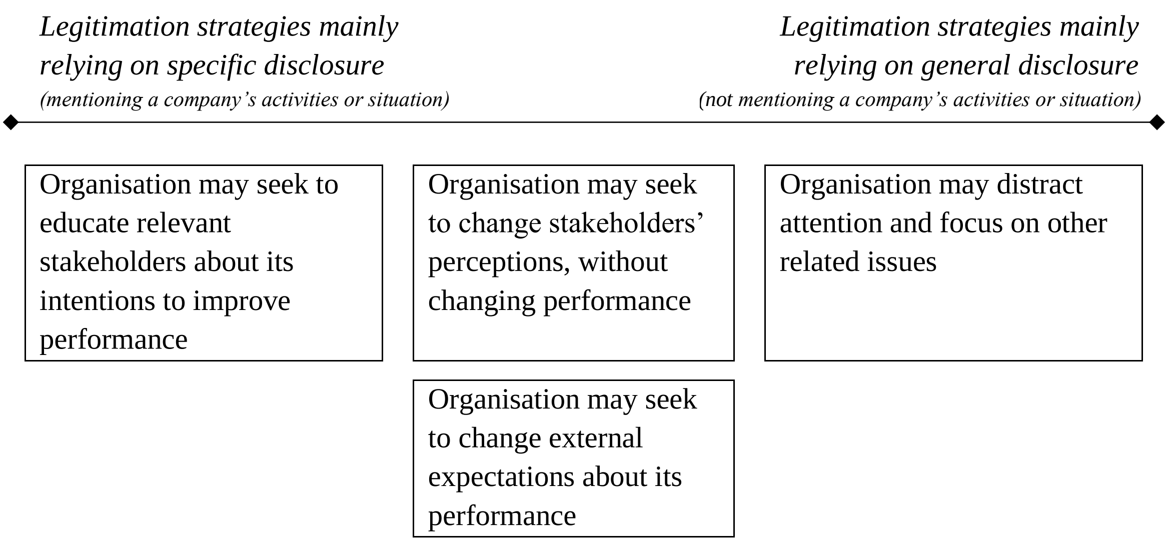

Figure 2.4: Lindblom's (1994) legitimation strategies vs Ingram and Frazier's (1980) specificity disclosure categories

2.4.1.2 Legitimacy theory applied to environmental disclosure

Corporate disclosure is often employed to legitimise corporate actions, reacting to economic, social and political factors (Guthrie and Parker, 1989). Therefore, when necessary, companies would adjust their disclosure policies to convey that their operations remain consistent with social expectations (Deegan and Gordon, 1996). Disclosures can be tailored to manage public impressions of company actions, contributing to enhance company's legitimacy (Cho, Roberts and Patten, 2010). For Patten (2002, p. 767), "annual report environmental disclosures are discretionary in nature", varying substantially across companies and time. Management can decide what and how much to disclose, in such a way, poor performers could appear like better performers. Disclosed information may tend to be "largely self-serving" (Ali Fekrat, Inclan and Petroni, 1996, p. 178), although not necessarily false information (Neu, Warsame and Pedwell, 1998).

In the carbon emissions context, Hrasky (2012) argues that, considering the new expectations from society about company's carbon footprint, a legitimation response is necessary to maintain company's legitimacy, which could be done using disclosure on carbon emissions and corporate activities, in order to convince stakeholders that the company is responding appropriately. Companies not aligned with society's expectations may experience threatened legitimacy. For example, when polluting the environment or facing serious environmental incidents or non-compliance with legislation, a company could have its legitimacy threatened (and its formal environmental license and social license suspended), as far as performance information is publicly available (Patten, 2002). This is an illustration of the "generalised perception" in Suchman's (1995) definition of legitimacy, as if the society was not aware about company's poor performance, there would be no social or political pressure. Dawkins and Fraas (2011, p. 306) argued that "where there is limited visibility, there will be limited concern", building on Deegan, Rankin and Tobin's (2002, p. 335) argument that "where there is limited concern, there will be limited disclosures". In this sense, legitimacy theory supports previous studies identifying a positive relationship between pressure from environmental lobbying groups (Deegan and Gordon, 1996) and media coverage (Bewley and Li, 2000), including climate change media visibility (Dawkins and Fraas, 2011), and environmental disclosure.

Gray, Kouhy and Lavers (1995) argue that poor performers have incentives to make increased environmental disclosures, which could be an increase in the extent or in the quality of disclosure. This would result in a negative relationship between environmental performance and voluntary environmental disclosure (i.e. poor performers would disclose more). Aligned with legitimacy theory, major environmental events related to BHP mining company, in Australia, were found to be associated with BHP's peak environmental disclosures post-1970s (Guthrie and Parker, 1989). Another evidence of this phenomenon would be the increased environmental disclosure in the aftermath of catastrophic oil spills (Patten, 1992), affecting not only the companies directly involved in the events but the whole oil industry, respectively known as organisational legitimisation and industry legitimisation processes (Deegan and Gordon, 1996, p. 194). Companies in environmentally-sensitive industries, subject to greater social pressure, were found to produce higher levels of disclosure (Deegan and Gordon, 1996; Cho and Patten, 2007). Literature has also documented increase in the quality of voluntary climate change disclosure by companies facing legitimacy threats (Lemma *et al.*, 2019; Lemma *et al.*, 2020)

Although legitimacy threats are usually associated with increase in disclosures, de Villiers and van Staden (2006) posit that legitimation strategies may also rely on reducing the volume of disclosure or changing the type of disclosure (from general to specific, or vice-versa). Reasons aligned with legitimacy theory for reducing disclosures include: when environmental concerns reduce, when a company change its strategy from gaining/repairing legitimacy to maintaining legitimacy, or when an issue is perceived to become sensitive.

For Hrasky (2012), Suchman's (1995) pragmatic and moral legitimacy are the most pertinent in corporate environmental disclosure strategies, as they rely on a dialogue with company's stakeholders, evidencing the overlap with stakeholders' theory. Pragmatic legitimacy is associated with a symbolic approach, as it is related to portraying "an image of the organisation that is honest and trustworthy, sharing and promoting the values that the audience also values" (Hrasky, 2012, p. 180), which may be done by using rhetorical statements not necessarily accompanied by relevant action. On the other hand, moral legitimacy is associated with a behavioural management approach to disclosure, as companies must provide substantive disclosure – providing information on their results and actions – to enable stakeholders to assess company's outcomes (consequential legitimacy) and processes (procedural legitimacy) (Hrasky, 2012).

Soft claims to be committed to the environment without substantiation – also treated as symbolic, general or low-quality disclosure – have been associated with companies with poor performance (Clarkson *et al.*, 2008; Hummel and Schilick, 2016), as these disclosures reiterate company's commitment with the environment with lower information cost, appropriate for a defensive approach. Similarly, incomplete reporting of emissions can be used as a symbolic act to address legitimacy exposures, as it allows "companies to appear to be responding to stakeholder pressures without really providing information that will allow for meaningful accountability" (Liesen *et al.*, 2015, p. 1049).

The association between unverifiable/vague disclosures and legitimacy threats was challenged by Tadros and Magnan (2019), who found that poor environmental performers – which are under greater pressure from society – disclose more economic information in response to legitimacy threats. The same behaviour was observed earlier by Hrasky (2012), who found that carbon-intensive sectors – also under greater scrutiny – rely more heavily on substantive action than the less intensive sectors, which rely on symbolic disclosure.

Important to note that disclosing less (more) specific information does not imply that there will be an increase (decrease) in the disclosure of general information (de Villiers and van Staden, 2006), as the two measures of disclosure are independent.

2.4.2 Voluntary disclosure theory

The economic-based voluntary disclosure theory was originally developed by Verrecchia (1983) and Dye (1985). This theory is also known as accounting disclosure theory (Peters and Romi, 2013), proprietary costs theory (Abraham and Shrives, 2014) and discretionary disclosure theory (Dobler, Lajili and Zéghal, 2014).

Voluntary disclosure theory was built on the notion that managers exercise discretion by defining the degree of information quality to be disclosed, based on a "threshold level of disclosure" (Verrecchia, 1983, p. 179). This threshold takes into account proprietary costs and shareholders' expectations, which also suggests an overlap with stakeholder theory. Disclosure is seen as a communication tool focused on market participants, used to reduce the information asymmetry between a company and its current or potential investors, affecting capital costs and company valuation. According to this theory, the "information differentials that exist between two parties" (Chithambo and Tauringana, 2014, p. 324), or the "principal-agent problem of asymmetric information" (Hahn, Reimsbach and Schiemann, 2015, p. 86) – which could also be approached from the lenses of agency theory – motivate companies to voluntarily disclose information based on an evaluation of costs and benefits, increasing transparency.

Proprietary costs are defined as the cost of preparing and sharing information. Proprietary costs include costs associated with releasing information that may be proprietary in nature, and therefore potentially damaging (e.g. misuse of proprietary information by competitors), and information that may be useful to stakeholders in a way that is harmful to a company's objectives, even when the information is positive (Verrecchia, 1983). Proprietary information is defined as "the information whose disclosure reduces the present value of cash flows of the firm" (Dye, 1986, p. 331), for instance, by generating regulatory action or liabilities, reducing consumer's demand or affecting organisation's credit rating (Dye, 1985). The notion of proprietary costs was touched earlier by Demski and Feltham (1976), suggesting that individuals might be encouraged to pay to not disclose information that could be used in an unfavourable manner. For Li, Richardson and Thornton (1997), companies have incentives to withhold bad news, such as avoiding market's negative assessment. Similarly, Al-Tuwaijri, Christensen and Hughes (2004) argued that if greater disclosure provides information that exposes a company to future litigation or may encourage potential competitors to enter the market, good performers might be encouraged to reduce their disclosure.

Environmental disclosure may represent proprietary costs, as it potentially "impacts trading relationships with business partners and customers; invokes costly litigation; affects the cost of capital; provides competitors with information about firm-specific sustainability strategies; and provides ammunition for environmental advocacy groups or non-governmental organisations (NGOs) inciting negative attention" (Peters and Romi, 2014, p. 641). For Verrecchia (1983, p. 182), "as the proprietary cost increases, the range of possible favourable interpretations of withheld information increases, thereby allowing the manager greater discretion". In other words, the greater the proprietary cost, the less negative the reaction to the absence of the related information in company's disclosures. Verrecchia (1983) argues that there is a discretionary disclosure equilibrium where the decision to withhold information is sustained by investors' uncertainty as to whether the information is 'bad' or 'not quite good enough' to justify disclosure. Dye (1985) corroborates with this argument, stating that investors are often uncertain about the kind of information managers hold, which may be an incentive to disclose information to differentiate it to the worst information managers could have. For Dye (1986), managers may choose to not disclose information when part of their private information is proprietary, or when disclosure of non-proprietary information may reveal proprietary information if there are known interdependencies between them.

Voluntary disclosure theory supports that someone who holds superior information will signal it, directly or indirectly, to achieve an economic benefit, which is also aligned with signalling theory. According to signalling theory, companies could produce signals to inform stakeholders of their attributes, reducing information asymmetry. As companies disclose more risk-related information, investors would produce a better assessment of the company's future performance, reducing uncertainty. Consequently, stakeholders would assume that the organisation is appropriately managed and is "relatively free from unexpected social (de-legitimating) shocks" (Gray *et al.*, 2010, p. 30). For Dye (1986), signalling becomes a substitute for disclosure, conveying information about company's earning capacity to generate returns without disclosing the information itself, arguing that employing signalling or disclosure depends on the efficiency of the signal and the cost to disclose the information. This differentiation between a signal and a disclosure, as argued by Dye (1986), could be associated with the differentiation between Clarkson *et al.*'s (2008) soft and hard disclosure, or the notion of symbolic vs substantive disclosure.

Sinclair-Desgagné and Gozlan (2003) developed a theoretical study combining features of signalling and persuasion games, highlighting the influence of stakeholders' characteristics on the quality of disclosure. They found that voluntary disclosures would be "very vague and inexpensive [(to be produced, disseminated and processed)] when the stakeholder is a priori confident" about the company (Sinclair-Desgagné and Gozlan, 2003, p. 391). On the other hand, "the necessity to reassure a worried stakeholder could force a firm to invest in more accurate environmental reporting" (Sinclair-Desgagné and Gozlan, 2003, p. 391), concluding that quality of environmental disclosure is demand-driven. In this sense, voluntary disclosure theory has also been employed to examine the potential relationship between environmental disclosure and outsiders' knowledge of company's environmental exposure (Bewley and Li, 2000), which would increase the "threshold level of disclosure" (Verrecchia, 1983, p. 179).

Companies could use signals, such as communication strategies, to demonstrate their superior quality and competence, including their expertise to manage environmental risks (Magness, 2010). One possible interpretation of voluntary disclosure theory is that it suggests a positive association between environmental performance and voluntary environmental disclosure, as superior environmental performers, with positive information, would have incentives to disclose it to differentiate themselves amongst other companies in the sector. Good performers would "project a proactive environmental image by providing candid information regarding their environmental performance, even though that information may be viewed as 'negative' on a situational basis" (Al-Tuwaijri, Christensen and Hughes, 2004, p. 467). In this sense, superior performers would rely on "objective environmental performance indicators which are difficult to mimic by inferior type firms" (Clarkson *et al.*, 2008, p. 304), also called "credible environmental disclosure" (Clarkson, Overell and Chapple, 2011, p. 32), while inferior performers would disclose less objective environmental information.

Applying voluntary disclosure theory to risk disclosure, Abraham and Shrives (2014) argue that it contributes to explain why managers prefer providing symbolic rather than substantive disclosures. They argue that this occurs as managers would try to minimise proprietary costs, which may cause a mismatch between company's internal risk register and the risks disclosed in annual reports. Elshandidy, Fraser and Hussainey (2013) examined the relationship between risk disclosures and risk at company level, suggesting that risky companies are motivated to provide higher levels of information to reduce information asymmetry.

2.4.3 Impression management

An alternative school of thought that could be employed to interpret discretionary disclosure is impression management. Impression management can be understood as an opportunistic behaviour from managers, using the discretion inherent in corporate narrative, to promote a more favourable perception about an organisation by selecting the content and the manner disclosure is presented (Merkl-Davies, D., Brennan and McLeay, 2011). In other words, impression management is related to "managers' attempt to present information in a manner that distorts readers' perceptions of corporate image and achievements" (Melloni, Stacchezzini and Lai, 2015, p. 300). Impression management may be associated with an inaccurate view of organisational outcomes and/or an accurate, but favourable, view of organisational outcomes, as summarised in the following image.

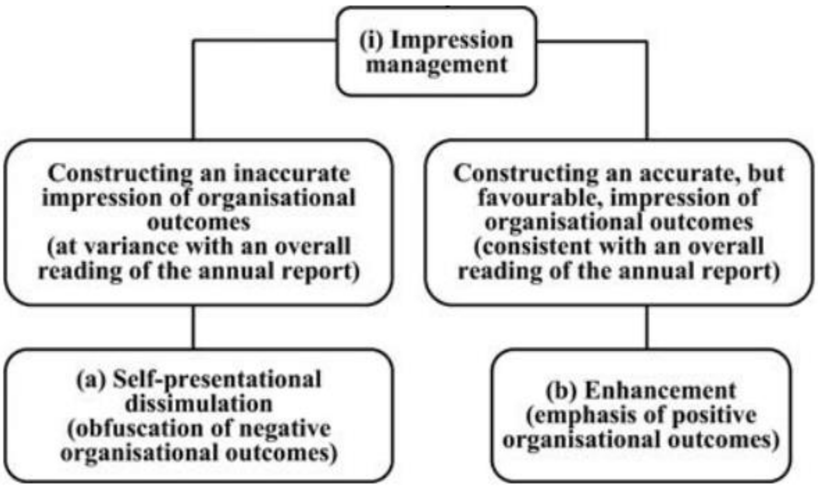

Figure 2.5: Impact of impression management on reporting behaviour (adapted from Merkl-Davies, Brennan and McLeay, 2011, p. 322)

Merkl-Davies and Brennan (2007) identified seven impression management strategies, split into two types of behaviour: concealment – by obfuscating negative outcomes or emphasising the positive ones – and attribution. Concealment strategies aimed at obfuscating bad news include making text more difficult to read and using persuasive language. On the other hand, concealment strategies to emphasise good news include thematic manipulation, visual and structural manipulation (i.e. how the information is presented), and choosing benchmarks and earnings number to portray performance in the best way possible.

The second type of impression management behaviour, attribution, is related to "a tendency to claim more responsibility for successes than for failures" (Merkl-Davies and Brennan, 2007, p. 126). This behaviour applied to annual reports results in often attributing positive outcomes to internal factors (e.g. strategy, including new products or investments, or management skills) and negative results to external factors (i.e. events outside the company, such as competition, economic factors and regulation), aiming at improving stakeholders' perceptions of an organisation. Several papers found empirical evidence supporting this attribution strategy, such as those studying letters to shareholders in annual reports (Bettman and Weitz, 1983; Staw, McKechnie and Puffer, 1983; Salancik and Meindl, 1984). In alignment with the attribution strategy, Baginski, Hassell and Hillison (2000), found that attributions were provided in 65.4% of the 2,085 management forecasts coded in their research, which evidences that this impression management strategy is often employed. All these impression management strategies, as structured by Merkl-Davies and Brennan (2007), are summarised in the next image.

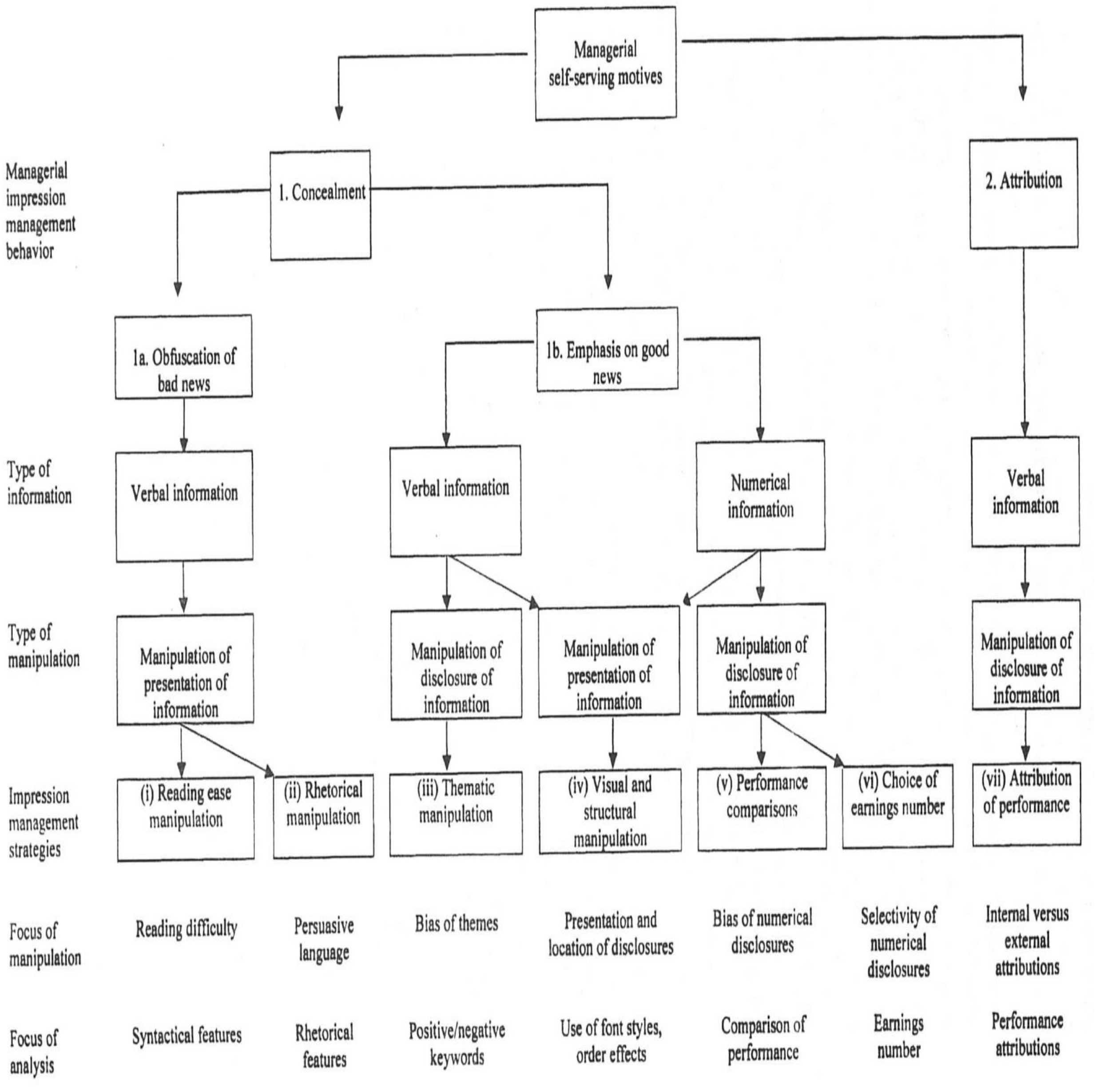

Figure 2.6: Impression management strategies (Merkl-Davies and Brennan, 2007, p. 128)

Associating the attribution strategy with different types of disclosure, considering the practice of attributing bad performance to external factors, one could expect an increase in the volume of disclosure on contextual factors, when performance is not favourable. This argument is discussed in the fourth chapter, mainly as part of the discussion on the hypotheses covering ratio of general to total disclosure (section 4.4).

2.5 Empirical literature review

GHG emissions risk disclosure is included in environmental disclosure as well as in risk disclosure. This section presents a review of empirical papers testing determinants of these two kinds of disclosure, especially relying on papers on environmental disclosure, which has been analysed since 1970s when the field of social and environmental accounting started (Parker, 1986).

This section particularly focuses on performance, risk and media visibility as determinants of environmental and risk disclosures, in studies following a cross-sectional timeframe. Performance is intrinsically related to risk. In addition, the literature investigating the relationship between environmental performance and disclosure is considerably more comprehensive than on the relationship between risk and disclosure, thus providing important findings on legitimacy and economic aspects impacting on the different types of disclosure.

2.5.1 Determinants of environmental disclosure

This sub-section discusses the cross-sectional relationship between determinants and disclosure at GHG emissions level, then moving to climate change level and finally expanding to an environmental level, which refers to most of the papers discussed here. All studies mentioned in this section are included in the literature review summary table, in Appendix 9.1. As presented in sections 2.2 and 2.3, several proxies have been used for the constructs discussed here, which partially explains the mixed results, in conjunction with differences in sampling (company country, industry and sizes), timeframe and analysis methods.

2.5.1.1 Environmental performance

The relationship between environmental performance and environmental disclosure has been intensively tested since 1980s, in a context of heightened society expectations exacerbated by major environmental incidents (e.g.: Bhopal chemical release in 1984; Exxon Valdez oil spill in 1989), when social responsibility disclosures were mainly voluntary and unaudited. From competing hypotheses based on legitimacy and voluntary disclosure theories, more recent papers have employed both theories in a complementary manner, also moving towards investigating different types of disclosure within environmental disclosure (e.g. quantitative vs non-quantitative information). Nevertheless, results are still inconclusive.

GHG emissions performance is part of climate change performance – together with energy consumption, including energy from renewable sources – which in turn is part of the broader environmental performance. Due to the importance of GHG emissions in company's overall environmental performance, some studies have used GHG emissions as a proxy for environmental performance (Baalouch, Ayadi and Hussainey, 2019; Freedman and Jaggi, 2011). Other proxies for environmental performance include scores provided by third parties, such as the Council on Economic Priorities (CEP, employed by Ingram and Frazier, 1980; Freedman, Martin and Wasley, 1990; Rockness, 1985; Wiseman, 1982), KLD strengths (Cho, Roberts and Patten, 2010; Dawkins and Fraas, 2011; Peters and Romi, 2014), Thomson Reuters ASSET4 (Baalouch, Ayadi and Hussainey, 2019) and Trucost ratings (Dawkings and Fraas, 2011). Recent studies have often used more specific environmental performance indicators, such as the amount of emissions and waste generated, most of them publicly available on corporate websites, annual reports, on CDP and on government websites (e.g. in the U.S., major stationary sources of GHG emissions, such as power plants, have reported their GHG emissions to the EPA since 2010). Starting from 2000, the Global Reporting Initiative (GRI) voluntary reporting standards have provided performance indicators related to every environmental aspect, such as GHG emissions, materials used, energy consumption, water withdrawal and significant spills, facilitating comparison between companies publishing GRI sustainability reports.

No paper has been found in the literature testing the relationship between GHG emissions performance and GHG emissions risk disclosure. Therefore, this sub-section approaches this potential association in other levels, considering that GHG emissions is a topic in climate change, which in turn is part of the environmental discipline, which is included in sustainability. The mixed results may be related to differences in these levels of construct for performance and for disclosure. Details of the measures employed are available in the summary table in Appendix 9.1, while a discussion of the findings is presented in the next paragraphs.

The papers reviewed in this sub-section are divided into eight groups, based on the level of the proxies for performance and disclosure (i.e. whether at GHG emissions, climate change, environment or sustainability level). When the proxy adopted does not match the construct that is intended to measure (e.g. using a performance measure, such as carbon-intensity, to proxy for risk exposure; or a climate change disclosure measure, such as CDP responses, to proxy for GHG emissions disclosure), papers will be categorised following the measures used, not the intention. The idea to divide this section into the following groups was inspired by Hummel and Schlick's (2016) advice on proxies for disclosure and performance capturing similar content, which is clearly not the case in most of the papers. Papers will be discussed in this section according to the following order of relationships:

a) sustainability performance and climate change risk disclosure
b) GHG emissions performance and GHG emissions (carbon) disclosure
c) GHG emissions performance and climate change disclosure
d) environmental performance and climate change disclosure
e) GHG emissions performance and environmental disclosure
f) GHG emissions performance and sustainability disclosure
g) environmental performance and environmental disclosure
h) sustainability performance and sustainability disclosure.

The following diagram presents the relationships tested on the papers reviewed in this section. Details of each study are available in Appendix 9.1.

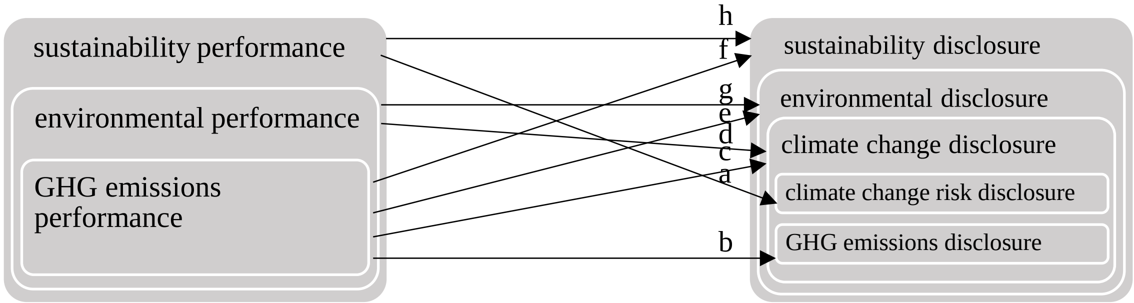

Figure 2.7: Relationships between performance and disclosure in the papers reviewed in this section

In group a), the only paper identified testing the relationship between an environment-related performance measure and climate change risk disclosure was written by Elijido-Ten (2017), who focused on world's largest listed companies. The author examined the association between sustainability performance (whether included in Corporate Knights list of companies with the best capabilities to manage sustainability risks, which could be seen as a contentious measure of performance) and the recognition of climate change related risks (whether a company acknowledges current or anticipated risks from climate change, based on CDP questionnaires). Although mainly relying on dichotomous variables, the author found that worse performers disclose regulatory risks more often. The study also found a negative relationship between sustainability performance and the amount of climate change risks minus opportunities disclosed on CDP. Based on this finding, Elijido-Ten (2017) argues that when climate change regulation is framed as a risk (i.e. climate change risks exceed climate change opportunities), it could influence the way the issue is perceived, probably leading to a more reactive approach to environmental management and consequently, leading to inferior sustainability performance.

In group b), only one recent study has been identified testing the relationship between GHG emissions performance and carbon disclosure, written by Rohani, Jabbour and Abdel-Kader (2021), focused on UK companies. The authors adopted a novel approach for disclosure: measuring density of carbon-related information, which is the ratio of carbon-related sentences over total number of sentences in sustainability reports or in the CSR section of the annual reports. Although not significant, the relationship is aligned with legitimacy theory: higher carbon-emitters per dollar revenue provide a higher ratio of carbon disclosure.

In group c), nine papers were identified testing the relationship between GHG emissions performance and climate change disclosure. The most common proxies employed are: GHG intensity for GHG emissions performance, and CDP disclosure index for climate change disclosure. In terms of performance, the exceptions are: Luo and Tang (2014) and Wedari, Jubb and Moradi-Motlagh (2021) who measured whether a company lowered its emissions relative to historical levels or other benchmarks, and Giannarakis, Zafeiriou and Sariannidis (2017), who used a binary variable to measure whether a company has incorporated emission reduction initiatives. Exceptions in terms of disclosure are: Freedman and Jaggi (2011) and Wedari, Jubb and Moradi-Motlagh (2021), both using self-constructed unweighted content analysis indices, and Giannarakis, Zafeiriou and Sariannidis (2017), who employed CDP Climate Performance Leadership Index (CPLI) instead of the often used CDP Carbon Disclosure Leadership Index (CDLI), as the former not only considers transparency but also the contribution to climate change mitigation. The following papers support predictions usually associated with legitimacy theory (worse performers, under greater scrutiny, use more disclosure, i.e. higher GHG intensity is associated with higher CDP disclosure score): Lemma *et al.* (2019) and Lemma *et al*. (2020), both focused on South African companies; He, Tang and Wang (2013), studying U.S. companies; and Wedari, Jubb and Moradi-Motlagh (2021), studying Australian companies. While the following papers support predictions from voluntary disclosure theory (i.e. better performers provide more disclosures): Luo and Tang (2014), looking at companies from the U.S., UK and Australia; Guenther *et al.* (2016), investigating world's largest companies, mainly from the U.S. and the UK; Giannarakis, Zafeiriou and Sariannidis (2017), looking at UK companies; and Bui, Houqe and Zaman (2020), looking at U.S. companies only. Freedman and Jaggi (2011) found no association between carbon emission and climate change disclosure. Important to note that Lemma *et al.* (2019; 2020) use GHG intensity as a proxy for carbon-risk exposure, which could justify including them in the next sub-section focused on the relationship between risk and disclosure. However, GHG intensity, as evidenced in the papers discussed in this paragraph, is just a relative measure of performance: instead of employing the absolute number of emissions, it is scaled by revenue, total assets, employees or any other figure to enable comparisons between companies with different sizes.

In group d), two papers have been identified assessing the relationship between environmental performance and climate change disclosure: Dawkins and Fraas (2011), and Peters and Romi (2014), both supporting predictions from voluntary disclosure theory. Significant similarities between these two papers: both relied on CDP disclosure score, focused on U.S. companies and used a third-party score, KLD environmental strengths, although Dawkins and Fraas (2011) combined them with another rating: Trucost total carbon emission.

In group e), five papers have been identified in the literature testing the association between GHG emissions performance and environmental disclosure. All of them employed content analysis indexes to measure environmental disclosures, except for Giannarakis, Konteos and Sariannidis (2014), who used Bloomberg ESG disclosure score. Amongst them, two studies confirmed hypotheses based on legitimacy theory (i.e. worse performers provide more disclosures): Dragomir (2010), focusing on European industry groups; and Braam *et al.* (2016), studying GRI reports from Dutch companies (also included in group g, as water consumption was used as an alternative proxy). Two studies found no significant relationship between GHG emissions performance and environmental disclosure: Baalouch, Ayadi and Hussainey (2019), focusing on French companies, and Giannarakis, Konteos and Sariannidis (2014), focusing on U.S. companies, although the latter found a positive association between the presence of emission reduction initiatives and environmental disclosure. Just Fontana *et al.* (2015) confirmed predictions from voluntary disclosure theory (i.e. better environmental performers provide more disclosures), looking at Italian companies, but only based on the interrelation between company size and environmental performance, otherwise no significant relationship would be found.

In group f), two papers were found testing the relationship between GHG emissions performance and sustainability disclosure, both using Bloomberg ESG disclosure score. Giannarakis, Konteos and Sariannidis (2014), already mentioned in the previous paragraph, found that higher GHG emissions are associated with better ESG disclosure score, looking at U.S. companies, aligned with legitimacy theory. This was challenged by Hassan and Romilly (2018), who found that the relationship carries opposite signs comparing developed with developing countries: higher GHG emissions are associated with more disclosure only in developing countries (aligned with legitimacy theory), while lower GHG emissions are associated with more disclosure in developed countries (aligned with voluntary disclosure theory).

In group g), 27 papers have been reviewed testing the relationship between environmental performance and environmental disclosure. Environmental performance was mainly measured using third-party ratings, such as CEP scores (therefore focusing on U.S. companies only) and

KLD scores, and specific environmental aspects (e.g. chemicals released). Amongst the papers, 26 out of 27 used content analysis indexes to measure environmental disclosure, some of them awarding more points to quantitative/specific information, with the exception of de Villiers and van Staden (2011) who measured number of sentences in environmental disclosures. Eight studies failed to clearly document a relationship between environmental performance and environmental disclosure: Cong and Freedman (2011); Dobler, Lajili and Zéghal (2015), Fekrat, Inclan and Petroni (1996); Freedman and Jaggi (1982); Freedman and Wasley (1990); Ingram and Frazier (1980); Rockness (1985) and Wiseman (1982).

Still in group g), amongst the studies testing the relationship between environmental performance and environmental disclosure, twelve papers found evidence confirming predictions based on legitimacy theory (i.e. worse performers use more disclosures). Most of them focused on U.S. companies, which is the case of the papers written by Aerts and Cormier (2009), Cho and Patten (2007), Cho and Roberts (2010), Cho *et al.* (2012), de Villiers and van Staden (2011), Guidry and Patten (2012), Hughes, Anderson and Golden (2001), Hughes, Sander and Reier (2000) and Patten (2002). However, the negative relationship was also evidenced amongst Dutch companies (Braam *et al.,* 2016), Australian companies (Clarkson, Overell and Chapple, 2011) and European companies (Dragomir, 2010). Differentiation between voluntary and mandatory disclosure has also been intensified. In this sense, Hughes, Sander and Reier (2000) and Hughes, Anderson and Golden (2001) found that poor performers disclose more mandatory information than better performers, while no difference has been found in voluntary disclosures.

Still in the group g), six studies testing the relationship between environmental performance and disclosure found a positive relationship, aligned with voluntary disclosure theory. Similarly with the negative relationship discussed above, most studies are focused on U.S. companies (Al-Tuwaijri, Christensen and Hughes, 2004; Clarkson *et al.*, 2008; Radu and Francoeur, 2017; Tadros and Magnan, 2019), except for Baalouch, Ayadi and Hussainey (2019) who focused on French companies, and Meng *et al.* (2014), studying Chinese companies.

In terms of quality of disclosure, Clarkson *et al.* (2008) found that poor environmental performers score significantly lower on hard measures (verifiable, difficult to imitate), which was supported by Meng *et al.* (2014) and contradicted by Clarkson, Overell and Chapple (2011), by Braam *et al.* (2016) and by Tadros and Magnan (2019). Regarding soft disclosures, Aerts and Cormier (2009) found that worse environmental performance is associated with more social-based environmental disclosure (e.g. environmental management, as opposed to economic-based disclosures, such as expenditures and pollution abatement), which was confirmed by Meng *et al.* (2014). Clarkson *et al.* (2008) also found that the ratio of “soft” (unverifiable) disclosures to total disclosures, considered a proxy for legitimisation, is higher for poor performers and for companies with negative coverage on the media, evidencing that companies adopt a defensive approach (i.e. intensifying disclosure of low proprietary costs) when under greater pressure.

Still in group g), Cho, Roberts and Patten (2010) followed a different route, assessing tone of voice in environmental disclosures from U.S. companies, finding that worse environmental performers exhibit significantly less certainty and more optimism than better performers. This result was challenged by Tadros and Magnan (2019), who found a positive relationship between performance (measured based on KLD ratings) and the presence of positive/neutral disclosures, also studying U.S. companies.

In the last group, h), Hummel and Schlick (2016) found a negative relationship between sustainability performance and low-quality sustainability disclosure, and a positive association between sustainability performance and high-quality disclosure, arguing that legitimacy and voluntary disclosure theories in conjunction explain these relationships. The study was focused on European companies and both disclosure and performance measures were based on GRI.

As it was clear in the previous paragraphs, the relationship between performance and disclosure has still delivered mixed results. However, contradictory results are more frequent with broader constructs (i.e. environmental disclosure as opposed to climate change disclosure) and when different levels of performance and disclosure are tested (e.g. GHG emissions performance and environmental disclosure, instead of GHG emissions performance and GHG emissions disclosure), which justifies Hummel and Schlick's (2016) advice saying that proxies for disclosure and performance must capture similar content. The trend to use both social-political and economic theories to explain the results, as observed in more recent papers, is also aligned with Hummel and Schlick (2016, p. 470): "The two theories [(legitimacy and voluntary disclosure)] are not mutually exclusive but dovetail to explain sustainability reporting behaviour".

2.5.1.2 Environmental risk

No paper has been found in the extant literature testing the relationship between GHG emissions risk and GHG emissions risk disclosure. For this reason, this sub-section focuses on papers testing the relationship between environmental risk and environmental disclosure, as they encompass GHG emissions.

Similarities were found in the first two studies identified in the literature assessing the potential relationship between environmental risk and environmental disclosure, including one of the authors involved (Bewley and Li, 2000; Li, Richardson and Thornton, 1997). The similarities include that both studies: 1) developed hypotheses based on voluntary disclosure theory, as environmental exposure could impact on managers' decision regarding the threshold level of disclosure, 2) focused on Canadian companies, 3) used content analysis indices to measure environmental disclosure (the first, checking whether information on specific environmental incidents have been disclosed, while the second one uses a weighted index), 4) used pollution propensity as the risk aspect (industry membership or participation in government pollution programmes), and 5) found a positive relationship between pollution propensity and environmental disclosure. In other words, the higher the environmental risk, the higher the extent of environmental disclosure, which was evidenced to be valid for total disclosure, financial and non-financial disclosure (Bewley and Li, 2000).

As opposed to the studies discussed above adopting measures of pollution propensity that are not company-specific, Dobler, Lajili and Zéghal (2015) measured each company's environmental risk, based on the information disclosed in 10-K forms, being "the first to use firm-level environmental risk variables to explain the level of corporate environmental disclosures" (p. 301). Focusing on U.S. companies and using a content analysis index to measure environmental disclosure, they also found a positive relationship between environmental risk and environmental disclosure, which holds when splitting disclosure items into economic-based and management-related disclosure. Their findings confirmed the hypothesis based on legitimacy theory, as environmental risk was defined as the "environmental threats under which a firm operates and that expose firms to public pressure in regard to environmental concerns" (Dobler, Lajili and Zéghal, 2015, p. 303).

In summary, a positive association has been found in the three empirical papers reviewed testing the relationship between environmental risk and environmental disclosure (i.e. companies with higher risk provide more disclosures), considering extension and quality of disclosure, evidenced by the papers using weighted content analysis indices (which considers not only the amount of items disclosed but the specificity in each item). These results could be explained based on legitimacy theory, arguing that higher-risk companies are under greater pressure from society and therefore, use more disclosure to protect their legitimacy.

2.5.1.3 Media visibility

Similarly to risk and performance, the association between media visibility and disclosure also supports interpretation from legitimacy theory and voluntary disclosure theory. As mentioned earlier, according to legitimacy theory, disclosure is a function of social and political pressures, as far as company's information is publicly available. The higher a company's media visibility, the higher its public scrutiny and, consequently, more extent disclosure is expected as an effort to enhance legitimacy. On the other hand, the higher the media visibility, the higher stakeholders' knowledge about the company, increasing their expectation for information and elevating the "threshold level of disclosure" (Verrecchia, 1983, p. 179).

As mentioned earlier, media visibility has been used as a proxy for company's exposure to public scrutiny (Al-Tuwaijri, Christensen and Hughes, 2004), for society awareness about a company's activities (Bewley and Li, 2000; Li, Richardson and Thornton, 1997; Tadros and Magnan, 2019), for community concerns (Deegan and Rankin, 1996), for environmental legitimacy (Aerts and Cormier, 2009) and for political costs (Gamerschlag, Möller and Verbeeten, 2010).

Media channels perform a key role in making some companies more visible to the public than others and informing the society about their activities, as when company's information is not available, stakeholder would struggle to judge company's alignment with society's expectations. Media coverage may motivate public concern, threatening a company's legitimacy. Companies that are more visible may attract more attention from several stakeholders who will try to influence companies' performance, including pressure groups (e.g. environmentalists) and political groups, increasing their chance of being target of actions such as consumer boycott and lobby for the nationalisation, expropriation or regulation of an industry or corporation. As summarised by Gamerschlag, Möller and Verbeeten (2010, p. 237): "They [visible companies] are potentially subject to higher political or societal costs as a result of their exposed position in the public". Sustainability disclosure and social responsibility disclosure in the media could help reduce the likelihood of adverse political actions, and consequently political costs, which include taxes, regulation and legal costs to oppose the political actions (Watts and Zimmerman, 1978).

Several studies have found positive associations between environmental media visibility and environmental disclosure (Aerts and Cormier, 2009; Bewley and Li, 2000; Li, Richardson and Thornton, 1997; Tadros and Magnan, 2019). This positive relationship was also confirmed between climate change media visibility and the presence of climate change disclosure on CDP (Dawkins and Fraas, 2011), and between media visibility and the quality of climate change disclosure on CDP (Tavakolifar *et al.,* 2021). In addition, climate change media visibility was also found to moderate the relationship between environmental performance and voluntary climate change disclosure (Dawkins and Fraas, 2011), suggesting that companies with lower visibility are less likely to provide disclosures.

In terms of types of environmental disclosure, environmental media visibility was found to be positively associated with hard disclosures (Tadros and Magnan, 2019), and both hard and soft disclosures (Aerts and Cormier, 2009). Tadros and Magnan (2019) found that quality of annual report environmental disclosures (i.e. presence of hard disclosures) is positively associated with environmental legitimacy, measured using Janis-Fadner coefficient of imbalance, categorising news articles as neutral, negative or positive (i.e. companies with more favourable media coverage on environmental aspects provide higher-quality disclosures). On the other hand, unfavourable media coverage on environmental aspects is associated with a higher ratio of soft to total disclosure, considered a proxy for legitimisation (Clarkson *et al.*, 2008).

2.5.1.4 Other determinants

Several factors impact on company's decision to disclose and the level of disclosure. As mentioned in Section 2.1, Adams (2002) identified three groups of factors impacting on sustainability disclosure: corporate characteristics, contextual factors and internal organisational factors. This sub-section provides an overview on the determinants of environmental disclosure other than the ones discussed in the previous sub-sections (namely environmental performance, environmental risk and media visibility), following the categorisation suggested by Adams (2002).

Amongst the corporate characteristics that influence environmental disclosure, company size and industry are apparently the most often tested, followed by financial performance measures. Papers have evidenced significant relationships between company specific determinants and GHG emissions disclosure, including corporate size, market capitalisation, profitability and industry (Chithambo and Tauringana, 2014; Prado-Lorenzo *et al.,* 2009; Saraswati, Amalia and Herawati, 2021). The same applies to climate change risk disclosure, which was found to be positively associated with company size and financial performance, and negatively associated with level of indebtedness (Kouloukoui, Marinho *et al.*, 2019). In terms of nature of carbon disclosure, companies in carbon-intensive sectors were found to use more substantive (action) disclosures, while those in the less intensive sectors provide higher levels of symbolic (rhetorical) disclosure (Hrasky, 2012). Hrasky (2012) also measured a specific category of carbon disclosure based on general statements related to carbon footprints but not directly related to the company, which was used six times more by companies in carbon-intensive sectors. This disclosure category will be employed in this research, as it will be explained in Section 5.4.2.

Regarding contextual factors, country and pressure from stakeholders have often been found to influence disclosure. Environmental disclosure is considered country-specific, as it depends on the legal, social, financial, cultural and political context in which a company operates (Adams and Kuasirikun, 2000; Barbu *et al.*, 2012), which was also evidenced in climate change risk disclosure (Kouloukoui *et al.*, 2019). This is illustrated by the fact that countries ratifying the Kyoto Protocol and setting emission limits have been found to be positively related with global warming disclosure (Freedman and Jaggi, 2011). In addition, international presence is found to have a significant positive influence on sustainability risk disclosure (Truant, Corazza and Scagnelli, 2017). Another contextual factor, pressure from stakeholders influencing climate change disclosure include institutional investor expectations (Cotter and Najah, 2012) and shareholder activism (Reid and Toffel, 2009), as well as environmental group membership impacting on environmental disclosure (Deegan and Gordon, 1996).

Looking at internal organisational factors, there are several studies exploring the effects of corporate governance mechanisms on environmental disclosure. In terms of board composition, the number of members in the board was found to explain the level of climate risk disclosure (Kouloukoui *et al.,* 2018), while the presence of a Chief Sustainability Officer and an environmental committee was positively associated with GHG disclosure transparency (Peters and Romi, 2014). In addition, a positive association has been found between GHG disclosures and board gender diversity (Tingbani *et al.*, 2020), reiterated by the fact that companies with the presence of multiple female directors on the board were found to be more likely to provide higher quality GHG emissions disclosures (Hollindale *et al.,* 2019). Similarly, the presence of female members in the audit committee has been found to be positively associated with the level of environmental disclosure (Wang and Sun, 2021). Climate change governance (board responsibility, executive incentives, frequency of carbon reporting etc) is not only positively related with carbon disclosure, but it was also found to moderate the relationship between performance and disclosure, "reducing managerial discretion over carbon disclosure" (Bui, Houqe and Zaman, 2020, p. 13).

2.5.2 Determinants of risk disclosure

Similar to Adams' (2002) categories of factors impacting on sustainability disclosure, literature has evidenced that corporate characteristics (e.g. size, industry, financial performance, risk), contextual factors (e.g. disclosure regulation) and internal organisational factors (e.g. governance) are also associated with risk disclosure.

There is extensive evidence that company size is associated with risk disclosures (Elzahar and Hussainey, 2012; Linsley and Shrives, 2006; Neri, Elshandidy and Guo, 2018; Wachira, 2018), mainly supporting that larger companies provide higher levels of risk disclosure. Previous papers also documented significant relationship between industry membership and risk disclosure, finding that industrial companies disclose more risk information than service companies in the UK (Elzahar and Hussainey, 2012) and that manufacturing companies provide more disclosures than other industries in Japan (Cooke, 1992), although non-significant relationships between risk disclosure and industry have also been evidenced (Abraham and Cox, 2007).

The papers employing risk as potential determinants of risk disclosure are included in the empirical review summary table, in Appendix 9.1. Important to note the distinct interpretation of some accounting measures, comparing studies from the environmental disclosure field and from the risk disclosure field. In environmental disclosure studies, leverage is usually used as a control variable associated with voluntary disclosure theory (Clarkson *et al.*, 2008; Guidry and Patten, 2012) or associated with pressure from providers of capital (Liesen *et al.*, 2015). On the other hand, in risk disclosure studies, accounting measures (e.g. leverage, current ratio) are considered proxies for risk (Elshandidy, Fraser and Hussainey, 2013; Linsley and Shrives, 2006), for example, leverage as a proxy for financing risk, liquidity ratios for liquidity risk etc.

Focusing on company risk as a determinant of quantity of risk disclosures, some studies have found positive associations (Abraham and Cox, 2007; Elshandidy, Fraser and Hussainey, 2013), while other studies have yielded non-significant associations (Elzahar and Hussainey, 2012; Linsley and Shrives, 2006; Neri, Elshandidy and Guo, 2018), as detailed in the next paragraph. The exception is a negative association found between environmental risk (collected from Innovest EcoValue'21™ Ratings) and risk disclosures in the UK (Linsley and Shrives, 2006), indicating that companies with lower environmental risk provide more risk disclosure sentences.

Amongst the papers evidencing a positive relationship between risk and risk disclosure, Elshandidy, Fraser and Hussainey (2013) found a positive association between both systematic (beta) and financing risks (leverage) and total and voluntary risk disclosures. In addition, Neri, Elshandidy and Guo (2018) found that book to market ratio is positively associated with quantity of risk disclosures, and also with the number of sentences containing qualitative as well as quantitative risk disclosure. Abraham and Cox (2007) found a positive association between risk, measured by the variance of stock returns, and quantity of risk disclosures in the UK, although the relationship between leverage and risk disclosures is not significant. Amongst the papers finding non-significant associations, Linsley and Shrives (2006) found non-significant results when testing the relationship between number of sentences in risk disclosures and the following proxies for company risk: beta factor, gearing ratio (leverage), asset cover, quiscore and book to market value of equity. These insignificant results were confirmed by Neri, Elshandidy and Guo (2018) for leverage and beta factor, and by Elzahar and Hussainey (2012) for gearing ratio (proxy for financing risk) and liquidity (proxy for liquidity risk). Moving to risk as a predictor of quality of risk disclosure, Neri, Elshandidy and Guo (2018) found that leverage and beta are associated with quantitative risk disclosure (positive for beta, negative for leverage).

Governance factors have also been tested as determinants of risk disclosure. Previous studies found that board size and board independence are associated with quantity of risk disclosure (Abraham and Cox, 2007; Beretta and Bozzolan, 2004; Elshandidy, Fraser and Hussainey, 2013), as well as quality of risk disclosure, which is also valid for audit quality as a predictor of risk disclosure (Neri, Elshandidy and Guo, 2018). While CEO duality (i.e. CEO is also the Chairman of the Board) seems to not impact on risk disclosures (Elzahar and Hussainey, 2012; Neri, Elshandidy and Guo, 2018).

2.6 Gaps in the literature

Academic papers on climate change risk disclosure are scarce, as discussed in Section 2.2.1. This occurs despite of the fact that social accounting was a hot-topic in the 1970s and early 1980s and re-emerged in the 1990s (Deegan, 2002), in addition to an increasing number of articles on carbon disclosure published in 2008 and 2012 as an impact of the Kyoto Protocol, and in 2015, as a result from the Paris Agreement (Borghei, 2021).

The relationship between risk and disclosure has been recently investigated, both in the risk disclosure literature and in the environmental disclosure literature and only one paper has been found in the intersection between both fields, testing the relationship between environmental risk and risk disclosure (Linsley and Shrives, 2006). The relationship between environmental disclosure and a company-specific measure of environmental risk was tested for the first time only less than a decade ago (Dobler, Lajili and Zéghal, 2015), confirming predictions from legitimacy theory, while two other studies tested the relationship with a non-specific risk exposure measure (Bewley and Li, 2000; Li, Richardson and Thornton, 1997). In the risk disclosure literature, different measures have been used to proxy for company risk (e.g. leverage, beta factor) and their relationship with risk disclosure is still inconclusive, yielding positive associations (Abraham and Cox, 2007; Elshandidy, Fraser and Hussainey, 2013) and non-significant associations (Elzahar and Hussainey, 2012; Linsley and Shrives, 2006; Neri, Elshandidy and Guo, 2018). In addition, no study has been found testing the association between disclosure and a company-specific measure of risk management, which could contribute to advance knowledge in this field.

Moving to environmental disclosure, which encompasses climate change disclosure, although it has been intensively investigated since early 1980s, there are still gaps in the literature. These gaps are evidenced by the mixed results, especially regarding the association between disclosure and performance, and by the inconsistent application of socio-political and economic theories. Measuring total environmental disclosure have delivered mixed results, both using word/sentence/line count – no significant relationship between disclosure and performance in Wiseman (1982) and negative relationship in Patten (2002) – and using content analysis indices – examples of negative associations, aligned with legitimacy theory, in Cho *et al.* (2012) and Patten (2002), and positive associations in Al-Tuwaijri, Christensen and Hughes, (2004), Clarkson *et al.* (2008), Dawkins and Fraas (2011), and Peters and Romi (2014). In order to clarify these mixed results, environmental disclosure literature has moved the focus towards different kinds of disclosure referencing a company's activities, such as management-related (soft) vs economic-based (hard) disclosures (Clarkson *et al.*, 2008), however mixed results still persist. On the other hand, disclosure not referencing a company's activities was rarely measured in the environmental disclosure literature, with only two papers identified in this regard: Ingram and Frazier (1980) and Hrasky (2012). This type of disclosure, not mentioning a company's activity, was acknowledged but not measured in the risk disclosure literature (Abraham and Cox, 2007; Elzahar and Hussainey, 2012; Linsley and Shrives, 2006).

Examples of gaps in the environmental disclosure literature include whether more extensive disclosures would be provided by poor environmental performers as an attempt to maintain their legitimacy (Patten, 2002) or by good performers, as a differentiation tool (Al-Tuwaijri, Christensen and Hughes, 2004; Clarkson *et al.*, 2008). Also, there is no clarity on whether weak environmental performers would use more quantifiable disclosures than their peers as a legitimation effort (Clarkson, Overell and Chapple, 2011; Braam *et al.*, 2016; Tadros and Magnan, 2019) or whether poor performers would use more non-quantifiable disclosures, with reduced proprietary costs (Aerts and Cormier, 2009). Gaps like these illustrate how difficult it has been to assess a company's environmental performance based on its disclosure, hindering using information to help directing investments to less-polluting companies and exerting pressure on the most polluting ones.

The reviewed papers demonstrate that further investigation is necessary to clarify the determinants of disclosure in the environmental and risk disclosure fields, including exploring different types of disclosure using more focused contexts (i.e. GHG emissions vs environment in general).

3 Industry reports on climate change disclosure

Climate-related disclosure has been highly-demanded due to several reasons, such as the intensification of the physical effects from climate-change (e.g. water scarcity, extreme temperatures), the impressive amounts involved in climate-related financial risks, activism directed to reduce investments in high-emission companies, media exposure and regulation, the latter being considered the main reason behind the increase in disclosure of non-financial information globally (EY, 2020). In 2020, most companies worldwide set targets to reduce their GHG emissions and approximately 40% of them acknowledged climate change as a financial risk (KPMG, 2020a).

Regarding the structure of this chapter, the first sub-section presents the main aspects of U.S. Stock Exchange regulation driving mandated climate change disclosure, followed by key international initiatives driving voluntary disclosure on climate change. These two initial sub-sections compose the foundation to understand the current state of climate risks disclosure in mandated and voluntary reports, in the U.S. and globally, which is discussed in the third sub-section, concluding with the industry gaps.

3.1 SEC regulation on climate change risk disclosure and the notion of materiality

SEC first addressed environmental disclosure in early 1970s, when registrants were informed that they should consider disclosing "the financial impact of compliance with environmental laws, based on the materiality of the information" (SEC, 2010, p. 10). Information is considered material if "a reasonable investor would consider it important in deciding how to vote or make an investment decision" (SEC, 2010, p. 11), which clearly carries a certain level of subjectivity, which is argued as preventing coherence in environmental reporting (Dimitt, 2009). The U.S. Stock Exchange sets disclosure requirements prohibiting companies from making false statements or omitting material information, and its staff reviews every public company's financial reports at least once every three years. The subjectivity around what would be considered material enough to be disclosed is seen as a major barrier to provide reliable climate change disclosure. Therefore, regulators have been urged to clarify the definition of materiality (Climate-Related Market Risk Subcommittee, 2020).

In response to institutional investors and simultaneously with new regulatory developments (EPA began to require large emitters of greenhouse gases to report their emissions), in 2010 SEC issued the Commission Guidance Regarding Disclosure Related to Climate Change, or simply the

Climate Change Guidance (SEC, 2010). This Guidance was an interpretive release aiming at clarifying how the existing disclosure requirements apply to climate change. With respect to the Risk Factors section in Form 10-K, the 2010 Climate Change Guidance reiterated that a discussion of the most significant risk factors should be provided; risks should be clearly stated, specifying how they affect the company; and risks that could apply to other companies should not be presented (SEC, 2019b). In addition, SEC recommended that risks are presented in a concise and logical manner, avoiding "boilerplate" risk factors, as "a discussion of risk in purely generic terms does not indicate how a risk may affect an investment in a particular registrant" (SEC, 2016). As it will be discussed in the sub-section on the current state of disclosures, these recommendations have clearly not been effective. A summary of SEC Climate-Related Disclosure Requests is presented in the timeline below, including the ones discussed above.

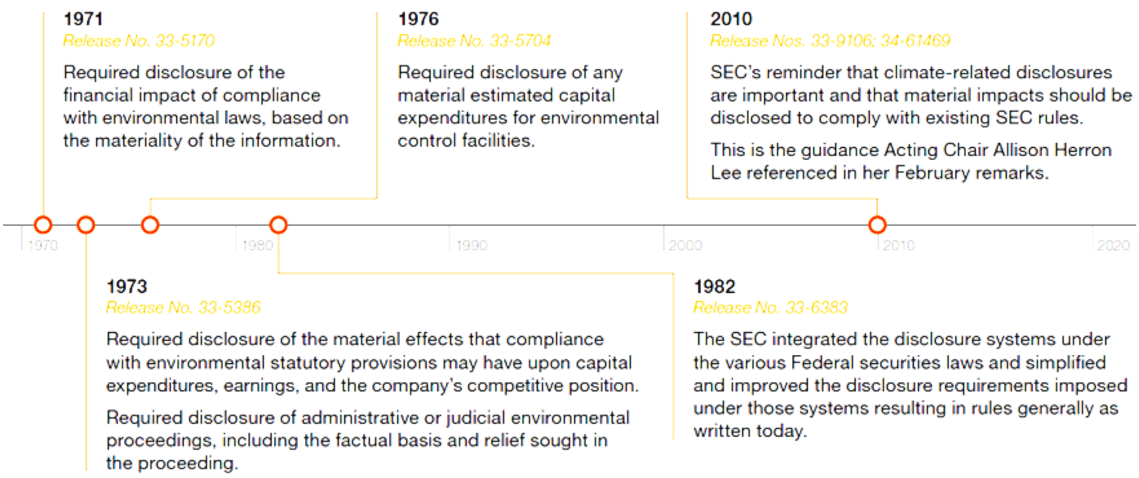

Figure 3.1: Timeline of SEC Climate-Related Disclosure Requests (PWC, 2021)

In August 2019, SEC proposed improvements in the quality of disclosure, in order to "address the lengthy and generic nature of the risk factor disclosure presented by many registrants" (SEC, 2019a, p. 65), acknowledging that although risk factor disclosures have increased, it is not necessarily associated with better disclosure. For the Risk Factors section, SEC proposed: 1) a summary when the section exceeds 15 pages, 2) changing from the "most significant" factors to the "material" factors, and 3) organising risk factors under relevant headings (such as market risk, environmental risks etc), with risk factors generally applicable to an investment in securities disclosed at the end of the section, under a separate heading. The August 2019 proposal was approved in August 2020, intended to obtain disclosures that are "tailored to reflect registrants' particular circumstances [… and] to improve the readability of disclosure documents, as well as discourage repetition and reduce the disclosure of information that is not material" (SEC, 2020b). These new rules are expected to indirectly enhance climate change risk disclosure, however this approach of not directly tackling climate change, considered "the single most momentous risk to face markets since the financial crisis", has been criticised (Lee, A., 2020).

In response to these calls for more specific regulation on climate change disclosure, SEC has worked towards updating its 2010 Climate Change guidance. In March 2021, SEC started a formal process to receive public input on climate change disclosures, which included questions such as "What information related to climate risks can be quantified and measured?" and "How can the Commission best regulate, monitor, review, and guide climate change disclosures in order to provide more consistent, comparable, and reliable information for investors while also providing greater clarity to registrants as to what is expected of them?" (SEC, 2021). In March 2022, SEC proposed rules to enhance and standardise climate-related disclosures, requiring listed-companies to disclose information about governance of climate-related risks, risk management processes, how climate-related risks have affected the company and the impact of climate-related events on financial statements, in addition to scope 1 and 2 GHG emissions (SEC, 2022b), following TCFD recommendations. The comment period ended in June, with huge participation from several stakeholders (SEC, 2022a), including opposing opinions arguing that with the proposal, SEC "exceeds its statutory" and "prioritises the demands of a subset of America's investment industry" (Cunningham, 2022, p. 17) and "threatens to impose massive, widespread costs on U.S. public companies" for the benefit of a small group (Morrison, 2022, p. 10).

SEC recent regulation efforts on climate change disclosure are aligned with market's expectation, as the Commodity Futures Trading Commission (appointed by the U.S. President) concluded below, in its Climate Subcommittee:

> "Given the disparity in the quality and extent of disclosures under the existing regime, clearer and more consistent guidance as well as mandatory disclosure requirements may be needed for climate risk disclosure that covers materiality assessments." (Climate-Related Market Risk Subcommittee, 2020, p. 92)

3.2 Multi-stakeholder climate change governance

There is a growing demand for climate change information from investors, governments, NGOs, the media, researchers and the society in general. On the other hand, legislation and stock exchange regulation have been insufficient to ensure high quality corporate disclosure on climate change. In this context, several multi-stakeholder international initiatives have been designed towards defining disclosure standards and providing guidance and platforms, aiming at contributing to enhance climate change reporting. Amongst these mechanisms, CDP and the TCFD will be presented in this sub-section, due to their importance and also because they will be mentioned in the next sub-section as a reference to assess quality of climate change disclosure. Details of other climate change governance initiatives are presented in Appendix 9.2, including the Greenhouse Gas Protocol, GRI, the Global Framework for Climate Risk Disclosure, and the Climate Disclosure Standards Board (CDSB).

Founded in 2000, CDP (previously Carbon Disclosure Project) is currently the world's most comprehensive database of self-reported environmental data, mainly focused on climate change, water and forests. CDP provides information from companies, cities and states from over 90 countries (CDP, 2020). Data are gathered through annual information requests and responses are made publicly available on the internet. CDP Climate Change questionnaire contains a specific section on climate change risks and opportunities, with several questions on risk identification, assessment and management, as well as type, likelihood, potential consequence and management method of the climate change risks and opportunities identified. Companies' answers have been used in academic studies as a measure of voluntary climate change disclosure (Dawkins and Fraas, 2011; Elijido-Ten, 2017; Peters and Romi, 2014).

The Task Force on Climate-related Financial Disclosures (TCFD) is a private-sector led taskforce established by the Financial Stability Board (FSB) at the request of G20 Finance Ministers and Central Bank Governors. TCFD is aimed at enhancing disclosures through the existing reporting processes, urging companies to consider short, medium and long-term potential consequences of climate change for materiality assessments. TCFD recommendations, released in 2017, structured climate risk disclosures around four thematic areas: governance, strategy, risk management, and metrics & targets, as detailed in the following figure. TCFD also provides specific guidance for higher-risk sectors, such as energy, transportation, forest products and insurance companies.

Recommendations and Supporting Recommended Disclosures

Governance	Strategy	Risk Management	Metrics and Targets
Disclose the organization's governance around climate-related risks and opportunities.	Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material.	Disclose how the organization identifies, assesses, and manages climate-related risks.	Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.
Recommended Disclosures	**Recommended Disclosures**	**Recommended Disclosures**	**Recommended Disclosures**
a) Describe the board's oversight of climate-related risks and opportunities.	a) Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term.	a) Describe the organization's processes for identifying and assessing climate-related risks.	a) Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process.
b) Describe management's role in assessing and managing climate-related risks and opportunities.	b) Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning.	b) Describe the organization's processes for managing climate-related risks.	b) Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks.
	c) Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.	c) Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management.	c) Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets.

Figure 3.2: TCFD recommended climate-related financial disclosures (TCFD, 2017, p. 14)

Efforts have been devoted to increase alignment between the climate change standards and frameworks. Examples include GRI and CDP developing a guidance in conjunction to avoid duplication (GRI and CDP, 2017), and CDP and CDSB working together to fulfil TCFD recommendations (CDSB and CDP, 2020). Important to note that standard setters have a key role helping regulate global markets, however "it is only when governments mandate disclosure that it becomes widespread, consistent and comparable" (KPMG, 2017, p. 37).

3.3 The current state of climate-related disclosures

> "The vast majority of financial reporting on climate change does not meet SEC [U.S. Securities and Exchange Commission] requirements. Most companies are not discussing company specific material information and are not quantifying risks or past impacts. Most are briefly discussing climate change using boilerplate language of minimal utility to investors, providing few material details about climate risks and opportunities facing them" (Coburn and Cook, 2014, p. 5).

Recent studies have assessed the current practice of climate risk disclosure, mainly motivated by the increasing demand for reliable climate-related information from investors, as illustrated by initiatives such as Ceres Investor Network on Climate Risk and Sustainability, the Network for Greening the Financial System, and the Climate Action 100+. This section presents the results from six studies: four adopting a global approach, respectively developed by KPMG, CDP, FSB TCFD (Financial Stability Board Task Force on Climate-related Financial Disclosures) and EY consulting, and two studies focused on U.S. companies, developed by the environmental NGO

Ceres. In general, findings have demonstrated that the quality of climate-related risk disclosure remains an issue, as highlighted in the quote above and detailed in the next paragraphs.

In a study issued five years after TCFD was established, KPMG (2020b) identified that 56% of the world's 250 largest companies publicly acknowledged climate change as a financial risk in their annual report, being the oil & gas industry the top one in this regard (81%). In terms of country of origin, French and Japanese companies scored the highest (with 94% and 71%, respectively), while only 54% of the U.S. companies amongst the 250 largest companies in the world acknowledged climate change as a financial risk. In terms of the type of climate risk reported, 47% of the largest companies in the world report on both the physical and transitional risks, being this rate 60% for the oil & gas industry. The study also revealed that 19% of the world's largest companies reported a net zero target and 27% report science-based targets, but only 17% described the company's strategy to achieve its decarbonisation targets.

The status of climate-related disclosure has been monitored by CDP, based on the responses to its climate change annual questionnaire. In 2019, 54% of companies confirmed they were exposed to substantive climate-related risks, in a sample with almost 7,000 worldwide responding companies (CDP, 2019). Amongst the risks declared, the number of transition risks (e.g. pricing of GHG emission, regulation on existing products, reporting obligations, customer behaviour) was almost twice the number of physical risks (e.g. precipitation and weather patterns, rising temperatures).

Companies' adherence to TCFD recommended disclosures (see Figure 3.2) has been monitored in two other studies: TCFD Status Report (TCFD, 2019) and EY Global Climate Risk Disclosure Barometer (EY, 2020), the latter also analysing disclosure quality. Both studies assessed financial filings, annual reports, integrated reports, and sustainability reports. Despite differences in the sample, timeframe and method (artificial intelligence vs human-guided analysis), both studies agree that adherence to TCFD's recommendations remains substantially low. Their key findings are aligned: 1) most companies disclosed climate-related information aligned with at least one TCFD recommended disclosure; 2) considering TCFD's 11 recommended disclosures, the least disclosed elements are Strategy (47%) and Risk Management (52%); and 3) information aligned with TCFD is more likely to be found in sustainability reports than in financial filings. In 2020, approximately 37% of the largest 250 companies in the world, and 18% of companies worldwide, reported in line with TCFD recommendations (KPMG, 2020), which evidences a significant progress considering that the recommendations were launched only three years earlier.

Besides coverage, EY Global Climate Risk Disclosure Barometer (EY, 2020) also assessed quality of disclosure, which was measured based on the level of detail provided in each TCFD disclosure item, classified as: 0- not publicly disclosed; 1- limited disclosure, 3- aspect disclosed in detail; 5- addressed all features of the aspect in the disclosure. Additional key findings from EY (2020) study include: 1) most companies are lacking high quality disclosures, with quality of disclosure scored at 26% for Governance, 24% for Strategy, 27% for Risk Management and 31% for Targets and Metrics, 2) the most exposed sectors (mining, manufacturing, transport and energy) scored higher, 3) U.S. companies achieved the highest score on quality of disclosures (63% in the U.S. vs. 27% globally) and showed the biggest year-on-year improvement, which could be attributed to shareholder resolutions and the threat of class action lawsuits (EY, 2020). The UK was the first G20 country to adopt mandatory disclosure for climate-related risks and opportunities, in line with Taskforce on Climate-related Financial Disclosures (TCFD) recommendations, from April 2022 (Gov.UK, 2021).

Two studies specifically focused on climate change disclosures provided by U.S. listed companies, issued by Ceres. In the first study, Coburn, Donahue and Jayanti (2011), state that good disclosure examples were rare, acknowledging that "boilerplate" disclosure are common in SEC filings, while reiterating that specificity and financial data are more valuable for investors. Ceres clarify what composes a good disclosure from the perspective of investors, emphasising the importance of quantification:

> "Good regulatory risk and opportunity disclosure not only describes existing and proposed regulations and the company's positioning, but quantifies the impact to the maximum extent feasible, while assigning a monetary value or a range of possible values to that impact. Quantification maximises the utility of disclosures for analysts and investors, who find it difficult to assess the financial impacts of purely qualitative disclosures" (Coburn, Donahue and Jayanti, 2011, p. 18)

Ceres' second study (Coburn and Cook, 2014) is divided into two parts: firstly, it analyses S&P 500's quality of climate change disclosures in 10-K forms, and secondly, it compares the results with disclosure from the same companies on CDP questionnaires. According to this study, although "more companies are saying something about climate in their 10-K filings […] they are not reporting more useful information. In fact, their disclosures appear to be getting briefer [between 2009 and 2013] and less specific" (Coburn and Cook, 2014, p. 12), which was also acknowledged by SEC (2019a), as mentioned earlier. The study also shows that: 1) voluntary disclosures (CDP) are less variable than mandated disclosures (10-K form); 2) more companies have provided CDP responses than have included climate-related information in their 10-K forms; and 3) voluntary disclosure rate and voluntary disclosure quality followed an upward trend, as opposed to mandated disclosure, for which rate was relatively flat from 2010 to 2013, while quality decreased, despite SEC Climate Change Guidance issued in 2010.

3.4 Industry gaps

> "Today's disclosures remain far from the scale the markets need to channel investment to sustainable and resilient solutions, opportunities, and business models. I believe in the power of transparency to spur action on climate change through market forces." Message from Michael Bloomberg, TCFD Chair (TCFD, 2019, p. i).

Industry reports have evidenced that, although the number of companies disclosing climate-related information has increased, quality of climate-related disclosure in mandated reports has decreased (Coburn and Cook, 2014) and companies are still failing to disclose their environmental risks (TCFD, 2019). Academic researchers have also spotted the current low quality of risk disclosures (lack of coherence, clarity and quantification), limiting their usefulness (Lajili and Zéghal, 2005) and preventing stakeholders to adequately assess companies' risk profiles (Linsley and Shrives, 2006).

If the industry does not close the gap related to quality of climate-related risk disclosure, the enormous potential of action on climate change that market forces could apply (as Michael Bloomberg mentioned in the quote above) would be wasted. In other words, if investors are properly informed about companies' exposure and management of climate-related risks, they will be in a better position to make investment decisions towards more sustainable businesses, directly contributing to tackle the issue of climate change. Similarly, if other stakeholders (such as activists, regulators and media) are properly informed about company's climate-related risks, they can put pressure on polluting companies and investors to speed up the change.

4 Conceptual model and hypotheses

This section presents the conceptual model for this research, building on the literature review and industry reports discussed in the previous chapters. Considering that GHG emissions risk disclosure is included in environmental disclosure and in risk disclosure, the hypotheses were built on empirical papers from these two fields. The model relies on the potential relationship between GHG emissions risk, risk management and media visibility as determinants of GHG emissions risk disclosure, controlling for company size and leverage.

The conceptual framework employs legitimacy theory and voluntary disclosure theory in a complementary way, as observed in recent papers measuring high-quality and low-quality disclosure (Hummel and Schlick, 2016) or employing economic and legitimacy incentives as determinants (Tadros and Magnan, 2019), complemented by impression management. Hypotheses were formulated based on both theories, using different types of disclosure (general vs specific) and determinants (GHG emissions risk, risk management and media visibility) that may be interpreted from both theoretical lenses. For example, according to legitimacy theory, a high-risk company would be under higher pressure from its stakeholders (e.g. coal-based power plants under scrutiny) and would be expected to provide more disclosures, in order to justify its risk level and explain how it manages risk. Conversely, a low-risk company may want to signal its superior risk management using a higher level of disclosure, as posited by voluntary disclosure theory. Similarly, media visibility could be a proxy for public scrutiny (related to a legitimacy threat) and for outsiders' knowledge about a specific company, associated with the information asymmetry between a company and the market. A quick summary of both theories from a disclosure perspective, as discussed in Section 2.2, is presented below.

Table 4.1: Theories employed in the conceptual model applied to disclosure

Legitimacy theory	**Voluntary disclosure theory**
How is disclosure interpreted based on this socio-political theory? Disclosure is a mechanism employed to legitimise corporate actions, reacting to economic, social and political factors (Guthrie and Parker, 1989). Therefore, disclosure should be adjusted to convey that company's operations remain consistent to social expectations (Deegan and Gordon, 1996), contributing to enhance company's legitimacy.	*How is disclosure interpreted based on this economic theory?* Disclosure is a communication tool to reduce information asymmetry with the market. It may represent good news for investors or proprietary costs (Verrecchia, 1983), exposing the company to future litigation or tougher competition (Al-Tuwaijri, Christensen and Hughes, 2004). Disclosure is a manner to demonstrate superior capacity and differentiate a company to its competitors (Clarkson *et al.*, 2008).
Based on this theory, what is the basis for disclosure discretion? • Amount of social and political pressure, as "where there is limited concern, there will be limited disclosures" (Deegan, Rankin and Tobin, 2002, p. 335). Factors that may increase pressure: performance information publicly	*Based on this theory, what is the basis for disclosure discretion?* • Proprietary costs (the cost of preparing and sharing information): the higher the proprietary costs, the greater the discretion (Verrecchia, 1983).

available (Patten, 2002), environmental risk (Dobler, Lajili and Zéghal, 2015), operating in environmentally-sensitive industries (Cho and Patten, 2007), presence of environmentalists (Guthrie and Parker, 1989; Deegan and Gordon, 1996) etc. • Poor performers' intention to appear like better performers (Ingram and Frazier, 1980; Gray, Kouhy and Lavers, 1995).	• Shareholder's expectation and previous knowledge (Dye, 1986; Verrecchia, 1983; Sinclair-Desgagne and Gozlan, 2003). • Intention to reduce information asymmetry between managers and investors. • Intention to demonstrate superior qualities and competence, e.g. expertise to manage environmental risks (Magness, 2010) and stronger environmental performance (Clarkson *et al.*, 2008).
Impression management • An opportunistic behaviour from managers, using the discretion inherent in corporate narrative, to promote a more favourable perception about an organisation by selecting the content and the manner disclosure is presented (Merkl-Davies, D., Brennan and McLeay, 2011).	• Two types of impression management behaviour: concealment – by obfuscating negative outcomes or emphasising the positive ones – and attribution - "a tendency to claim more responsibility for successes than for failures" (Merkl-Davies and Brennan, 2007, p. 126) • Therefore, following the attribution strategy, one could expect an increase in the volume of disclosure on contextual factors, or general disclosure, when performance is not favourable.

The hypotheses that will be presented here posit potential associations between determinants and the presence and different types of GHG emissions risk disclosure. The types of disclosure included in the model follow Ingram and Frazier's (1980) categories of general and specific disclosure, respectively: 1) disclosure not referencing a company's own activities or situation; and 2) disclosure referencing a company's own activities or situation. In addition, based on these two types of disclosure, two other measures were generated: total disclosure (summing up general and specific disclosure) and ratio of general or specific disclosure to total disclosure, as the ratios enable understanding the dynamics between both types of disclosure.

Considering the disclosure types that will be employed in this research, Hrasky (2012) found that carbon-intensive companies use six times more general disclosure, and two times more specific disclosure, in their annual reports than companies in less-intensive sectors. Ingram and Frazier's (1980) tested the relationship between environmental performance and general and specific disclosure, and did not find significant relationships, although results suggest that worse performers provide slightly more disclosures than the better performers in both categories.

Although literature has evidenced that both increasing and reducing volume and specificity of disclosures have been used as legitimation tools (de Villiers and van Staden, 2006), hypotheses were set expecting a positive relationship between legitimacy threats and extent of disclosure (i.e. worse environmental performance associated with increased disclosure). This direction has been selected as it corresponds to the prevalent view in the disclosure literature based on legitimacy theory (Patten, 2002) and it complements predictions from voluntary disclosure theory, which anticipates a positive relationship between environmental performance and disclosure (i.e. better performers disclose more).

In addition to GHG emissions risk, the conceptual model also includes GHG emissions risk management as an alternative determinant. This is intended to address the fact that reducing risk into a linear measure may present problems, as the same value could be associated with distinct contexts in terms of risk exposure, consequence, probability and risk management (Kaplan and Garrick, 1981), as illustrated in Figure 5.3. Risk management and risk exposure (which will be considered in the sample criteria) in conjunction determine the risk level. Thus, for each hypothesis on risk, another hypothesis is set for risk management.

4.1 Hypotheses on the presence of GHG emissions risk disclosure

There is extensive literature arguing that companies with worse environmental performance are under greater scrutiny and consequently, use higher levels of disclosure as a legitimation tool (Aerts and Cormier, 2009; Cho and Roberts, 2010; Cho *et al.*, 2012; de Villiers and van Staden, 2011; Dragomir; 2010; Guidry and Patten, 2012; Hughes, Anderson and Golden, 2001; Hughes, Sander and Reier, 2000; Patten, 2002). Environmental risk has also been used as a proxy for company's exposure to public pressure (Dobler, Lajili and Zéghal, 2015; Semenova and Hassell, 2008) as it is related to the probability of unwanted events, including those with catastrophic consequences, which could be seen as a misalignment with society's value system.

Considering high GHG emissions risk or weak GHG emissions risk management as potential legitimacy threats, which would motivate increased disclosure to protect legitimacy, it is hypothesised that:

> H_{1a}. *The likelihood of disclosing a GHG emissions risk in a company's annual report is higher for companies with higher GHG emissions risk.*

> H_{1b}. *The likelihood of disclosing a GHG emissions risk in a company's annual report is higher for companies with weaker GHG emissions risk management.*

The hypotheses above are also aligned with the notion of materiality, that drives mandated disclosures, as the higher the risk level, the higher the probability or the consequence of the risk, and therefore, the higher the costs potentially involved. As listed-companies could be penalised if they do not disclose material information, no hypothesis has been set based on voluntary disclosure theory on the presence of GHG emissions risk disclosure, as it would posit that lower risk (less material) would be associated with greater probability of disclosure.

Media visibility has been used as a proxy for company's exposure to public scrutiny (Al-Tuwaijri, Christensen and Hughes, 2004), for society awareness about a company's activities (Tadros and Magnan, 2019) and for community concerns (Deegan and Rankin, 1996). According to legitimacy theory, disclosure is a function of social and political pressures, as far as company's information is publicly available. The higher a company's media visibility, the higher society's awareness about the company and potentially its public scrutiny. But also, the greater the expectation for company information, in alignment with voluntary disclosure theory. Consequently, more extent disclosure would be expected as an effort to enhance company's legitimacy and address stakeholders' information demand. Positive associations have been found between environmental media visibility and environmental disclosure (Aerts and Cormier, 2009; Bewley and Li, 2000; Li, Richardson and Thornton, 1997; Tadros and Magnan, 2019), which was also confirmed between climate change media visibility and climate change disclosure (Dawkins and Fraas, 2011). Therefore, it is hypothesised that:

> *H_{1c}. The likelihood of disclosing a GHG emissions risk in a company's annual report is higher for companies with higher GHG emissions media visibility.*

In the hypothesis above and in the following ones related to media visibility, it is worth it explaining that instead of considering company's media coverage in general (i.e. company's mentions on the media in any context), this study focuses on media articles touching a specific context, in this case, GHG emissions. This is aligned with Hummel and Schlick's (2016) advice on proxies for disclosure and its determinants capturing similar content (i.e. as the focus of this research is on GHG emissions risk disclosure, the media visibility aspect should also focus on the same level of information: GHG emissions).

4.2 Hypotheses on the extent of general disclosure

General statements with information related to GHG emissions but not conveying how they apply to the company providing the disclosure are considered low-quality disclosure, as they do not inform the reader about a company's activities or contribute to reduce the information gap between a company and its stakeholders. However, the presence of this kind of disclosure has been measured in the environmental disclosure literature (Ingram and Frazier, 1980) and more specifically, in a carbon disclosure paper (Hrasky, 2012), exemplified by sentences such as "Methane gas produced by landfills and other activities has a global warming potential 21 times higher than carbon dioxide" or "Carbon dioxide equivalent is the basis of comparing the warming effect of greenhouse gases" (Hrasky, 2012, p. 185).

Although sentences like the ones above, classified as general disclosure (Ingram and Frazier, 1980), may help explain the context in which a company operates, they do not help differentiate a company amongst its peers. However, it is argued here that disclosures like these may be useful for legitimation purposes as they could distract stakeholders' attention, focusing on the climate change context instead of focusing on a company's response to it. Considering Lindblom's (1994) four legitimation strategies (discussed in Section 2.2.1.1), the strategy on diverting stakeholders' attention is one of the most adopted by Australian mining companies (Yongvanich and Guthrie, 2007), as well as by UK and Chinese companies to communicate bad news (Lin, 2021). Thus, companies under legitimacy threats could be motivated to use this kind of disclosure more intensively, which is argued here that would be the case for high GHG emissions risk companies or those with weak GHG emissions risk management. Impression management also supports the hypotheses set based on legitimacy theory on general disclosure, as following the attribution behaviour, companies would attribute negative results (i.e. high risk or low risk management) to external factors.

Therefore, all the hypotheses for disclosures not referencing a company's activities (i.e. general disclosure) are based on legitimacy theory and impression management, not on voluntary disclosure theory, as general disclosure is not appropriate to reduce information asymmetry between a company and the market, which is the purpose of disclosure from an economic perspective.

Literature has demonstrated that companies facing legitimacy threats, such as poor environmental performance or high environmental risk, use more soft, low-quality disclosure than better performers (Aerts and Cormier, 2009; Clarkson *et al.*, 2008; Hummel and Schlick, 2016; Lemma *et al.*, 2020; Meng *et al.*, 2014) as these disclosures are less likely to attract scrutiny than specific quantitative disclosures. Non-specific disclosure empowers poor environmental performers "to disguise their true performance and to simultaneously protect their legitimacy" (Hummel and Schlick, 2016, p. 455). Companies' preference for non-specific information has also been observed in the risk disclosure literature (Abraham and Shrives, 2014). Considering that companies under legitimacy-threats would have more incentives to use a type of disclosure that diverts readers' attention, it is hypothesised that:

> *H_{2a}. There is a positive relationship between GHG emissions risk and GHG emissions risk general disclosure.*
>
> *H_{2b}. There is a negative relationship between GHG emissions risk management and GHG emissions risk general disclosure.*

Hypothesis H_{2a} posits that the higher a company's GHG emissions risk, the higher its amount of GHG emissions risk general disclosure. Companies with high GHG emissions risk level are those with high exposure to GHG emissions (e.g. operations emitting large amounts of GHGs) and/or with insufficient risk management (e.g. not enough pollution abatement measures, such as adopting renewable energy sources, producing low-carbon products or buying carbon credits).

Hypothesis H_{2b} posits that the weaker the risk management (which would represent increased legitimacy threat), the higher the amount of general disclosure.

Hypotheses H_{2a} and H_{2b} are also aligned with the impression management strategy named attribution, related to attributing positive outcomes to internal factors and the negative ones to external factors, as presented in section 2.4.3. Following the attribution strategy, companies with negative outcomes (e.g. weak performance or increased risk level) would often justify them based on external factors (e.g. regulations, competitions, weather aspects etc), which would potentially be associated with increased disclosure on external factors, which in this research is named general disclosure. Therefore, also based on impression management, increased risk level or reduced risk management would be associated with increased amount of general disclosure, as argued in Hypotheses H_{2a} and H_{2b}.

In alignment with H_{2a} and H_{2b}, arguing that companies under higher pressure will use higher levels of general disclosure for legitimation purposes, which is corroborated by the positive association between media visibility and disclosure found in the previous studies already mentioned in Section 4.1 (Aerts and Cormier, 2009; Bewley and Li, 2000; Dawkins and Fraas, 2011; Li, Richardson and Thornton, 1997; Tadros and Magnan, 2019), it is hypothesised that:

> H_{2c}: *There is a positive relationship between GHG emissions media visibility and GHG emissions risk general disclosure.*

The hypothesis above posits that companies with more mentions on news articles covering GHG emissions provide larger amounts of GHG emissions risk disclosure not referencing a company's activities.

4.3 Hypotheses on the extent of specific and total disclosure

Disclosure classified as referencing a company's activities (i.e. specific disclosure) may contain different types of information, which may be specific to the company or not, in qualitative and quantitative terms, with different proprietary costs. Therefore, this type of disclosure could be used for different purposes (e.g. legitimation, reducing information asymmetry, differentiation in the market etc), which would be aligned with predictions based on legitimacy theory as well as on voluntary disclosure theory. Legitimacy theory would anticipate that companies under higher pressure, with their legitimacy threatened, would use more disclosure to maintain their legitimacy, while the best performers in the industry, according to voluntary disclosure theory, would use more disclosure to convey their good news and reduce information asymmetry between the company and the market. Impression management, following the attribution strategy, would posit that companies with positive results would attribute them to internal factors, potentially increasing their specific disclosure.

Although literature testing the relationship between risk and disclosure is quite scarce in the environmental field, previous studies have found a positive relationship between environmental risk and environmental disclosure, demonstrating that the higher the risk, the more extensive the disclosure (Bewley and Li, 2000; Dobler, Lajili and Zéghal, 2015; Li, Richardson and Thornton, 1997). However, the measures employed have been quite distinct. In terms of risk, Li, Richardson and Thornton (1997) measured pollution propensity based on company's inclusion in a government environmental monitoring programme (binary), which was also followed by Bewley and Li (2000). Pollution propensity is a risk exposure measure and it is not company-specific. On the other hand, Dobler, Lajili and Zéghal (2015) calculated company-level environmental risk by multiplying company's environmental risk exposure by its environmental risk consequence, both assessed based on company's disclosures. In terms of disclosure, these three studies were focused on disclosures referencing a company's activities, or specific disclosure following Ingram and Frazier (1980). Li, Richardson and Thornton (1997) looked at whether a company discussed or not a specific environmental incident the company was involved with. In contrast, Bewley and Li (2000) and Dobler, Lajili and Zéghal (2015) used weighted disclosure indexes, assigning higher values to more specific disclosures (i.e. economic-related disclosure), enabling investigating the association with different types of disclosure. Thus, both Dobler, Lajili and Zéghal (2015) and Bewley and Li (2000) found a positive relationship between environmental risk and total, financial and non-financial disclosure (i.e. the riskier the company, the greater the amount of disclosure). Similarly, studies investigating the relationship between company risk and risk disclosure have found positive associations (Abraham and Cox, 2007; Elshandidy, Fraser and Hussainey, 2013).

As discussed above, studies in the environmental disclosure and in the risk disclosure fields mainly point to a positive relationship between risk, or risk exposure, and disclosure, explained by legitimacy theory. In addition, Hrasky (2012) found that carbon-intensive companies (i.e. higher GHG emissions risk) use two times more specific disclosure in their annual reports than companies in less-intensive sectors (i.e. lower GHG emissions risk). Therefore, it is hypothesised that:

> *H_{3a}. There is a significant positive relationship between GHG emissions risk and GHG emissions risk specific disclosure.*
>
> *H_{3b}. There is a significant negative relationship between GHG emissions risk management and GHG emissions risk specific disclosure.*

As explained earlier, the hypotheses above were set based on legitimacy theory following previous studies on risk (Dobler, Lajili and Zéghal, 2015; Bewley and Li, 2000; Li, Richardson and Thornton, 1997) and on specific disclosure (Hrasky, 2012). However, it would also be possible to set competitive hypotheses based on voluntary disclosure theory (i.e. lower risk or stronger risk management companies would use more disclosure referencing a company's activities to equip investors and shareholders with information on companies' risk exposure and risk management systems), which was not done to avoid contradicting empirical literature. Competing hypotheses would also be aligned with impression management, as companies would potentially attribute their low risk level or strong risk management skills to internal factors, providing more specific disclosure than companies with lower performance.

As mentioned in the previous paragraphs and in Section 4.2, the relationship between risk and both kinds of disclosure that compose total disclosure (general and specific disclosure) was hypothesised to be positive (H_{2a} and H_{3a}), while the relationship with risk management was anticipated to be negative in both cases (H_{2b} and H_{3b}). In addition, papers measuring extent of total disclosure counting words, sentences, lines or pages have found positive relationships between legitimacy threats and total disclosure. This is the case of Patten (2002) and de Villiers and van Staden (2011) for bad environmental performance, and Deegan and Gordon (1996) for companies in environmentally sensitive industries. Therefore, regarding total disclosure it is hypothesised that:

> *H_{4a}. There is a positive relationship between GHG emissions risk and GHG emissions risk total disclosure.*
>
> *H_{4b}. There is a negative relationship between GHG emissions risk management and GHG emissions risk total disclosure.*

As mentioned in the previous sections, both legitimacy and voluntary disclosure theories would suggest a positive association between media visibility and disclosure. The dominant view in the environmental disclosure field is that the higher the media visibility, the higher the pressure from society and therefore, a higher level of disclosure would be expected as a tool to protect legitimacy, although reduced disclosure has also been used to face legitimacy threats (de Villiers and van Staden, 2006). From the perspective of voluntary disclosure theory, media visibility has been used as a proxy for outsiders' knowledge about a company's activity (Bewley and Li, 2000; Tadros and Magnan, 2019). In this regard, the higher the media visibility, the higher stakeholders' awareness about a company, increasing their expectation for information and elevating the "threshold level of disclosure" (Verrecchia, 1983, p. 179). Companies with an increased demand for information would be more motivated to use disclosures referencing their activity. Therefore, aligned with both legitimacy and voluntary disclosure theory, it is hypothesised that:

H_{3c}. There is a positive relationship between GHG media visibility and GHG emissions risk specific disclosure.

Considering that a positive relationship is expected between media visibility and general disclosure (H_{2c}), and between media visibility and specific disclosure (H_{3c}), it is hypothesised that the same would apply to total disclosure:

H_{4c}. There is a positive relationship between GHG media visibility and GHG emissions risk total disclosure.

4.4 Hypotheses on the ratio of general/specific disclosure to total disclosure

Literature on environmental disclosure and on risk disclosure have measured the amount of disclosure based on words/sentences/lines (Linsley and Shrives, 2006; Patten, 2002; Wiseman, 1982), on the presence and quality of specific disclosure items included in content analysis indices – e.g. Wiseman (1982) and Clarkson *et al.* (2008) – and based on disclosure ratings, such as CDP (Dawkins and Fraas, 2011) and Bloomberg ESG score (Giannarakis, Konteos and Sariannidis, 2014). These methods have been used to measure total disclosure and distinct types of disclosure within it.

Only one study has been identified measuring the proportion between different kinds of disclosure. In this regard, Clarkson *et al.* (2008) measured the ratio of soft disclosure (disclosure lacking substantiation and easily imitated) to total disclosure, named legitimisation factor, and found that it was higher for poor environmental performers and for those with unfavourable media coverage. However, both soft and hard categories in Clarkson *et al.* (2008) were assessed based on disclosures referencing a company’s activities or situation regarding specific items in their disclosure index, therefore, their findings are not directly applicable to this study.

Although Hrasky (2012) did not calculate the ratio between a specific type of disclosure and total disclosure, her results support ratio calculations. Hrasky (2012) evidenced that the ratio of general disclosure to total disclosure corresponds to 4.69% for Australian companies in less carbon-intensive sectors, while it corresponds to 12.30% for companies in more carbon-intensive sectors. Therefore, considering that companies in less carbon-intensive sectors have lower GHG emissions risk than those in more carbon intensive sectors, it is hypothesised that:

H_{5a}. There is a positive relationship between GHG emissions risk and the ratio of GHG emissions risk general disclosure to total disclosure. Conversely, there is a negative relationship between GHG emissions risk and the ratio of GHG emissions risk specific disclosure to total disclosure.

H_{5b}. There is a negative relationship between GHG emissions risk management and the ratio of GHG emissions risk general disclosure to total disclosure. Conversely, there is a positive relationship between GHG emissions risk management and the ratio of GHG emissions risk specific disclosure to total disclosure.

In the hypotheses above, there are two sentences in each hypothesis as the ratios complement each other (i.e. while higher risk is predicted to be associated with a higher ratio of general disclosure to total disclosure, lower risk is automatically predicted to be associated with a higher ratio of specific to total disclosure). From a theoretical perspective, the hypotheses above are aligned with voluntary disclosure theory because lower risk companies, which are superior performers, are expected to provide a greater proportion of specific disclosure, as they have good news to convey and general disclosure it not appropriate to reduce information asymmetry and help differentiation in the market. Hypotheses above are also aligned with the attribution strategy in impression management, building on the discussion in section 4.2. on the hypotheses related to general disclosure. As companies would attribute negative results (i.e. high risk or weak risk management) to external factors (i.e. using general disclosure) and positive results (i.e. low risk or strong risk management) to internal factors (i.e. using specific disclosure), it is argued here that it would change the proportion between general and specific disclosure in total disclosure, resulting in increased ratio of general disclosure to total disclosure. Legitimacy theory does not offer a clear indication on the direction of the relationship between risk and ratio of disclosure, as different legitimation strategies could be adopted to address increased legitimacy threats, which could use both general and specific disclosure (de Villiers and van Staden, 2006).

As mentioned in the previous sub-section, the relationship between media visibility and disclosure could be analysed from both theoretical lenses. However, for ratio of general or specific disclosure to total disclosure, legitimacy theory does not offer a clear direction, while voluntary disclosure theory does. Following Lindblom's (1994) strategies to face legitimacy gaps, a company seeking to distract stakeholders could use a greater ratio of general disclosure, while a company attempting to educate stakeholders about its good intentions could use a greater ratio of specific disclosure. In contrast, based on voluntary disclosure theory, the higher a company' media visibility, the higher outsiders' knowledge about a company's activity (Bewley and Li, 2000; Tadros and Magnan, 2019), elevating the "threshold level of disclosure" (Verrecchia, 1983, p. 179), which would imply using a greater proportion of specific disclosure compared to general disclosure (i.e. general disclosure does not convey information about the company, just about the context). As both ratios complement each other to compose 100% of total disclosure, it is hypothesised that:

H_{5c}. There is a negative relationship between GHG emissions media visibility and the ratio of GHG emissions risk general disclosure to total disclosure. Conversely, there is a

positive relationship between GHG emissions media visibility and the ratio of GHG emissions risk specific disclosure to total disclosure.

4.5 Control variables

Based on previous empirical papers, this study controls for company size and leverage as they have been found to impact on environmental disclosure and risk disclosure. Size is considered to capture "several factors including financial resources, political costs, and information asymmetry" (Lemma *et al.*, 2019, p. 115). Depending on the size of a company, it may have more resources available to deal with disclosure proprietary costs (Verrechia, 1983), and economies of scale could reduce information production costs (Clarkson *et al.*, 2008, p. 315). From a social perspective, company size could be interpreted as a proxy for socio-political pressure (i.e. the larger the company, the larger its footprint, visibility and pressure from stakeholders), which is confirmed by company size being highly correlated with media visibility (Braam *et al*., 2016).

Literature has consistently evidenced that company size influences environmental disclosure (Patten, 1992; Gray, Kouhy and Lavers, 1995; Deegan and Gordon, 1996; Bewley and Li, 2000; Semenova, 2010). There is also evidence demonstrating that company size is associated with climate change disclosure (Prado-Lorenzo *et al.*, 2009; Stanny and Ely, 2008), although there is no evidence that size specifically explains the level of climate change risk disclosure (Kouloukoui *et al.*, 2018). Company size also impacts on risk disclosures (Elzahar and Hussainey, 2012; Linsley and Shrives, 2006; Neri, Elshandidy and Guo, 2018; Wachira, 2018).

The second control variable selected, leverage, may capture several aspects, such as pressure from providers of capital (Liesen *et al.*, 2015) and company financing risk (Elshandidy, Fraser and Hussainey, 2013; Linsley and Shrives, 2006). This is aligned with the fact that lenders, as part of their risk management systems, require borrowers to provide information on their social and environmental performance. Studies have evidenced the influence of leverage on environmental disclosures (Clarkson *et al.*, 2008), on GHG disclosures (Chithambo and Tauringana, 2014; He, Tang and Wang, 2013) and on risk disclosures (Elshandidy, Fraser and Hussainey, 2013), although non-significant results have also been found (Liesen *et al.*, 2015).

4.6 Conceptual model

The diagram below presents the conceptual model with the hypotheses discussed in the previous sub-sections. As explained, five different measures of GHG emissions risk disclosure have been adopted: 1) presence of disclosure, 2) disclosure not referencing a company's activities (general disclosure), 3) disclosure referencing a company's activities (specific disclosure), 4) total disclosure and 5) ratio of general or specific disclosure to total disclosure, which explains several hypotheses assigned to the same relationships (arrows below). In addition, GHG emissions risk and risk management will be employed, justifying unfolding each hypothesis into $_a$ and $_b$, and also into $_c$ for media visibility.

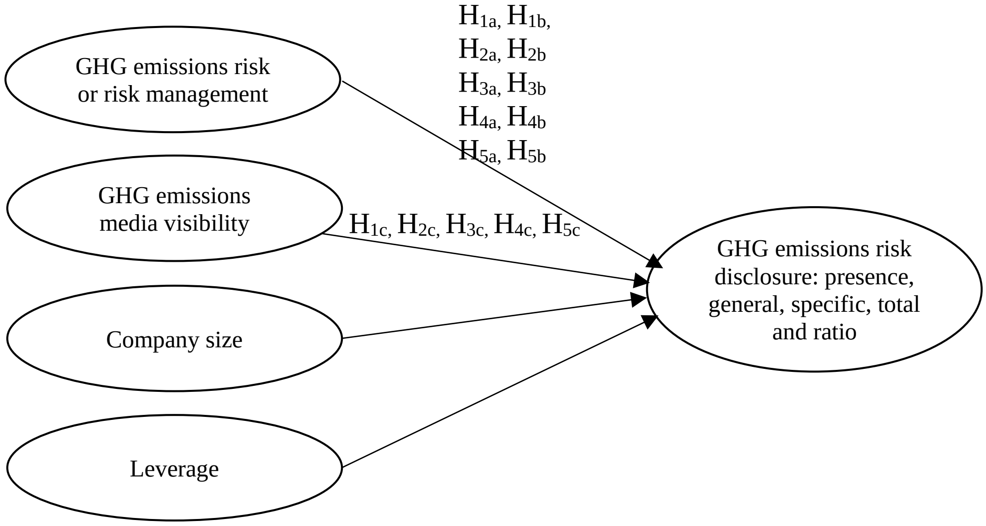

Figure 4.1: Conceptual model proposed for this study

5 Research Design

As mentioned in the conceptual model proposed for this study, hypotheses have been developed based on legitimacy theory, voluntary disclosure theory and impression management, to predict potential relationships between GHG emissions risk and risk management, and GHG emissions media visibility and five measures of GHG emissions risk disclosure: presence of disclosure, general, specific and total disclosure and ratio of general or specific disclosure to total disclosure, controlling for company size and leverage. The hypotheses will be tested following the research methodology discussed in this section, that includes logistic and linear regressions.

5.1 Research strategy

The approach adopted in the study is deductive, as hypotheses have been deduced based on previous studies and theories. In light of the findings, theories and previous studies will be revisited, to understand the implications and how this study may contribute to advance the knowledge about GHG emissions risk disclosure in particular, and environmental disclosure and risk disclosure in general.

This study adopts a positivist epistemological approach. Thus, organisations are seen as observable entities and by analysing facts about them, it is possible to explain their behaviour and the forces that act on them. Bryman and Bell (2003, p. 28) differentiate "the explanation of human behaviour (as in the positivist approach to the social sciences) and the understanding of human behaviour [(interpretivist approach)]", being the first one more aligned with this study.

This study adopts an objectivist ontological position, which portrays that an organisation has a reality external to social actors, independent from the individual views of the social actors that compose an organisation and from the observer. As this research aims at testing relationships (between GHG emissions risk, risk management and media visibility and different types of disclosure), it entails assuming that the variables are objectively measurable. The aim can only be achieved by using a quantitative approach. In contrast to qualitative research, this study does not require investigating the meaning that distinct individuals would attribute to a social phenomenon. In fact, this study requires taking a step back, observing the behaviour, counting and analysing it. Following a quantitative approach, quantitative secondary data will be collected (GHG emissions risk, risk management and media visibility, company size and leverage) and company's disclosures will be quantified, which has been often used in studies examining non-financial disclosures (de Villiers and van Staden, 2006; Deegan, Craig and Gordon, 1996; Gibson and

O'Donovan, 2007; Guthrie and Parker, 1989; Ingram and Frazier, 1980; Mallin, Michelon and Raggi, 2012; Patten, 2002; Wiseman, 1982).

5.2 Research design and data collection

This study will follow a cross-sectional research design, as it aims at investigating the relationships between risk and risk management, media visibility and disclosure at a single point in time, with no intention to investigate how they have evolved over time. All variables refer to the year of 2017, as the 2017 annual reports, filed by 31 March 2018 (within three months after the end of the fiscal year), were the most recent annual reports available when data collection started in 2018, therefore the reports analysed were issued before recent changes in SEC regulation on climate change disclosure (see section 3.1). Company's GHG emissions risk and risk management were collected as of 01 January 2018 (the closest to 2017 year-end available, considering that risk measures are monthly reviewed). GHG media visibility refers to articles published throughout 2017 and company size and leverage as of 31 December 2017. The fact that disclosure occurs after the completion of the fiscal-year reiterates the potential causal relationship with risk, risk management and media visibility as determinants, since it is hypothesised that risk, risk management and media visibility may influence management's disclosure decisions.

This research will rely on secondary data, collected for other purposes and without the involvement of the researcher. In contrast to primary data, secondary data enable working with a greater number of cases and require less resources. Considering that the relevant data for this research have already been collected – and are available as part of annual reports and a third-party dataset – there would be little reason to collect primary data. The research will focus on a considerable number of cases (200 companies), supporting the identification of variation in different variables, as required by quantitative analysis methods.

For the purpose of this study, ten variables must be collected: two risk measures (risk and risk management), GHG media visibility and five disclosure measures (presence of GHG emissions risk disclosure, general, specific and total disclosure, and ratio of general/specific GHG emissions risk disclosure to total disclosure), besides company size and leverage, which will be employed as control variables. Variables will be discussed in the Sections 5.4 and 5.5.

5.3 Sample size and description

Companies will be the unit of analysis in this research. A company must meet the criteria below to be included in the sample (the rationale for these selection criteria will be explained in the next paragraphs):

- Be listed in the U.S. Stock Exchange, issuing a Form 10-K (annual report) for the fiscal year ended on 31 December 2017, not combined with its parent company;
- Be a member of one of these industries: airlines, marine, road & rail transport; chemicals; metals & mining, construction materials and steel; oil & gas; or paper & forest products;
- Company's GHG emissions risk must be assessed by an independent party (in this study, by MSCI).

This research will rely on a sample composed of 200 companies following the criteria above for the logistic regressions. Another criterium has been included to select a sub-sample, composed of 132 companies, which will support the analysis of the different types of GHG emissions disclosure using linear regressions:

- Company's Risk Factors section in Form 10-K must contain at least one GHG emissions risk.

The following table presents how the companies in the sample are distributed, according to their industry group and whether they disclosed a GHG emissions risk in their 2017 annual reports. Sample criteria will be explained in the following paragraphs.

Table 5.1: Sample distribution

Industry	**No. of companies**	**GHG emissions risk in 2017 Form 10-K**	
		Yes	No
Airlines, marine, road & rail transport	21 (10.5%)	9 (42.9%)	12 (57.1%)
Chemicals	25 (12.5%)	10 (40%)	15 (60%)
Metals & mining, construction materials and steel	24 (12%)	12 (50%)	12 (50%)
Oil & gas	121 (60.5%)	97 (80.2%)	24 (19.8%)
Paper & forest products	9 (4.5%)	4 (44.4%)	5 (55.6%)
Total (sample and sub-sample)	200	132 (66%)	68 (34%)

Public companies from the U.S. were selected for the sample for several reasons. Firstly, the U.S. Stock Exchange regulations determine a specific section in the annual report to disclose material risks, which enabled a more objective collection of GHG emissions risk disclosure. Looking for climate change disclosure throughout the whole extension of an annual report – some U.S. companies' annual reports may reach 200 pages – could increase subjectivity and prevent working with a large dataset, as textual analysis is usually time-consuming. This is not the case for computer-based textual analysis, however this technique also has some shortcomings, which would be exacerbated by the fact that risk disclosure encompasses a broad array of information, including risk management systems, mitigation efforts, current and future investments, unwanted events and consequences. Other major English-speaking countries were also considered, as quantifying textual disclosures requires familiarity with the language. Companies from the UK were not included in the sample as the UK Stock Exchange does not specify in which part of the annual report the risks should be disclosed, although recommendations from TCFD are welcome (London Stock Exchange Group, 2017). Similarly, Indian companies were not included in the sample because, although they must answer this question in their annual reports: "Does the company identify and assess potential environmental risks? Y/N", discussing a company's material environmental risks is not mandatory, even when the answer is yes for potential environmental risks (Securities and Exchange Board of India, 2015). Only companies issuing a 10-K form not combined with their parent companies were included in the sample, otherwise, the scope of the risk factors section would be broader than the company itself, generating a misalignment with the other variables in the model.

The second reason for not including companies from other countries is that the number of companies from other countries in MSCI ESG Ratings is considerably small, which is the case for Canada and Australia. Thus, adding companies from Canada would represent a small addition in terms of sample size, which was not required considering the number of predictors in the model. In the dataset from where GHG emissions risk was collected, MSCI ESG Ratings, 33.2% of the entries are from the U.S. (3,850 out of 11,598 entries), while only 4.1% are from Canada and 3.2% for Australia. In addition, access to Australian companies' annual report costs approximately £23 per report (Australian Securities and Investments Commission, 2020), as opposed to the U.S. companies' reports that are freely available.

Only companies issuing annual reports with fiscal year ending on 31 December were selected for the sample, as this is the most common year end date for 10-K forms (although several companies adopt 30 September, similar to the U.S. federal government). As mentioned in the previous sub-section, 2017 has been selected as the reference for all variables in the model, as it refers to the most recent annual report available when data collection started, in 2018.

Previous studies have found that companies in environmentally-sensitive industries provide higher levels of environmental disclosure (Clarkson *et al.*, 2008; Deegan and Gordon, 1996; Patten, 2002; Semenova and Hassell, 2008), with more carbon intensive sectors also providing more carbon footprint-related disclosures (Hrasky, 2012). As companies without GHG emission risk disclosure are not included in the sub-sample for the OLS multiple regressions, only companies from the industries with the highest GHG emissions risk exposure were included in the sample. As presented in Table 5.1, companies from the oil & gas industry are prevalent in the sample. This occurred because amongst the top GHG emissions risk exposure industries (as rated on MSCI ESG Ratings), oil & gas is the one with the greatest number of companies in the MSCI ESG Ratings. Oil & gas is recognised in the literature as environmentally-sensitive (Cho and Patten, 2007; Clarkson, Overell and Chapple, 2011), a high-carbon industry (Stanny and Ely, 2008) and it has one of the highest climate disclosure scores (Coburn and Cook, 2014; Doran and Quinn, 2008). Other industries considered environmentally-sensitive in the literature include utilities, mining, chemicals and paper & pulp (Cho and Patten, 2007; Clarkson, Overell and Chapple, 2011).

In order to test the hypotheses defined for this research, a company-specific measure of GHG emissions risk was required. Having its GHG emissions risk measured by a third party is a requirement for a company to be included in the sample, as it seems to be the only viable way to collect company-level GHG emissions risk. Other manners to access company's GHG emissions risk would be: 1) directly contacting the companies or 2) calculating their risk level based on public information, as adopted by Dobler, Lajili and Zéghal (2014; 2015). Firstly, as risk information is highly sensitive, companies would probably deny sharing information beyond what has been already included in their disclosures. Secondly, calculating company's risk based on company's disclosures could be biased towards company's positioning statements – risk of mismatch between companies' disclosures and their internal risk registers (Abraham and Shrives, 2014) – and may impose some guesswork due to insufficient information publicly available. MSCI was the only independent party identified assessing company's GHG emissions risk, as discussed in Section 5.5.1.

A sample of 200 companies for the logistic regressions, and a sub-sample of 132 companies for the linear regressions, are considered appropriate for this research for two reasons. Firstly, they are aligned with the formula proposed by Tabachnick and Fidell (2013, p. 123): $N > 50 + 8 \times m$ (where m= number of independent variables, in this case: risk or risk management, media visibility, company size, and leverage), resulting in 132 > 50 + 8 × 4, and finally 132 > 82. Secondly, following Field (2013, p. 313), a sample with 132 companies exceeds the common rule of thumb of at least 10 or 15 cases of data per predictor, as the current sample has 33 observations per predictor.

5.4 Dependent variables

For this study, five measures of GHG emissions risk disclosure will be employed as dependent variables: presence of GHG emissions risk disclosure, general, specific and total disclosure, and ratio of general or specific disclosure to total disclosure. As discussed in Section 2.2, several methods have been used in academic studies to measure disclosure, often producing numbers employed in quantitative analysis. These methods include textual analysis to measure the extent of disclosure based on the number of words, sentences, lines or pages (Abraham and Cox, 2007; Kouloukoui *et al.*, 2018; Patten, 2002), content-analysis indices checking the presence of specific disclosure items (Clarkson *et al.*, 2008) and sometimes also their specificity level (see Table 2.1. for examples), scores such as CDP climate change disclosure score (Peters and Romi, 2014), and counting the number of climate change risks in annual reports (Doran and Quinn, 2008) and in CDP questionnaires (Elijido-Ten, 2017). No GHG emissions risk disclosure measure has been identified in the literature. Considering the focus of this study is on GHG emissions risk disclosure, textual analysis has been selected as the variables will be measured based on objective categories of text applied to a predefined set of sentences. The other methods, such as content-analysis indices, CDP score and counting the number of risks, would be more applicable to disclosures that are not as specific as GHG emissions risk disclosure, such as climate change disclosure or environmental disclosure.

Some authors consider misleading to evaluate corporate social responsibility reporting solely based on annual reports (Zéghal and Ahmed, 1990). One of the arguments is that other communication channels, such as websites and press releases, may be more appropriate to manage legitimacy in a timely manner, as annual reports are published only once a year at a given time (Pellegrino and Lodhia, 2012), which also occurs with sustainability reports. However, annual reports are still considered “a key vehicle of reliable corporate environmental information transfer to stakeholders” (Dobler, Lajili and Zéghal, 2015, p. 302). Annual reports are the preferred source of information for several stakeholder groups (Deegan *et al.*, 2002), which is related to their breadth of coverage and availability. Risks are routinely disclosed through annual reports, as they are the most often used medium to communicate with shareholders in a systematic way (Hughes, Anderson and Golden, 2001).

Annual reports have been widely used to measure environmental disclosure (Wiseman, 1982; Deegan and Gordon, 1996; Patten, 2002; Cho, Roberts and Patten, 2010), and also to measure sustainability risk disclosure (Truant, Corazza and Scagnelli, 2017). U.S. 10-K annual reports have been employed in several environmental disclosure studies (Al-Tuwaijri *et al.*, 2004; Cho and Patten, 2008) because they provide “a common and reliable source of information” (Dobler, Lajili and Zéghal, 2014, p. 4), due to regulation and frequent reviews.

Forms 10-K for the year ended on 31 December 2017 were retrieved from SEC website (SEC, 2020a), searching by company’s name obtained from MSCI ESG Ratings dataset. All the reports were analysed by the author, who has professional experience in environmental risk. Twelve randomly selected annual reports, out of 200 employed in this research, were also analysed by two invited coders, as detailed in Section 5.8, following the Coding Guide available in Appendix

9.4. The author carried out the textual analysis using NVivo software, increasing traceability and preventing calculation errors, as NVivo automatically counts the number of words in each code.

The analysis started by identifying GHG emissions risks in the list of risks disclosed by each company in the Risk Factors section of the annual report. According to regulation from the U.S. Stock Exchange, all 10-K reports must contain a section named "Item 1A. Risk Factors", composed of a list of risks, each of them with a title and a discussion. Focussing on the content from the risk factors section made the textual analysis feasible (lengthy annual reports, with approximately 200 pages, are not rare in the U.S.) and helped overcoming the difficulty in defining risk disclosure, as there are several definitions for risk, associated with hazard, threat, harm, uncertainty, probability and positive and negative outcomes (Linsley and Shrives, 2006).

5.4.1 Presence of GHG emissions risk

For each company, the Risk Factors section in the annual report was consulted to identify the risks with titles mentioning at least one of these keywords: "greenhouse gas", "GHG", "climate" (in the context of climate change), "carbon" or "global warming". This list was compiled based on Doran and Quinn's (2008) key phrases to identify discussions on climate change in 10-K Forms, and Hrasky's (2012) keywords to identify carbon footprint-related disclosures in annual and sustainability reports. Both studies used the keywords "climate change", "greenhouse gas" and "global warming", and for this study, two keywords were added: "GHG", as a synonym of greenhouse gas, and "carbon", which has constantly been used in reference to carbon emissions (carbon dioxide is the most prevalent GHG). Risks not mentioning at least one of the keywords above in their titles were not considered (e.g. Company X "is subject to numerous governmental regulations and it can be costly to comply with these regulations"), even when GHGs were mentioned in the risk explanation, as it was judged that these risks were not proper GHG emissions risks, but a broader risk sometimes with a GHG aspect. Risks mentioning climate change in the title but not covering GHG emissions in the explanation were not considered (e.g. a climate change risk focused on physical risks only, such as extreme temperature and flooding). The first dependent variable, whether a company has included a GHG emissions risk in its Risk Factors (binary), was measured based on this initial analysis.

When the selected risks include aspects not related to GHG emissions in the explanation, these sentences were not considered. Not counting specific sentences and sometimes full paragraphs occurred just a few times, in some overall climate change risks and in overall environmental risks (e.g. in a broad climate change risk, sentences on physical risks such as extreme weather were not counted).

After identifying each company's GHG emissions risks and the correspondent explanation, each sentence was classified into general or specific disclosure, as explained in the next sub-section.

5.4.2 GHG emissions risk general, specific and total disclosures

The hypotheses set for this study posit potential associations between GHG emissions risk, risk management and media visibility and two main types of GHG emissions risk disclosure: disclosure referencing a company's own activities or situation (specific disclosure), and disclosure not referencing a company's own activities or situation (general disclosure). Both categories follow Ingram and Frazier's (1980) specificity categories applied to environmental disclosure. Ingram and Frazier's (1981) general disclosure is directly associated with the category named 'Other' defined by Hrasky (2012) to analyse climate change disclosure, which was created for general statements related to climate change that are not directly related to the company or its activities, such as definitions, descriptions of measurement methods and scientific facts. The other two GHG emissions risk disclosure measures employed in this study comprise adding general to specific disclosure, resulting in total disclosure, and the proportion of general or specific disclosure to total disclosure, generating the ratio discussed in the next sub-section.

The decision to focus on these two objective mutually exclusive categories of disclosure – referencing and not referencing a company's activities or situation – is aligned with a gap identified in the environmental disclosure literature and in the risk disclosure literature. Disclosure not referencing a company's activity has been ignored in most of the studies, although it may also contribute to clarify the mixed results. Disclosure has often been assessed based on: 1) the presence and the quality of disclosure on specific themes, following content-analysis indices (Wiseman, 1982; Clarkson *et al.*, 2008) and 2) on the amount of total disclosure (Deegan, Craig and Gordon, 1996; Elzahar and Hussainey, 2012; Patten, 2002). In the first case, the focus would be on sentences referencing a company's activity, to check whether a company has reported a specific item from the index or not. While in the second case, total disclosure would contain sentences referencing and not referencing a company's activity. However, the amount in each category has only been measured in two studies: one yielding non-significant results (Ingram and Frazier, 1980) and one with no company-specific measure of risk or performance, only high-emitting or low-emitting industry membership (Hrasky, 2012).

Other factors corroborate with the decision to focus on the two types of disclosure selected for this research (referencing and not referencing a company's activities or situation), as opposed to disclosure categories such as quantitative vs qualitative, or company-specific vs applicable to other companies (Abraham and Shrives, 2014). Firstly, quantitative information is scarce in climate change risk disclosure (Kelly, 2007) and in risk disclosures in general (Abraham and

Shrives, 2014), which would hinder categorisations such as qualitative vs. quantitative disclosure, or monetary vs. non-monetary, often associated with disclosure quality in the literature (see Table 2.1). To illustrate the scarcity of quantitative information in risk disclosures, literature indicates that only 17% of the information in risk disclosures collected from manufacturing companies' annual reports was quantitative (Dobler, Lajili and Zéghal, 2011), while merely 7% of the forward-looking information was quantified in annual reports from textile, food processing and water companies (Beattie, McInnes and Fearnley, 2004). Preliminary data collection also demonstrated that quantitative information is extremely rare in the Risk Factors section of the companies selected for this study and when it was found, it was mostly not specific to the company (e.g. legislation thresholds). In addition, considering the scarcity of quantitative information in risk disclosures, a deep understanding about the industries selected for the sample would be required to differentiate qualitative company-specific information from qualitative industry-specific (see Appendix 9.3 for a tentative in this regard), which could hinder the coding process.

After classifying each sentence from the GHG emissions risks identified into general or specific disclosure, it was necessary to count the extent of each kind of disclosure. Previous studies have used number of pages (Guthrie and Parker, 1989; Gibson & O'Donovan, 2007), lines (Wiseman, 1982; Patten, 2002), sentences (de Villiers and van Staden, 2011; Ingram and Frazier, 1980; Wiseman, 1982; Mallin, *et al.*, 2013) and words (Abraham and Cox, 2007; Deegan and Gordon, 1996; Kathyayini *et al.*, 2012) to measure the level of environmental or risk disclosure. Comparing word count, number of sentences, number of pages and proportion of pages in annual reports, both Hackston and Milne (1996) and Deegan and Gordon (1996) found small differences between them.

For this study, words in sentences classified as general or specific disclosure were counted, producing quantitative data for the statistical tests. The decision to count words, instead of sentences or pages, was aimed at avoiding human error in the calculations: NVivo, the software used for the textual analysis, does not perform sentence count, only word count. The software facilitates working with a robust dataset and results tend to be more accurate, especially in long texts. In addition, it is important to mention that counting words is not intended to produce "figures that are exact or precise in any manner" (Deegan and Gordon, 1996, p. 189), but rather to provide an indication of differences between the distinct types of GHG emissions risk disclosure and test potential relationships.

The text below exemplifies the disclosure categories adopted for this research. Sentences classified as specific disclosure are displayed in regular font (148 words), while general disclosure is displayed in italic (17 words).

> "**Concerns about climate change and other air quality issues may affect our operations or results.** Concerns about climate change and regulation of GHGs and other air quality issues may materially affect our business in many ways, including increasing the costs to provide our products and services, and reducing demand for, and consumption of, our products and services, and we may be unable to recover or pass through a significant portion of our costs. In addition, legislative and regulatory responses to such issues may increase our operating costs and render certain wells or projects uneconomic, and potentially lower the value of our reserves and other assets. As these requirements become more stringent, we may be unable to implement them in a cost-effective manner. To the extent financial markets view climate change and GHG emissions as a financial risk, this could adversely impact our cost of, and access to, capital. *Both the EPA and California have implemented laws, regulations and policies that seek to reduce GHG emissions*." (California Resources Corporation, 2018, p. 23).

In sum, in this study there will be one measure for general and one for specific GHG emissions risk disclosure, both following Ingram and Frazier (1980) specificity categories, and a measure of total GHG emissions risk disclosure, summing up both previous measures. Words in sentences classified as general or specific disclosure will be counted, to generate quantitative data to be used in the regression analyses. The next sub-section discusses the fifth measure of GHG emissions risk disclosure: ratio of general or specific disclosure to total disclosure.

5.4.3 Ratio of general/specific disclosure to total disclosure

The last dependent variable in this research corresponds to the proportion of each type of disclosure in total GHG emissions risk disclosure, or the ratio of general or specific disclosure to total disclosure. Summing one ratio to the other will compose 100% of total disclosure, therefore they complement each other. Due to this characteristic, the results yielded by one ratio in the regression model will be the opposite of the results yielded by the other ratio. The ratios are inter-related, enabling investigating the relationship between both kinds of disclosure, while general and specific disclosure are independent measures (i.e. if a company uses larger quantities of disclosure not referencing its activities, this does not mean that this same company will use a smaller amount of disclosure referencing its activities).

Rohani, Jabbour and Abdel-Kader (2021) used ratio of carbon-related sentences over total number of sentences in sustainability reports or in the CSR section of the annual reports to measure density of carbon-related information. Focusing on quality of disclosure, Clarkson *et al.* (2008) calculated ratio of soft disclosure (disclosure lacking substantiation) to total disclosure, which was used to proxy for legitimisation. No other study has been identified in the literature using a measure that enables investigating the dynamics between two independent types of disclosure. In this study, the ratio of general disclosure is calculated by dividing the number of words in the general disclosure category by total disclosure, which was also followed to calculate the ratio of specific disclosure.

5.5 Independent variables

In this study, there are three independent variables of interest: GHG emissions risk and risk management, and GHG emissions media visibility. In addition, there are two control variables, namely company size and leverage. All these variables are derived from secondary data.

5.5.1 GHG emissions risk and risk management

The market has calculated risk as a measure that combines exposure (or probability, likelihood) and potential consequences (or impact) of undesirable events (Dobler, Lajili and Zéghal, 2014; Kaplan and Garrick, 1981; World Economic Forum, 2021). In order to overcome the difficulty to access quantitative information on corporate risk level, as this is proprietary information, Dobler, Lajili and Zéghal (2014) estimated exposure and consequence of environmental risks based on content-analysis of companies' disclosure in 10-K filings. This approach could result in a biased risk assessment towards company's messages and could require some guesses – less than 40% of companies have clearly reported environmental risks (KPMG, 2015) – and would be a constraint for a broad dataset, due to the significant effort required to identify information in company's disclosures to support these assessments.

Independent companies have provided environmental risk ratings based on company's and third parties' documents and reviews, including reports issued by government and NGOs, visits and company consultation. Considering the variety of sources consulted, it could be assumed that independent risk ratings are more valid than those measures calculated only looking at company's disclosures, mentioned in the paragraph above. Risk ratings have been used by investors to compare investment options, and by researchers as a proxy for environmental risks, as illustrated below.

Previous empirical studies mainly relied on one of these three suppliers for environmental risk measures: KLD (Chatterji, Levine and Toffel, 2009; Chatterji and Toffel, 2010), Innovest (Linsley and Shrives, 2006) and GES (Semenova and Hassell, 2008). However, all of them have discontinued their risk rating products. GES terminated the production of GES Risk Rating at the beginning of 2015. KLD and Innovest were acquired by MSCI in 2010, under the umbrella of RiskMetrics (RiskMetrics had acquired Innovest and KLD in 2009). MSCI still issues MSCI ESG KLD STATS, but this dataset is currently focused on performance instead of risk. MSCI also issues MSCI ESG Ratings, which is focused on measuring a company's financially relevant ESG risks, keeping Innovest's Intangible Value Assessment framework as their core methodology (Eccles, Lee and Stroehle, 2019). MSCI ESG Ratings will be used as the source of GHG emissions risk measures for this research as there is no GHG emissions risk quantitative measure publicly available, and MSCI was the only supplier identified in the market for quantitative GHG emissions risk at company level . Two other rating were carefully considered as potential sources of the risk measure for this research, ISS-Oekom Corporate Rating and Thomson Reuters ESG Scores, however both ratings are performance-driven and do not contain a quantitative GHG emissions risk measure.

MSCI has measured environmental performance for more than 40 years – through its legacy companies including KLD and Innovest – and is the world's largest provider of environmental, social and governance indexes and research, rating 8,500 companies worldwide (MSCI, 2020). MSCI ESG Rating started in 2007 and has been extensively used in the financial market (Huber and Comstock, 2017) and more recently, have also been employed in academic papers (for instance, by Brogi and Lagasio, 2019; Kim, Chung and Park, 2013). MSCI experts rate companies according to their exposure to environmental, social and governance risks and how well they manage those risks.

The following diagram summarises MSCI ESG Rating framework and provides an overview of its process. MSCI collects information from more than 1,000 data points on ESG policies, programmes and performance from companies' disclosure and alternative data (e.g. government and NGO reports, media articles etc) to calculate a company's exposure and management scores on 37 key issues selected on an industry-basis, under 10 themes, further combined into three pillars (environment, social and governance), resulting in an ESG rating. The process uses technology and artificial intelligence to collect and analyse the data, relying on a team of 200 analysts to check and validate the data. Companies are invited to participate in a formal data verification process.

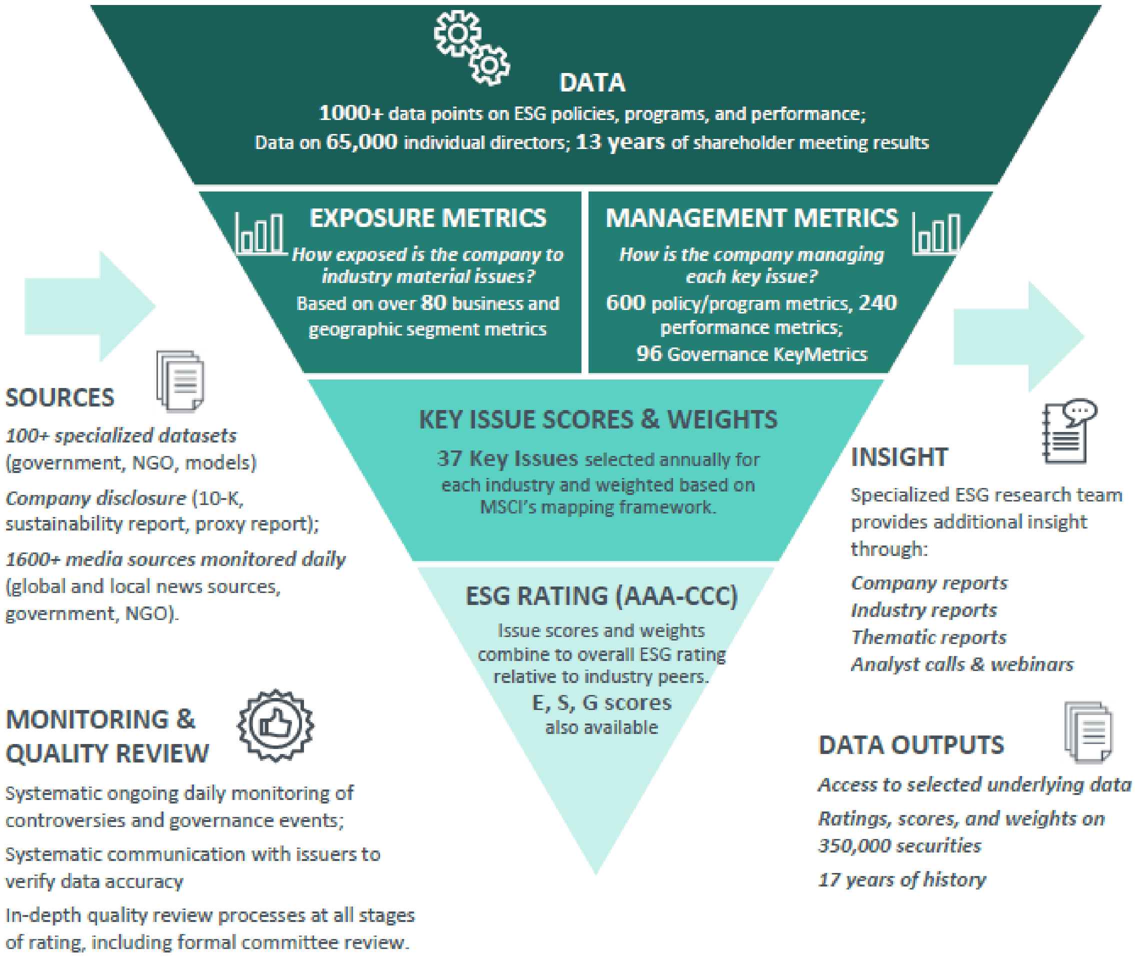

Figure 5.1: ESG Rating framework and process overview (MSCI ESG Research, 2018, p. 2)

Two measures will be extracted from MSCI ESG Ratings to be used as proxies for GHG emissions risk and risk management: carbon emissions key issue score and carbon emissions management score. These measures are highlighted in the following diagram, showing where they fit in the data hierarchy presented above. Risk exposure was not included as an independent variable as it was used as a criterium to select the industries in the sample (companies from the industries with the highest GHG emissions risk exposure were included).

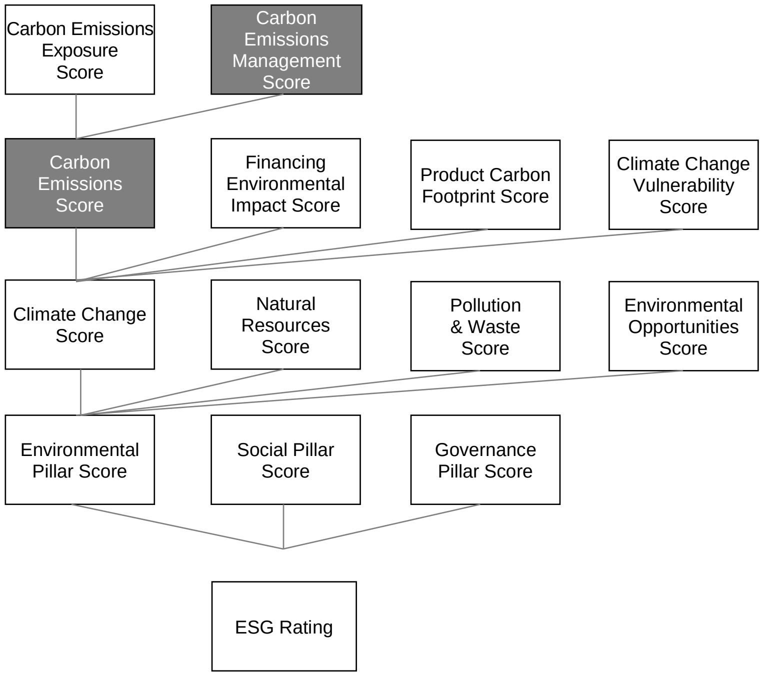

Figure 5.2: GHG emissions risk measures to be extracted from MSCI ESG Rating database

According to MSCI, companies score higher in their carbon emissions score if they proactively invest in low-carbon technologies and increase their carbon efficiency. Management metrics are related to the risk mitigation programmes in place, including efforts to reduce exposure through comprehensive carbon policies and implementation mechanisms, including carbon reduction targets, production process improvements, emissions capture equipment, and switching to cleaner energy sources.

The scores in each level of the diagram above are combined to calculate the score of the level underneath. Although this calculation would imply some collinearity issues, this is not a problem as risk and risk management will not be used in the same regression equations. Carbon emissions management score is calculated based on data points, and if there were controversies related to carbon emissions within the last three years (such as an accident or regulatory action), the score may be reduced. The carbon emissions score (between 0 and 10) is calculated by combining carbon emissions exposure and carbon emissions management scores, following the chart below (the higher the exposure, the better the risk management must be, i.e. a higher level of exposure requires a higher level of demonstrated management capability in order to achieve the same overall score). For example, a company scoring 8 for exposure (high exposure) and 5 for management (medium level management) will result in 10 for carbon emissions score. On the other hand, a company scoring 8 in carbon emissions exposure and 8 in carbon emissions management (strong management mechanisms) will result in a score of 7 for carbon emissions. The higher the resulting carbon emission score, the lower the risk. In order to facilitate interpretation, carbon emissions risk score will be multiplied by -1, in such a way the higher the value, the higher the risk level.

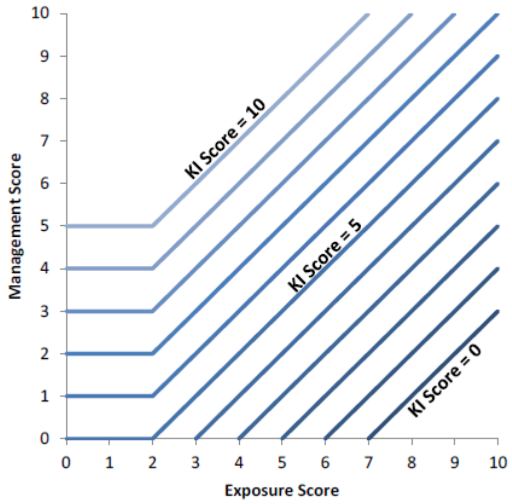

Figure 5.3: Risk based on risk exposure and risk management combined (MSCI, 2018, p. 6)

In summary, GHG emissions risk and risk management range from 0 to 10. For the risk management score, 0 means very poor while 10 would be for a very good management level of GHG emissions issues (the higher, the better). For GHG emissions risk, multiplied by -1 to facilitate interpretation, 0 means that the management system is insufficient to deal with the high exposure level, while -10 is the lowest risk level possible, meaning that the management system is robust considering the exposure level. Risk and risk management, which will be retrieved from MSCI ESG Ratings, are continuous interval variables.

Kaplan and Garrick (1981) alert that reducing risk into a linear measure may present problems, as the same level of risk may be associated with different contexts, as illustrated in Figure 5.3 above. In this study, this limitation is minimised as all companies in the sample are from high GHG exposure industries, and the underlying dimension of risk management is also adopted in the model.

5.5.2 GHG emissions media visibility

As presented in Section 2.3.2, media visibility has been measured in the literature by counting the number of media articles mentioning a company, often in specific contexts (e.g. environment, climate change), on printed media (e.g. Al-Tuwaijri, Christensen and Hughes, 2004) and/or wired media (Dawkins and Fraas, 2011). Some measures also consider whether the articles are positive, negative or neutral, which is commonly consolidated using Janis-Fadner coefficient (Aerts and Cormier, 2009).

The proxy for GHG emissions media visibility in this research will be collected from ABI/Inform Global (ProQuest, 2021), capturing news from printed and online media sources. Printed media coverage alone has been considered insufficient to assess media visibility, considering the increasing relevance of the wired media to support the 24-hour news cycle (Dawkins and Fraas, 2011). Although the credibility of some news websites is questionable, there is no doubt on the impact of the internet to spread information and put extra pressure on corporations (Illia, 2003).

Launched in 1970s, ABI/INFORM Global is one of the most comprehensive business databases in the market, that includes in-depth coverage from thousands of news sources. ABI/Inform Global includes 18 newspapers, such as the New York Times and the Wall Street Journal, which are often used to assess a company's media visibility in environmental disclosure studies (Al-Tuwaijri, Christensen and Hughes, 2004; Dawkins and Fraas, 2011; Tadros and Magnan, 2019). ABI/INFORM Global also searches on more than 1,000 trade journals, 203 magazines and 20 wire feeds sources. It is a product offered by ProQuest and access is granted to all Kingston University students via iCat.

For this study, companies' mentions on GHG-related media articles will be quantified. This is aligned with Dawkins and Fraas' (2011) concept of issue visibility, as opposed to general visibility that does not specify the context in which a company is cited on the media. Focusing on GHG-related media articles is also aligned with Hummel and Schlick's (2016) advice saying that proxies for disclosure and its determinants must capture similar content, which implies that determinants for GHG emissions disclosure should also be related to GHG emissions. Therefore, the search on ABI/INFORM Global was carried out looking for news published between 01 January and 31 December 2017 containing a company's name and at least one of these keywords: "greenhouse gas", "GHG", "climate change", "carbon" or "global warming", on printed and wired media. The list of keywords was the same discussed in Section 5.4.1 to identify GHG emissions risks in annual reports, aligned with Doran and Quinn (2008) and Hrasky (2012). The source types selected for the search on ABI/INFORM Global were: blogs, podcasts & websites, magazines, newspapers, reports, trade journals and wire feeds, and only content in English was searched.

Considering the importance of media visibility as a predictor of GHG emissions risk disclosure in this research, two alternative measures will be employed in the sensitivity analysis: the first captures the extent of media visibility, grouping the companies in four categories, based on the same data collection presented above; the second alternative measure of media visibility only focuses on traditional media (newspapers, magazines and trade journals). Both will be discussed in detail in section 6.5 Sensitivity analysis.

5.5.3 Control variables

Following previous studies on environmental disclosure and on risk disclosure, this research will employ two control variables: company size and leverage.

There is a consensus in disclosure studies that company size impacts on company's disclosure, with larger companies providing more disclosure (Bewley and Li, 2000; Gray, Kouhy and Lavers, 1995a; Linsley and Shrives, 2006; Patten, 1992; Semenova, 2010). The second control variable, leverage, plays an important role in risk disclosure studies, as it has been used as an accounting-risk measure to proxy for company financing risk. In environmental disclosure studies, leverage is usually a control variable associated with voluntary disclosure theory. Details on previous studies using the selected control variables and how they will be measured are presented in the next sub-sections.

5.5.3.1 Company size

Company size has often been used in environmental disclosure and in risk disclosure studies as a control variable, as size is considered to capture most of the pressure from stakeholders (Patten, 2002; Bewley and Li, 2000) and to indicate the resources available for a company (Semenova, 2010). Prior studies have found a positive association between company size and the number of risk disclosures (Linsley and Shrives, 2006) and between company size and climate change disclosure (Prado-Lorenzo *et al.*, 2009; Stanny and Ely, 2008). A positive association has also been found between company size and environmental disclosure (Patten, 1992; Gray, Kouhy and Lavers, 1995a; Bewley and Li, 2000; Semenova, 2010), especially for companies in environmentally-sensitive industries (Deegan and Gordon, 1996). This relationship can be explained in a simple manner:

> "Once an industry is deemed to be environmentally damaging, all things being equal, it would be assumed that larger firms create more environmental costs than smaller ones, unless they provide evidence to the contrary." (Deegan and Gordon, 1996, p. 197)

The size of a company leads to "greater potential public pressure relative to environmental concerns" (Patten, 2002, p. 767), which justifies its usage as a proxy for stakeholder exposure, as "society may have higher expectations for the environmental performance of larger firms" (Bewley and Li, 2000, p. 208). Braam *et al.* (2016) found that company size and media coverage are collinear and suggested that company size could also be used as a proxy for corporate visibility (which is not an issue in this research as the proxy for media visibility is focused on GHG emissions context, not overall company's visibility).

Company size has been measured by total assets (Clarkson *et al.,* 2008; Semenova, 2010) and total sales (Deegan and Gordon, 1996; Patten, 2002; Linsley and Shrives, 2006; Cong and Freedman, 2011), which have been found to be highly correlated (Deegan and Hallam, 1991), in addition by market value of common equity (Al-Tuwaijri, Christensen and Hughes, 2004; Linsley and Shrives, 2006). Following previous studies, this research will adopt total assets as a proxy for company size, collected from 10-K Forms, in U.S. dollars, as of 31 December 2017. To reduce kurtosis of the distribution to acceptable levels for parametric statistics, the natural log of total assets will be used in the regressions.

5.5.3.2 Leverage

Leverage refers to the amount of debt incurred by a company. It has been employed in several environmental disclosure studies, as a financial control variable in alignment with voluntary disclosure theory. Leverage has also been used to proxy for pressure from providers of capital (Liesen *et al.,* 2015). In risk disclosure literature, leverage has been used as a proxy for financial risk, delivering inconclusive results – non-significant in Linsley and Shrives (2006) and Neri, Elshandidy and Guo (2018), and positive and significant in Elshandidy, Fraser and Hussainey (2013). In general, literature has evidenced that companies with higher leverage provide more risk disclosures (Elshandidy, Fraser and Hussainey, 2013) and higher levels of environmental disclosure (Clarkson *et al.*, 2008). In terms of GHG disclosures, the relationship with leverage was found to be positive when disclosure is measured using content analysis in the annual reports, sustainability reports and websites (Chithambo and Tauringana, 2014), while negative when measured based on CDP disclosure score (He, Tang and Wang, 2013).

For this study, leverage will be measured as the ratio of total debt divided by total assets, similarly to previous studies in the environmental disclosure field (Clarkson *et al.* 2008; Tang and Wang, 2013). Data to calculate the ratio will be collected from 10-K reports as of 31 December 2017.

5.6 Variables summary

The following table summarises the key information on the variables that will be included in the quantitative analysis, showing the type of variable and what it measures.

Table 5.2: Variables in the logistic and linear regression models

Dependent variables		
Variable	*Type*	*What it measures*
DISC_GHG	Categorical	Whether a company has disclosed at least one risk with at least one of these keywords in the title: "greenhouse gas", "GHG", "climate" (in the context of climate change), "carbon" or "global warming". 0= no GHG emissions risk, 1= with GHG emissions risk
DISC_Gen	Ratio	GHG emissions risk general disclosure, measured in words (number of words in sentences with no reference to a company's activities or situation, collected from 10-K annual reports)
DISC_Spe	Ratio	GHG emissions risk specific disclosure, measured in words (number of words in sentences referencing a company's activities or situation, collected from 10-K annual reports)
DISC_Tot	Ratio	GHG emissions risk total disclosure, measured in words, which corresponds to the sum of general and specific disclosures, collected from 10-K annual reports
DISCgenR	Ratio	Ratio of general disclosure to total disclosure
DISCspeR	Ratio	Ratio of specific disclosure to total disclosure
Independent variables		
Variable	*Type*	*What it measures*
RISK	Interval	GHG emissions risk, collected from MSCI ESG Rating and multiplied by -1, resulting in values between -10 and 0 (the higher the value, the higher the risk)
RISK_Mgt	Interval	GHG emissions risk management, between 0 and 10, collected from MSCI ESG Rating. The higher the value, the stronger a company's risk management
MEDIA	Ratio	Number of news stories mentioning a company's name and at least one of these keywords: "greenhouse", "GHG", "climate change", "carbon" or "global warming", collected from ABI/INFORM Global, considering printed and wired media
Control variables		
Variable	*Type*	*What it measures*
SIZE	Interval	Company size, measured as natural log of total assets in U.S. dollars, collected from 10-K reports
LEVERAGE	Ratio	Ratio of total debt divided by total assets, collected from 10-K annual reports

5.7 Hypotheses testing

This research will employ two types of regressions to test the hypotheses: binary logistic regression and ordinary least square (OLS) multiple regression. Binary logistic regression enables testing a model where the outcome variable is categorical, and the predictor variables are continuous or categorical. Using this method enables predicting the probability of the dependent variable occurring given known values of the predictors. In this research, logistic regressions were employed to determine whether and how GHG emissions risk, risk management and media visibility influence the presence or absence of GHG emissions risk disclosure in a company's Risk Factors section of the annual report.

OLS multiple regressions have been used in most of the empirical studies examining the association between constructs in the field of environmental disclosure (Cho, Roberts and Patten, 2010; Clarkson *et al.*, 2011; Dawkins and Fraas, 2011; Dobler, Lajili and Zéghal, 2014; Patten,

2002) and in the risk disclosure field (Elzahar and Hussainey, 2012; Neri, Elshandidy and Guo, 2018). Multiple regression enables determining the statistical significance of the predictions presented in the hypotheses, determining the strength of the relationship between a single dependent variable and multiple independent variables (Field, 2013), identifying the relative importance of each predictor.

The method of predictor selection adopted in this study for both types of regression will be the forced entry method, where all predictors are included in the model simultaneously, not requiring a decision about the order to enter them. The model relies on robust theoretical and empirical reasons for including the selected predictors and all of them are expected to significantly contribute to explain the dependent variable. This justifies using forced entry instead of the hierarchical regression (blockwise entry), where predictors are entered into the model in order of importance in predicting the dependent variable. An alternative method of predictor selection would be stepwise regression, which is more appropriate for exploratory purposes as the order to enter the predictors into the model is purely based on a mathematical criterion, influenced by random variation in the data and which may not provide replicable results, explaining why this method is avoided by statisticians (Field, 2013).

As the predictors include two risk measures (risk and risk management), two OLS multiple regression models have been developed for each dependent variable (presence of GHG emissions risk disclosure, general disclosure, specific disclosure, total disclosure and ratio of general or specific disclosure to total disclosure), following the example below on general disclosure:

$$\text{DISC\_Gen}_i = b_0 + b_1\,\text{RISK}_i + b_2\,\text{MEDIA}_i + b_3\,\text{SIZE}_i + b_4\,\text{LEVERAGE}_i + \text{error}_i$$

$$\text{DISC\_Gen}_i = b_0 + b_1\,\text{RISK\_Mgt}_i + b_2\,\text{MEDIA}_i + b_3\,\text{SIZE}_i + b_4\,\text{LEVERAGE}_i + \text{error}_i$$

A summary of the variables included in the estimation models is available in Section 5.6. Following the convention in business research, this study will use the significance level of 0.05.

5.8 Validity and reliability

Validity is mainly related to checking whether a measure of a concept really measures the respective concept. The measures used in this research follow the literature and industry practice, relying on the expertise of previous researchers to enhance face validity. This is also applicable to the measure of GHG emissions risk, which is mainly used in the financial market and has recently been employed in academic studies (Brogi and Lagasio, 2019; Kim, Chung and Park, 2013).

In terms of construct validity, most of the measures employed were previously used to proxy for the selected constructs. Although no other academic study was found collecting the risk measures from MSCI ESG Ratings, this dataset was designed to identify environmental, social and governance risks and opportunities, and MSCI is an experienced supplier in the field (more than 40 years measuring environmental performance).

Regarding convergent validity, when possible, measures of the same construct obtained through distinct methods will be employed for the variables of interest. In this sense, two measures related to risk will be employed (risk and risk management, from MSCI ESG Ratings) and two alternative measures of GHG emissions media visibility will be collected for the sensitivity analysis (both from ABI/INFORM Global but one grouping companies in categories e and the other focused on printed media).

Reliability is fundamentally concerned with consistency of measures (i.e. a measure should consistently reflect the construct being measured). All the independent variables in this research rely on secondary data, which have been used in academic papers and in the financial market. The independent variables of interest were collected from distinguished proprietary datasets (MSCI ESG Ratings for the risk variables, and ABI/INFORM Global for media visibility), while the control variables were collected from 10-K annual reports, all these information sources built on clear rules to ensure reliability. As explained in section 5.5.1, MSCI ESG Ratings are calculated based on more than 1,000 data-points collected from media sources, datasets and company's disclosures, reviewed by a team of 200 specialised ESG analysts, and companies are invited to verify data accuracy. As mentioned in Section 5.5.2, ABI/INFORM Global is one of the most comprehensive business research databases on the market, launched 50 years ago, providing access to the most important periodicals (trade journals, magazines and newspapers) which can be searched using a comprehensive search tool. And finally, as argued in section 5.4, 10-K annual reports are produced following specific requirements defined by the Stock Exchange, prohibiting companies from making false statements or omitting material information, and they are often reviewed by the Stock Exchange team. Searches on these platforms using the same criteria yield consistent results.

The dependent variables, measuring GHG emissions risk disclosure, rely on textual analysis, which is intrinsically subjective. However, reliability can be enhanced by developing decision rules that the coder can refer to. An initial sample of GHG emissions risks from 15 companies randomly selected (7.5% of the sample), was coded by the author, following Ingram and Frazier's (1980) definition of general and specific disclosure. The coding guide (Appendix 9.4) was built during this preliminary coding, and it was enhanced after the first invited coder applied it and results were compared with the coding produced by the author.

Krippendorff (1980) discusses three types of reliability applied to content analysis: stability, accuracy and reproducibility. Stability is related to coding the data consistently over time, which was tested by the author coding the reports from a sub-sample twice, following the same coding rules, ensuring intra-rater reliability. No clear indication on the recommended number of units that should compose this sub-sample has been found in the literature and several papers using content-analysis do not even mention this type of reliability. For this study, 7.5% of the sample, which corresponds to 15 companies randomly selected, were re-coded by the author after three months, following the same coding rules. The size of the sub-sample was considered appropriate because the difference between general and specific disclosure is objective.

The coded text was compared using NVivo, which provides two measures of inter-rater reliability for each code applied: percentage agreement and Kappa coefficient. Percentage agreement is the number of units of agreement divided by the total units of measure. While Kappa coefficient, which ranges from −1 to +1, considers the amount of agreement that could be expected to occur through chance, generating a coefficient= 1 when users are in complete agreement, or ≤ 0 when there is no agreement among the coders (other than what would be expected by chance). There is some controversy about what is considered a fair agreement, which may change depending on the research field and the purpose of the study, but in general a Kappa coefficient between 0.4 and 0.6 is considered moderate agreement and between 0.6 and 0.8 would be considered substantial agreement, while above 0.8 would indicate excellent agreement (McHugh, 2012; QSR International, 2015). The comparison between the reports coded twice by the author within a 3-month interval produced no value under 94 for percentage of agreement and under 0.89 for kappa coefficient, which indicate excellent agreement.

Accuracy is related to how well the coding reflect a pre-set standard, which in this case is addressed by developing and testing a detailed coding guide and by following previous studies (Hrasky, 2012; Ingram and Frazier, 1980) to classify disclosure sentences in general or specific information. The third type of reliability applied to content analysis identified by Krippendorff (1980), reproducibility, usually arises when there is more than one coder. In this study, all annual reports were analysed by the author, with two other coders involved only to test inter-rater reliability. These invited coders were selected due to their previous professional experience in environmental risk in environmentally-sensitive industries and their fluency in English. Each invited coder quantified GHG emissions risk disclosures from six randomly selected companies and results were compared. Comparing the coding done by the author with the first invited coder, no percentage of agreement was lower than 92 and no Kappa coefficient was smaller than 0.82. Although the results were satisfactory, there was opportunity to slightly enhance the coding guide adding some examples. A second coder has been invited to code six other randomly selected reports based on the updated coding guide. Inter-rater reliability between the author and the second coder was slightly higher, with no percentage of agreement lower than 92 and no Kappa coefficient lower than 0.84, confirming inter-coder reliability.

6 Quantitative analysis

This section presents the results of the quantitative analysis methods employed in this research, namely descriptive statistics, correlations and regressions, all of them carried out using IBM SPSS Statistics 26. Logistic regressions were employed to understand whether GHG emissions risk, risk management and media visibility influence the probability of a company disclosing a GHG emissions risk in its annual report. OLS multiple regressions were used to test whether GHG emissions risk, risk management and media visibility determine the extent of different types of GHG emissions risk disclosure. The main results are presented in this section and full SPSS reports are available in the Appendices.

6.1 Descriptive statistics

Descriptive statistics will be used to provide an overview of the data, aiming at describing the distribution of the companies in the sample according to each variable in the model. The main charts related to the variables of interest are presented in this section, complemented by histograms and scatter plots available in Appendix 9.5 (full sample) and 9.6 (sub-sample).

6.1.1 Descriptive statistics: Full sample

As presented in Table 5.1, the sample is composed of 200 companies, from the oil & gas, airlines, marine, road & rail transport, chemicals, metals & mining, construction materials, steel and paper & forest products industries. The full sample will be employed in the logistic regressions, focused on investigating what influences the probability of a company disclosing a GHG emissions risk. A sub-sample, composed of 132 companies that disclosed at least one GHG emissions risk, will be employed in the OLS multiple regressions, focused on investigating the predictors of different types of GHG emissions risk disclosure. Descriptive statistics will be presented below for the full sample and for the sub-sample.

Table 6.1: Descriptive statistics for the full sample (200 companies)

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
DISC_ GHG	200	0	1	0.66	0.47	-0.68	-1.55
RISK	200	-10.00	0	-2.59	2.06	-0.58	-0.03
RISK_MGT	200	1.60	7.70	3.11	1.32	1.21	0.88
MEDIA	200	0	1012	81.39	190.88	3.36	10.65
SIZE	200	13.47	26.57	22.22	1.78	-1.54	6.41
LEVERAGE	200	0.00%	173.34%	37.44%	23.98%	1.74	6.26

The table above presents the descriptive statistics for all variables used in the logistic regressions. DISC_GHG, the dependent variable, refers to whether a company has disclosed a GHG emissions risk or not. Its mean is 0.66 as 132 out of 200 companies disclosed a GHG emissions risk, which corresponds to 66% of the sample. The mean value for company's risk level is -2.59, varying from -10 (lowest risk level) to 0 (highest risk level). This is complemented by the histograms below, indicating that the most frequent value (mode) for risk is 0, scored by 40 companies (or 20% of the sample). This high risk level can be explained by the fact that all companies in the sample are members of industries with high carbon exposure and their company-specific risk management level has been poor, as observed on the second histogram below (mean of 3.11 out of 10, with more than 60 companies, or 30% of the sample, scoring 2.00, which represents weak risk management). The chart illustrating how risk management and risk exposure are combined to calculate risk is available in Figure 5.3.

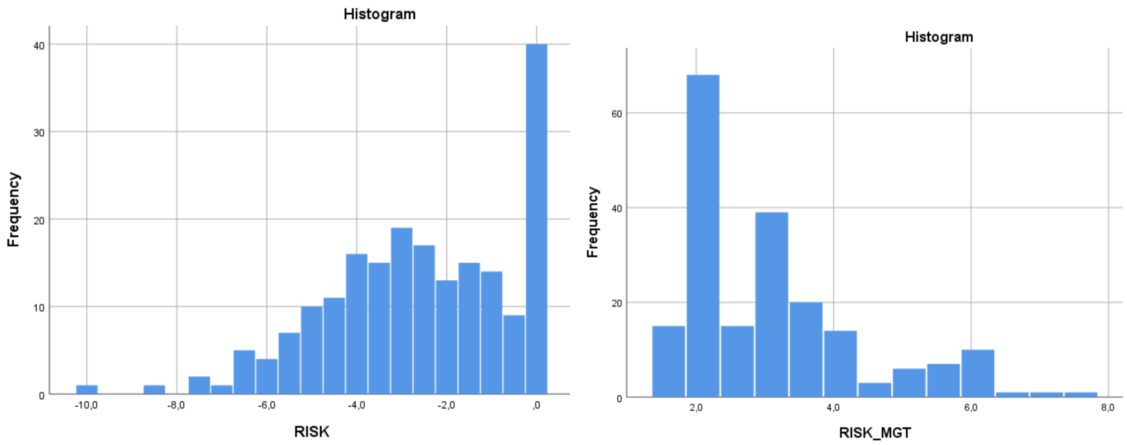

Figure 6.1: Risk and risk management variables histograms for the full sample

On average, companies were mentioned on 81 media articles covering the GHG context in 2017. The histogram below indicates that most companies had up to 200 mentions, with more than 150 companies being mentioned on up to 50 articles, with only some exceptions being mentioned on more than 400 articles. The corresponding scatter plot, also below, indicates several outliers and potential influential cases, which will be checked when the regressions are run. Considering that media visibility distribution is highly skewed, as evidenced in Table 6.1 above and in the next chart, two alternative measures will be explored in the sensitivity analysis: the first measure grouping companies in four categories depending on the number of mentions on GHG-related media articles, and the second measure focusing on traditional (printed) media only.

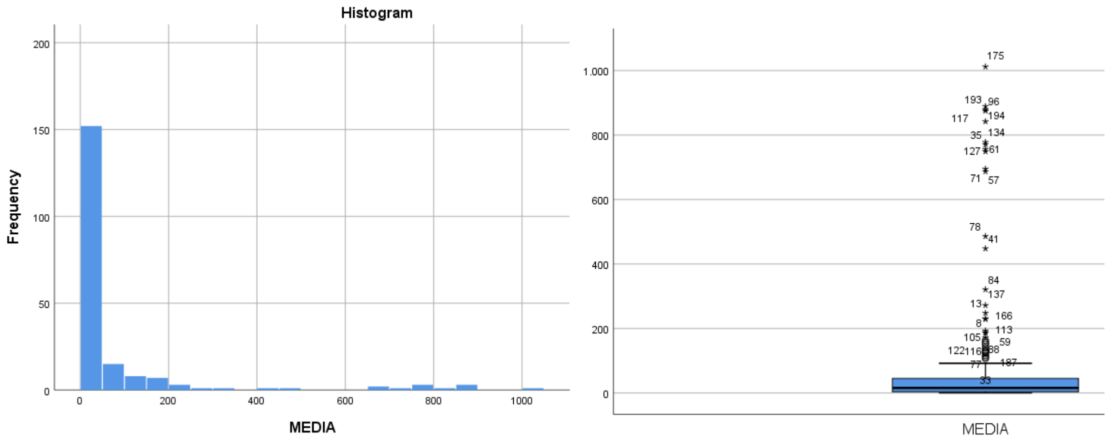

Figure 6.2: Media variable histogram and scatter plot for the full sample

Important to note that although skewness and kurtosis are not completely within the expected parameters for a normal curve for all variables (i.e. skewness between -1 and +1, and kurtosis between -4 and +4), there is no requirement for normality in the distributions that compose the independent variables in OLS regression. The assumption in this regard refers to normality of errors, which will be confirmed later.

6.1.2 Descriptive statistics: Sub-sample

The next table presents descriptive statistics for the 132 companies that disclosed at least one GHG emissions risk in their annual report, out of 200 companies that compose the full sample. The sub-sample will be used to run the OLS multiple regressions, with different types of disclosure as the dependent variable.

Table 6.2: Descriptive statistics for the sub-sample (132 companies)

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
DISC_Gen	132	0	1036	297.49	256.13	0.81	-0.22
DISC_Spe	132	26	709	229.33	111.00	0.73	1.69
DISC_Tot	132	29	1,340	526.83	289.77	0.52	-0.39
DISCgenR	132	0.00%	91.03%	48.04%	24.25%	-0.24	-0.84
RISK	132	-8.40	0	-2.40	1.97	-0.52	-0.35
RISK_MGT	132	1.70	6.40	3.04	1.19	1.09	0.53
MEDIA	132	0	1,012	110.79	228.05	2.62	5.79
SIZE	132	14.25	26.57	22.35	1.65	-1.16	4.80
LEVERAGE	132	0.00%	146.18%	37.55%	21.22%	1.52	4.80

On average, companies in the sub-sample provided 526 words of GHG emissions risk disclosure (DISC_Tot), which is roughly one page of single-spaced text, roughly composed of 297 words in sentences of general disclosure and 229 words in sentences of specific disclosure. Considering the proportion between general and specific disclosure, on average companies spend 48% of the words in their GHG emissions risk total disclosures with general disclosure. Looking at the minimum and maximum values, some companies spend up to 91% of the words in their GHG emissions risk disclosure with general sentences, while some use only specific disclosure (they scored 0% in DISCgenR). In sum, on average companies spend slightly more words providing specific GHG emissions risk disclosure (51.96%) than general disclosure (48.04%). The histogram below shows that there are companies using most of the combinations between general and specific disclosure, from 0% general disclosure and 100% specific disclosure, to 91.03% general disclosure and 8.97% specific disclosure.

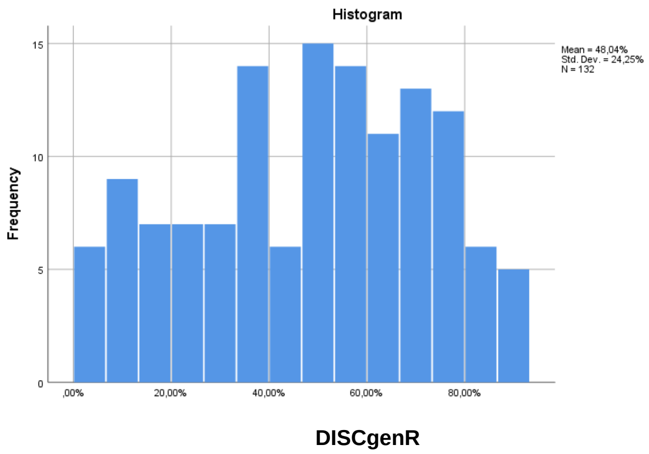

Figure 6.3: Ratio of general disclosure to total disclosure histogram for the sub-sample

Comparing with the full sample, the 132 companies that disclosed at least one GHG emissions risk presented slightly higher levels of risk (mean of -2.40 vs -2.59), slightly lower level of risk management (mean of 3.04 vs 3.11) and higher level of GHG media visibility (mean of 110.79 vs 81.39). Mean values for size and leverage are quite similar comparing both samples. The mean value of size, submitted to log transformation, corresponds to companies that declared total assets valued in US$ 4.7 billion (in the UK, companies with total assets equivalent to more than US$ 30 million are considered large companies). In terms of leverage, companies in the sub-sample, on average, have their ratio of total debt to total assets at 37.55%.

Most variables present skewness and kurtosis values which fall within the benchmarks (i.e. between -1 and 1 for skewness and -4 and 4 for kurtosis), with MEDIA being the furthest distribution from a normal curve. If outliers and influential cases are identified when running the regressions, they will be dealt with.

6.1.3 Differences in characteristics of companies that report and do not report GHG information

As detailed in the previous section, the sub-sample of companies reporting GHG risk information is composed of 132 companies, while the other 68 companies in the full sample do not report it. The previous section demonstrated that both the full sample and the reporting sub-sample present quite similar descriptive statistics when looking at each variable in the model, although companies in the sub-sample are slightly riskier, with weaker risk management and higher media visibility. This section compares companies reporting GHG emission risk disclosure with those not providing this type of disclosure, highlighting their main differences.

As explained in the Research Design, companies considered not providing GHG emissions risk disclosure are those that did not include GHG-related keywords in the title of the risk factors presented in their annual report. However, they may have included this information in the explanation of a risk that is not properly named as a GHG or climate change risk, in such a way they did not clearly convey that they are reporting it.

Regarding differences in the industries of the companies that compose the sample, as presented in Table 5.1, a proportion between 40% and 50% of the companies in each industry provided GHG emission risk disclosure, while in the oil & gas industry, 80.2% of the companies did so, demonstrating that this type of disclosure is considerably more frequent in this industry. This is not a surprise as the oil & gas industry is considered the top sector acknowledging climate change as a potential risk to the business in the annual report (81%), while only 41% of companies in the Industrials, Metals & Manufacturing industry acknowledge it (KPMG, 2020). In addition, the oil & gas is historically a high carbon industry and was highlighted by the TCFD as a sector with particular exposure to climate risk. The next table presents the descriptive statistics for the sub-sample of 68 companies not providing GHG emission risk disclosure.

Table 6.3: Descriptive statistics for the companies not providing GHG emissions risk disclosure (68)

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
RISK	68	-10.00	0	-2.96	2.20	-0.60	0.22
RISK_MGT	68	1.6	7.7	3.24	1.55	1.19	0.55
MEDIA	68	0	172	24.32	39.04	2.30	4.91
SIZE	68	13.47	25.98	21.95	1.99	-1.90	7.48
LEVERAGE	68	0.00%	173.34%	37.23%	28.77%	1.86	6.30

Comparing with descriptive statistics of the sub-sample of companies providing GHG emission risk disclosure, in Table 6.2, the table above shows that the companies not providing GHG emissions risk disclosure follow quite similar characteristics of those providing it regarding to risk, risk management, size and leverage. However, MEDIA exposure is quite different between the two groups: while those companies reporting GHG emission risk disclosure had up to 1,012 mentions on the media per year, with a mean value of 110.79 media articles mentioning them, the companies not providing GHG emission risk disclosure had up to 172 media articles mentioning them throughout the year, with a mean value of 24.32 articles, showing that the non-reporting group is considerably less visible on the media. This difference is evidenced in the histograms below showing the distribution of the MEDIA variable for both sub-samples, demonstrating that the companies not providing GHG emissions risk disclosure compose a more homogeneous group of companies with low visibility on the media, with most of them not exceeding 50 mentions.

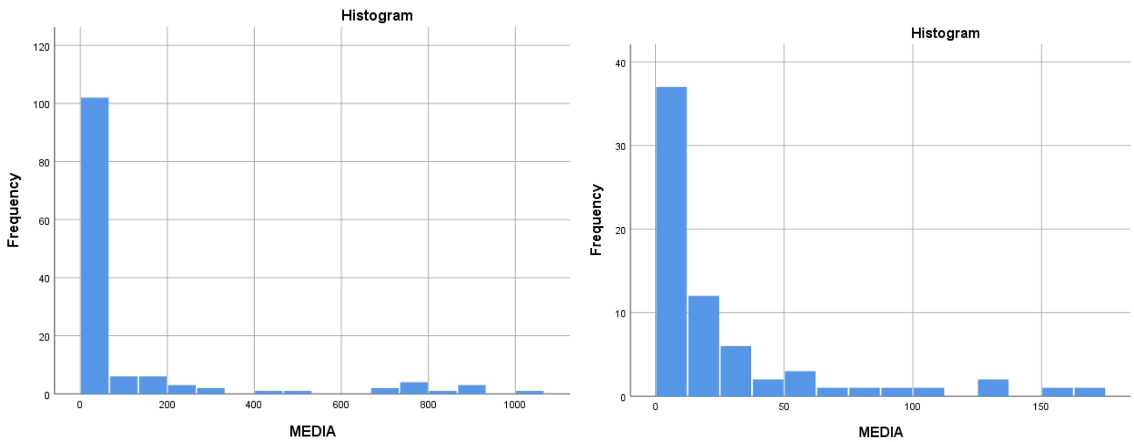

Figure 6.4: Media histograms for the companies providing (left) and not providing (right) GHG emissions risk disclosure

6.2 Correlations

Potential correlations between the variables were tested using SPSS to calculate Pearson's correlation coefficient. Correlation coefficients demonstrate whether the variables are associated and the strength of the association, which may indicate potential multicollinearity issues amongst the independent variables.

6.2.1 Correlations for the full sample

The table below presents the correlations between the variables employed in the logistic regressions for the full sample, composed of 200 companies.

Table 6.4: Pearson's correlation coefficients for the full sample (200 companies)

	DISC_GHG	RISK	RISK_MGT	MEDIA	SIZE	LEVERAGE
DISC_GHG	1					
RISK	0.129 (0.068)	1				
RISK_MGT	-0.070 (0.323)	-0.638** (0.000)	1			
MEDIA	0.215** (0.002)	-0.228** (0.001)	0.107 (0.131)	1		
SIZE	0.108 (0.129)	-0.262** (0.000)	0.395** (0.000)	0.304** (0.000)	1	
LEVERAGE	0.006 (0.929)	-0.090 (0.204)	0.004 (0.954)	0.010 (0.883)	0.035 (0.618)	1

***. Correlation is significant at the 0.01 level (2-tailed).*

The table above indicates a moderate correlation between risk and risk management (-0.638), which is not a concern as these variables will not be used in the same regression models. As expected by definition, risk is negatively related to risk management (better risk management is associated with lower risk level). All the other correlation coefficients are lower than 0.4, indicating that there is a linear relationship between each pair of variables however it is not strong. There is a significant positive relationship between media and the presence of a GHG emissions risk in the annual report (DISC_GHG), which suggests that more mentions on media articles covering the GHG context are associated with increased likelihood of disclosing a GHG emissions risk. The table also shows that the relationship between media and risk is negative and significant (i.e. higher risk levels are associated with less media visibility), which is quite unexpected considering legitimacy theory would predict that higher risk companies would be under greater scrutiny from society.

6.2.2 Correlations for the sub-sample

The next table presents the correlation coefficients for the sub-sample, composed of 132 companies disclosing at least one GHG emissions risk in their annual reports. The sub-sample will support the OLS multiple regressions to investigate whether GHG emissions risk, risk management and media visibility determine the extent of different types of GHG emissions disclosure. The variable DISCspeR (ratio of specific disclosure to total disclosure) has not been included in the next table as its correlation coefficients are similar to the ones yielded by DISCgenR (ratio of general disclosure to total disclosure), with opposite sign and similar significance level, as they are related by definition.

Table 6.5: Pearson's correlation coefficients for the sub-sample (132 companies)

	DISC_Gen	DISC_Spe	DISC_Tot	DISCgenR	RISK	RISK_MGT	MEDIA	SIZE	LEVERAGE
DISC_Gen	1								
DISC_Spe	0.106 (0.225)	1							
DISC_Tot	0.925** (0.000)	0.477** (0.000)	1						
DISCgenR	0.827** (0.000)	-0.246** (0.004)	0.637** (0.000)	1					
RISK	0.340** (0.000)	0.097 (0.267)	0.338** (0.000)	0.288** (0.001)	1				
RISK_MGT	-0.261** (0.002)	-0.073 (0.406)	-0.259** (0.003)	-0.219* (0.012)	-0.601** (0.000)	1			
MEDIA	-0.129 (0.141)	0.188* (0.031)	-0.042 (0.633)	-0.186* (0.032)	-0.338** (0.000)	0.147 (0.092)	1		
SIZE	-0.070 (0.425)	0.148 (0.090)	-0.005 (0.953)	-0.128 (0.142)	-0.313** (0.000)	0.355** (0.000)	0.343** (0.000)	1	
LEVERAGE	0.103 (0.242)	0.063 (0.472)	0.115 (0.190)	0.037 (0.674)	-0.150 (0.085)	0.109 (0.212)	0.011 (0.900)	-0.089 (0.311)	1

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

The table above indicates that there is a high and significant positive correlation (0.925) between general disclosure and total disclosure, which is not seen between specific disclosure and total disclosure (0.477). As expected, a high correlation also occurs between general disclosure and the ratio of general disclosure to total disclosure (0.827), which is not an issue as they will be used in distinct models. Risk is positively correlated with all types of disclosures, while risk management is negatively correlated with all types of disclosures, both significant for general and total disclosure and for the ratio of general to total disclosure, with all correlation coefficients weaker than 0.35. The moderate correlation between risk and risk management (-0.601, negative as expected by definition) does not represent an issue as these variables will not be employed in the same estimation model.

The relationship between media and the disclosure variables is weak (all coefficients are between -0.2 and 0.2), being the relationship negative except for specific disclosure (i.e. reduced media coverage is associated with increased general and total disclosure and increased ratio of general to total disclosure, while increased media coverage is associated with increased specific disclosures).

6.3 Logistic regressions

Binary logistic regression has been employed to determine whether and how GHG emissions risk, risk management and media visibility influence the presence of GHG emissions risk disclosure in a company's Risk Factors section of the annual report, considering the full sample composed of 200 companies.

6.3.1 Diagnostics

The estimation models are composed of a categorical variable (0 when a company did not disclose a GHG emissions risk, and 1 otherwise) as the dependent variable, and risk or risk management, media visibility, size and leverage as predictors. Residual statistics have been checked, as detailed below, to make sure the model is not biased. Parameters for standardised residuals, Cook's distance and leverage were considered, as explained in the next paragraphs.

According to the Empirical Rule (also named '68-95-99.7% Rule'), 95% of the observations in a normal curve should fall within 2 standard deviations of the mean, therefore, when more than 5% of the residuals fall outside 2 standard deviations from the mean, the furthest residuals from the mean should be investigated and maybe removed from the sample, as they may be exerting an undue influence on the model. For the regression employing the risk variable, 4 cases fall outside 1.96 standard deviation, which is within the limit of 5% of the sample, or 10 cases. For the regression model employing the risk management variable, only 3 cases fall outside 1.96 standard deviation, also within the limit of 5% of the sample. Details of their distance from the mean are provided in the table below.

Table 6.6: Residuals outside 1.96 standard deviations in the logistic regression models

Model	**RISK (1a)**	**RISK_Mgt (1b)**
Residuals outside 1.96 standard deviations	4 residuals -2.604 -2.416 -2.138 -2.042	3 residuals -2.123 -2.117 -2.078

Cook's distance is a measure that consider the impact of a single observation on the whole estimation model, and values greater than 1 may potentially affect results (Field, 2013, p. 306). The maximum value for Cook's distance in the regression employing the risk variable (model 1a) was 0.381, while in the equation employing risk management (model 1b) it was 0.308, both considerably lower than 1, therefore there was no reason for concern based on this measure.

Leverage measures the influence of the observed value of the dependent variable over the predicted values. The expected value for leverage is $(k+1)/N$, where k is the number of predictors and N is the sample size (Field, 2013, p. 791). In this case, $(4+1)/200=0.025$. Any value bigger than 3 times leverage, or 0.075 in this case, could be cause of concern. For the equation employing the risk variable (1a), 7 cases produced leverage statistics above 0.075, specified below, while for the equation with risk management (1b), there were 8 cases. However, as Cook's value was considerably low for all these cases (less than 0.390), there was little reason to delete these observations.

Table 6.7: Leverage values above expectation in the logistic regression models

Model	RISK (1a)	RISK_Mgt (1b)
Leverage values	0.204	0.197
	0.194	0.176
	0.171	0.173
	0.157	0.160
	0.129	0.143
	0.089	0.094
	0.075	0.087
		0.077

After confirming that there was no case over influencing the model, based on the diagnostics above, results are presented in the next section.

6.3.2 Results

Summarised results are presented below, and the corresponding tables extracted from SPSS are available in Appendices 9.7.1 and 9.7.2. In model 1a, the odds ratio Exp(B) is higher than 1 for GHG emissions risk (RISK) and for GHG emissions media visibility (MEDIA) and both are significant at 0.05 level, which indicates that higher risk level and higher GHG media visibility increase the likelihood of disclosing GHG emissions risk (DISC_GHG). Results also indicate that a unit increase in RISK increases the probability of disclosing a GHG emissions risk in 25.2%, while a unit increase in MEDIA increases the probability in 0.8%.

Table 6.8: Results of logistic regression employing the risk variable (model 1a)

	B	Standard error	Sig.	Exp(B)	95% C.I. for Exp(B) Lower	Upper
Constant	-1.006	2.022	0.619	0.366		
RISK	0.225	0.079	0.005	1.252	1.072	1.463
MEDIA	0.008	0.003	0.019	1.008	1.001	1.014
SIZE	0.086	0.094	0.360	1.089	0.907	1.308
LEVERAGE	0.001	0.006	0.934	1.001	0.988	1.013

Note: -2LL=232.863, R^2= 0.111 (Cox & Snell) 0.154 (Nagelkerke), $p < 0.01$

For the model employing risk management (1b), presented in the next table, MEDIA is significant at 5%, while RISK_Mgt is borderline non-significant (p=0.055). Aligned with the previous model, results suggest that higher GHG media visibility increases the likelihood of a company disclosing a GHG emissions risk. In the model below, one unit increase in media visibility increases the probability of DISC_GHG occurring in 0.7%, aligned with the previous model, that indicated this increase at 0.8%.

However, the relationship between risk management and the likelihood of disclosing a GHG emissions risk is in the opposite direction, comparing with the risk variable in previous model: results suggest that stronger risk management (which is often associated with a lower risk level) reduces the likelihood of disclosing a GHG emissions risk. One unit increase in RISK_Mgt decreases the probability of DISC_GHG occurring in 21.7% (1- odds ratio of RISK_Mgt, which is 1 - 0.783).

Table 6.9: Results of logistic regression employing the risk management variable (model 1b)

					95% C.I. for Exp(B)	
	B	**Standard error**	**Sig.**	**Exp(B)**	**Lower**	**Lower**
Constant	-1.077	2.053	0.600	0.341		
RISK_Mgt	-0.245	0.127	0.055	0.783	0.610	1.005
MEDIA	0.007	0.003	0.025	1.007	1.001	1.014
SIZE	0.100	0.099	0.311	1.105	0.911	1.342
LEVERAGE	-0.001	0.006	0.881	0.999	0.987	1.012

Note: -2LL=237.586, R^2= 0.090 (Cox & Snell) 0.124 (Nagelkerke), $p < 0.01$

XPost Blogit workbook (Cheng and Long, 2018) has been employed to compare the effect of RISK, RISK_Mgt and MEDIA on DISC_GHG. Histograms showing the distributions are displayed below to facilitate interpretation. At the bottom of the RISK histogram, two values were added to the X axis, corresponding to the mean (-2.59) and the value of RISK at one positive standard deviation (-0.53), and below them, the respective probability of DISC_GHG occurring considering all the other variables in the model (1a) at the mean value. Thus, a one standard deviation increase in RISK increases the probability of disclosure by 8.1% (difference between 81.4% and 73.3%).

At the MEDIA histogram below, two values have also been added to the X axis: the mean (81.39) and MEDIA at one positive standard deviation (272.27), and the respective probabilities of a company disclosing a GHG emissions risk considering all the other variables in the model (1a) at the mean. Thus, a one standard deviation increase in MEDIA increases the probability of disclosure by 19.4% (difference between 92.7% and 73.3%). Therefore, comparing the increase in the probability from one positive standard deviation increase, we conclude that both RISK and MEDIA have an effect on DISC_GHG, but MEDIA seems to be more influential (19.4% > 8.1%).

However, it is important to keep in mind that the MEDIA distribution is visibly not a normal curve, confirmed by skewness (3.36) and kurtosis (10.65) values presented in Section 6.1.1. Therefore, the MEDIA distribution does not follow the rule that 68% of the cases should be within one standard deviation from the mean, as it would be expected in a normal curve.

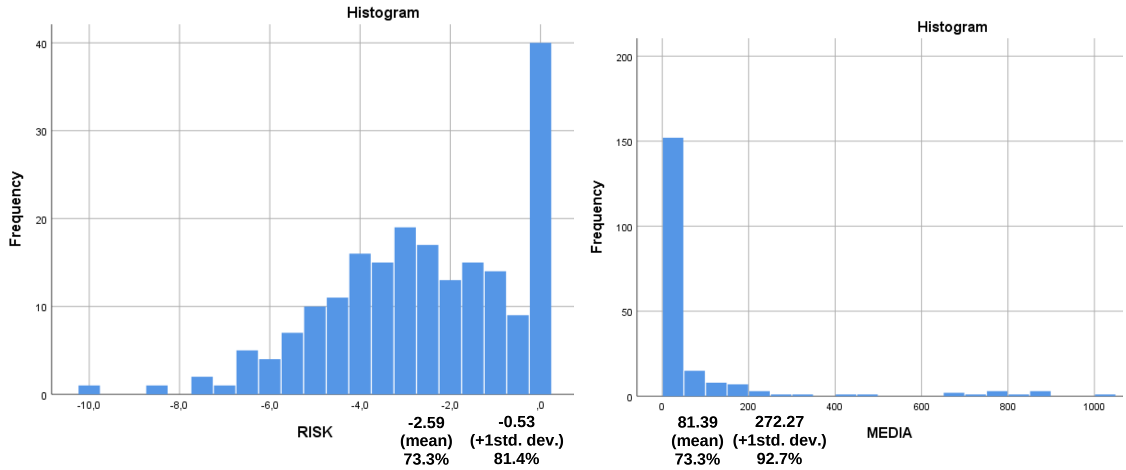

Figure 6.5: RISK and MEDIA histograms with mean and one positive standard deviation

For model 2a, two values have been added to the RISK_Mgt histogram below: the mean value (3.11) and RISK_Mgt at one positive standard deviation (4.43), with the respective probabilities of DISC_GHG occurring when all the other variables in the model are at the mean. Thus, one standard deviation increase in RISK_Mgt decreases the probability of disclosure by 7% (difference between 71.4% and 64.4%). Results for MEDIA in model (1b) indicate that one standard deviation increase in MEDIA increases the probability of disclosure by 19.1%, very close to the increase of 19.4% found in model (1a). Therefore, results from model 2a also suggest that both RISK_Mgt and MEDIA have an effect on DISC_GHG, but MEDIA seems to be more influential (19.1% > 7%).

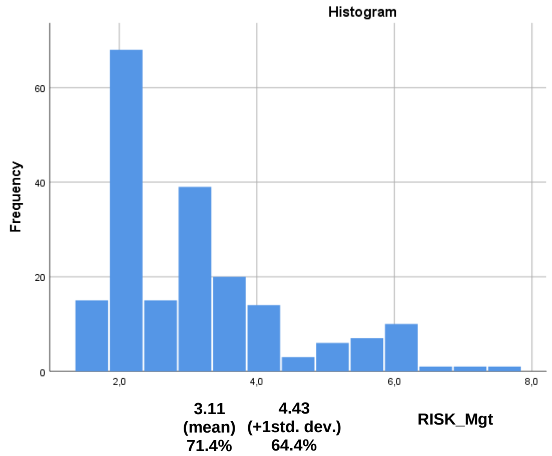

Figure 6.6: Risk management histogram

The findings are aligned with predictions from legitimacy theory: companies under legitimacy threats (i.e. higher risk level, weaker risk management or higher media visibility) are motivated to provide more disclosures to protect their legitimacy. The opposite sign comparing RISK and RISK_Mgt (i.e. an increase in RISK increases the probability of a company disclosing a GHG emissions risk, while an increase in RISK_Mgt reduces it) reiterates the fact that, as presented in Section 6.2, risk is negatively correlated with risk management, which implies that stronger risk management is associated with reduced risk, while a weaker risk management is associated with increased risk.

The result for MEDIA could also be interpreted from the lenses of the voluntary disclosure theory: considering disclosure as a tool to reduce the information gap between a company and the market, when the market is more informed about the company, its information expectation is higher, increasing the information threshold. Non-significant relationships have been found between the control variables, namely size and leverage, and the probability of disclosing GHG emissions risk. Considering only the companies in the sample disclosing GHG emissions risk (132 out of 200), the next section will investigate what determines the level and quality of disclosure provided.

6.4 OLS multiple regressions

This section presents the results of the OLS multiple regressions, employed to test the relationship between risk, risk management and media visibility as predictors of different types of GHG emissions risk disclosure, namely: general, specific and total disclosure and ratio of general or specific disclosure to total disclosure. Regressions will be conducted using a sub-sample composed of 132 companies which provided GHG emissions risk disclosure in 2017. The section also explains how each assumption has been tested, ensuring that the results are valid.

6.4.1 Preliminary analysis and assumptions

This section explains the steps taken for the preliminary analysis and for the assessment of the assumptions, to make sure the regression models are not unduly biased. The preliminary analysis is mainly related with identifying missing cases (none identified), outliers and influential cases, and with multicollinearity. The assumptions are related to assessing independence of errors, linearity, homoscedasticity and normality of errors. Charts and tables related to the preliminary analysis and the assumptions are available in the SPSS reports included in Appendix 9.8.

6.4.1.1 Outliers and influential cases

Outliers are observations with unusual data, that deviates from the rest of the sample, and their presence can bias the estimation. Influential cases are those outliers that exert a huge influence over the model. In OLS regression, outliers may have an even greater influence as deviations are squared. Outliers were investigated using Casewise Diagnostics tool (based on the Empirical Rule), followed by checking Cook's and Mahalanobis distances, and Standardised DfBeta.

Alignment with the Empirical Rule was checked in all linear regression models (5%, or 6 residuals for a sample of 132 companies, were allowed outside 2 standard deviations). No observation was removed based on the application of the Empirical Rule as no regression model produced more than 6 residuals outside 2 standard deviations, as detailed below.

Table 6.10: Residuals outside 2 standard deviations in the OLS regression models

Dependent variable	**DISC_Gen**		**DISC_Spe**		**DISC_Tot**		**DISCgenR**	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Residuals	4 residuals	5 residuals	6 residuals	4 residuals	5 residuals	3 residuals	6 residuals	4 residuals
outside 2	2.790	2.622	3.774	3.879	2.505	2.535	-2.379	-2.295
standard	2.745	2.618	2.339	2.360	2.111	2.530	2.271	-2.238
deviations	2.198	2.144	-2.235	2.183	2.064	2.037	2.250	-2.111
	2.193	2.106	2.125	-2.052	2.060		2.074	-2.036
		2.013	2.113		2.058		-2.063	
			2.112				-2.051	

After checking the residuals based on the Empirical Rule, the values for Cook's distance were checked. In this research, Cook's distance was checked for all regression models to make sure the value was less than 1 for all observations. Similarly with the Empirical Rule, no case has been removed based on Cook's distance, as evidenced by the maximum Cook's values presented in the next table (none above 0.37).

Table 6.11: Maximum values for Cook's distance in the OLS regression models

Dependent variable	**DISC_Gen**		**DISC_Spe**		**DISC_Tot**		**DISCgenR**	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Cook's distance	0.109	0.166	0.302	0.361	0.074	0.120	0.104	0.148

Mahalanobis distance is another measure to identify influential cases, associated with the influence of the observed value of the dependent variable over the predicted values. In this research, cut-off point for Mahalanobis distance was calculated considering the number of predictors, the sample size and the significance level. Following Barnett and Lewis (1978), the cut-off adopted was 18.43, which is recommended for a sample with 100 observations, using 4 predictors, at 0.05 significance level – in Barnett and Lewis' (1978) table, 100 was the closest sample size to the 132 companies employed in this research; the next sample size in their table was 200. The maximum Mahalanobis distance observed was 33.548 for the regression models using the risk variable, and 32.155 for the models using risk management.

In all OLS regression models, three cases presented Mahalanobis above the threshold adopted for this research (18.43), all of them from the oil & gas industry. These three cases were removed, one by one, resulting in a regression model meeting all the thresholds above (Empirical Rule, Cook's distance and Mahalanobis distance) and the cut-off for Standardised DfBeta, explained below. Results for the resulting sample with 129 companies were similar to those produced by the regressions using the full sub-sample (132 companies instead of 129). The similarity with the results without removing the potential influential cases indicates that the outliers exert small influence on the model (which was expected, considering their low Cook's distance).

The third measure to identify influential cases is Standardised DfBeta, which indicates the difference between a parameter estimated using all observations in the sample and using all the other observations except for a specific one. Values for Standardised DfBeta were checked, looking for absolute values above 1 to be excluded (Field, 2013, p. 308). No case has been excluded based on this measure, in alignment with the maximum absolute values identified in each regression model with the full sub-sample (132 companies), presented in the table below (none above 0.9).

Table 6.12: Maximum values for Standardised DfBeta in the OLS regression models

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Standardised DfBeta	0.729	0.897	0.811	0.876	0.597	0.762	0.711	0.848

6.4.1.2 Multicollinearity

Multicollinearity is related to the degree of correlation between the independent variables in the model. High levels of collinearity between the predictors (above 0.8 or 0.9) may generate untrustworthy *b* coefficients (motivated by increases of their standard errors), limit the amount of variation in the outcome the model accounts for, and provide no clarity of the importance of the predictors, as collinear variables would account for similar variance in the outcome (Field, 2013).

Multicollinearity was initially considered observing Pearson's correlation coefficients, which revealed no high correlation between variables used in the same estimation model (Section 6.2.2). After running each regression model, this assumption was assessed based on the variance inflation factor (VIF) and tolerance statistics. VIF indicates whether a predictor has a strong linear relationship with any other predictor in the model, while the tolerance statistics is calculated as 1 divided by VIF. General guidelines suggest that there should be no VIF greater than 10, while tolerance statistic below 0.2 indicates a potential problem (Field, 2013). All estimation models in this research presented VIF and collinearity tolerance within the expected parameters, therefore no variable has been removed from the models due to collinearity issues. All multiple regressions employing the risk variable presented the maximum value of VIF of 1.229, while it was 1.297 for the models employing risk management, both much lower than the threshold of 10.

6.4.1.3 Independence of errors

The assumption of independence of errors posits that the residuals of any two observations should be uncorrelated, or independent, which could be confirmed looking at Durbin-Watson test. Field (2013, p. 311) advises that Durbin-Watson values smaller than 1 or greater than 3 are certainly cause for concern, which is aligned with Norušis' (2005) argument that Durbin-Watson values should be between 1.50 and 2.50. All regression models in this research, except for one, produced Durbin-Watson values within the limits set by Norušis' (2005), while the only exception was marginally outside these limits but still within the limits set by Field (2013), as summarised below. Therefore, there were no issues related to independence of errors.

Table 6.13: Durbin-Watson values in the OLS regression models

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Durbin-Watson	2.286	1.575	1.744	1.776	1.472	1.811	1.519	1.589

6.4.1.4 Linearity and homoscedasticity

Linearity and homoscedasticity are two other assumptions that should be confirmed to avoid bias in the model, and they can be checked in conjunction, using a scatterplot. Linearity implies that there should be a linear relationship between the predictor variables and the dependent variables, while homoscedasticity implies that the variance of the dependent variable is constant at all levels of the predictor variables.

Linearity and homoscedasticity can be confirmed using a plot of standardised residuals against standardised predicted values, which should look like a random array of dots, demonstrating that there is no systematic relationship between the predicted values and the errors in the model. The plot below was produced by the model with general disclosure as the dependent variable and risk as one of the predictors (model 2a), confirming that there are no issues with linearity and homoscedasticity. The plots for all the other linear regressions (available in Appendix 9.8) also look like a random array of dots, demonstrating that the assumptions of linearity and homoscedasticity have been met in all situations.

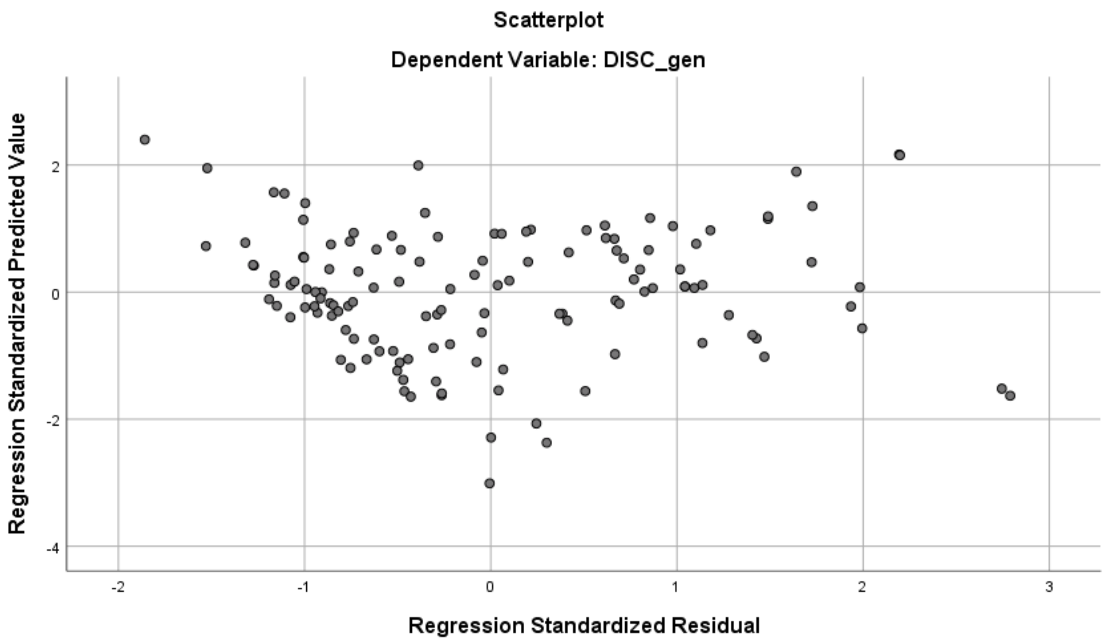

Figure 6.7: Plot of standardised residuals against standardised predicted values for model 2a

6.4.1.5 Normality of errors

The assumption of normally distributed errors posits that the difference between the predicted values and the observed values should be random and normally distributed, with a mean of 0. This means that most of the residuals will be zero or very close to zero, with only a few exceptions, following the Empirical Rule.

Two charts enable checking this assumption, both available for all models in Appendix 9.8: the standardised residuals histogram and the normal probability plot (P-P plot). The histogram should be approximately bell-shaped, while the dots on the P-P plot should lie along the diagonal line, which indicates a normal distribution (Field, 2013, p. 350). The following charts were produced for model 2a (with general disclosure as the dependent variable and risk as one of the predictors), confirming that the assumption of normality of error has been met. All the other charts look quite similar, confirming that this assumption has been met in all linear regression models.

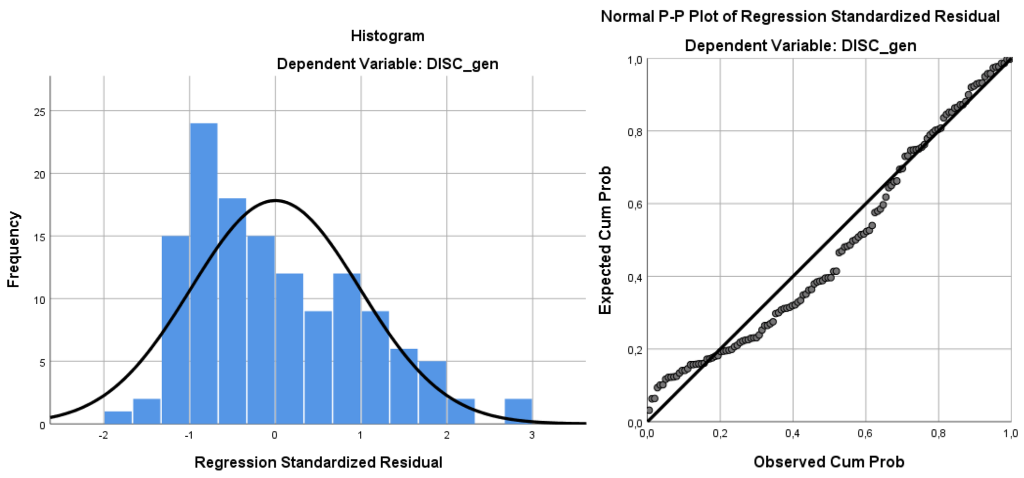

Figure 6.8: Standardised residuals histogram and P-P plot for model 2a

6.4.2 Results of the OLS multiple regressions

OLS multiple regressions (or linear regressions) have been employed to test the relationship between risk, risk management and media as predictors of the different types of GHG emissions risk disclosure, considering a sub-sample of 132 companies that disclosed a GHG emissions risk in their 2017 annual report. Results are summarised in the following table.

Table 6.14: OLS multiple regressions results

Dependent variable	**DISC_Gen**		**DISC_Spe**		**DISC_Tot**		**DISCgenR**	
Model	*(2a)*	*(2b)*	*(3a)*	*(3b)*	*(4a)*	*(4b)*	*(5a)*	*(5b)*
Intercept	92.164	140.012	-9.677	8.011	82.487	148.023	55.505*	58.672*
	(0.296)	(0.438)	(-0.070)	(0.057)	(0.237)	(0.410)	(1.834)	(1.914)
RISK	49.161***		13.234**		62.395***		3.267***	
	(4.162)		(2.511)		(4.719)		(2.845)	
RISK_Mgt		-62.249***		-15.183*		-77.433***		-4.140**
		(-3.183)		(-1.764)		(-3.506)		(-2.207)
MEDIA	-0.031	-0.132	0.103**	0.076*	0.072	-0.056	-0.010	-0.017*
	(-0.307)	(-1.307)	(2.274)	(1.708)	(0.632)	(-0.491)	(-1.026)	(-1.740)
SIZE	11.244	13.277	10.631*	10.770	21.875	24.047	-0.082	0.054
	(0.805)	(0.897)	(1.706)	(1.654)	(1.399)	(1.439)	(-0.060)	(0.038)
LEVERAGE	2.007**	1.729*	0.577	0.489	2.584**	2.218*	0.089	0.070
	(1.982)	(1.673)	(1.276)	(1.076)	(2.279)	(1.901)	(0.900)	(0.708)
Observations	132	132	132	132	132	132	132	132
Adjusted R^2	0.117	0.071	0.065	0.042	0.136	0.074	0.070	0.047
F-statistics	5.360***	3.512***	3.264**	2.424*	6.155***	3.621***	3.448**	2.609**

***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. This table reports ordinary least squares coefficient estimates and t-statistics (in parentheses). DISC_Gen refers to general disclosure DISC_Spe refers to specific disclosure and DISC_Tot refers to total disclosure, all of them measured in number of words. DISCgenR refers to the ratio of general disclosure to total disclosure, measured as a percentage. RISK and RISK_Mgt refer to GHG emissions risk and risk management, respectively. MEDIA proxies for GHG media visibility, measured in number of media articles. SIZE refers to company size (natural log of total assets) and leverage refers to financial leverage (ratio of total debt to total assets). Detailed descriptions of all variables are provided in Sections 5.4 and 5.5, and summarised in Section 5.6.

When regression results indicate outliers and influential cases, they were removed based on Cook's, Mahalanobis and Standardised DfBeta values. As there were not significant differences between the results from the full sub-sample and from the sub-sample removing outliers (i.e. outliers were not big enough to bias the results), the table above presents the results for the full sub-sample (132 companies). Detailed report from SPSS for the results from the full sub-sample and from the sub-sample removing outliers are available in the Appendix 9.8.

The table above shows that all regression models are significant to explain GHG emissions risk disclosure, with their explaining power (adjusted R^2) ranging from 0.04 to 0.13. Results evidence that both risk and risk management are significantly related to all types of disclosure, being a positive relationship with risk and a negative relationship with risk management. Risk and risk management variables are significant at 0.05 level in all models, except for the 3b model, where RISK_Mgt is only significant at 0.1 level. Therefore, results suggest that companies with higher GHG emissions risk provide higher levels of disclosure in all categories, including a higher proportion of general disclosure to total disclosure. The latter is confirmed by comparing beta coefficient for general disclosure (49.16) and for specific disclosure (13.23), indicating that for each one-point increase in risk, 49 words are added to general disclosure and only 13 for specific disclosure.

GHG media visibility (MEDIA) is only significantly related at 0.05 level to specific disclosure, which suggests that companies mentioned on more media articles in a GHG context provide higher levels of specific disclosure. Size was not significantly related at 0.05 level to any disclosure variable, while leverage is significantly related to general disclosure and total disclosure in the models using the risk variable.

Results are aligned with legitimacy theory, as higher risk and weaker risk management are related to higher levels of general, specific and total disclosures. Media was found to positively influence the level of specific disclosure and increasing the ratio of specific disclosure to total disclosure, which could be motivated by legitimation purposes (higher media visibility put companies under greater scrutiny) or economic purposes (stakeholders' knowledge about the company demanding more disclosures). A detailed discussion on the findings is provided under each hypothesis, in Section 7.1

6.5 Sensitivity analysis

Considering the importance of media visibility as a potential predictor of disclosure in this research and the high skewness of its distribution, the estimation models were also tested using two alternative measures of GHG emissions media visibility. The first is a measure that captures extent of visibility, grouping the companies under none, little, medium and high visibility categories. The second is a media visibility measure that focuses on traditional media only, instead of including electronic sources as in the main analysis. Regressions with both alternative measures of media visibility are discussed in the next sub-sections.

6.5.1 Extent of media visibility

Considering that the measure of media visibility is highly skewed both for the full sample and for the sub-sample of companies reporting GHG emissions risk (see tables 6.1 and 6.2), a measure that captures extent of visibility has been employed, grouping the companies into four categories (MEDIAcat). The first category (1) is dedicated to companies with no GHG emissions media visibility in 2017, and the remainder companies were divided into three terciles: little (2), medium (3) and high visibility (4). The tables below present descriptive statistics for the media visibility variable used in the main analysis and after this categorisation, both for the full sample and for the sub-sample, showing that it is now within the expected thresholds for skewness and kurtosis aligned with a normal distribution.

Table 6.15: Media visibility descriptive statistics for the full sample (200 companies)

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
MEDIA	200	0	1012	81.39	190.88	3.36	10.65
MEDIAcat	200	1	4	2.73	1.02	-0.21	-1.11

Table 6.16: Media visibility descriptive statistics for the sub-sample (132 companies)

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
MEDIA	132	0	1,012	110.79	228.05	2.62	5.79
MEDIAcat	132	1	4	2.80	0.96	-0.20	-1.03

The charts below present the histogram before and after this categorisation.

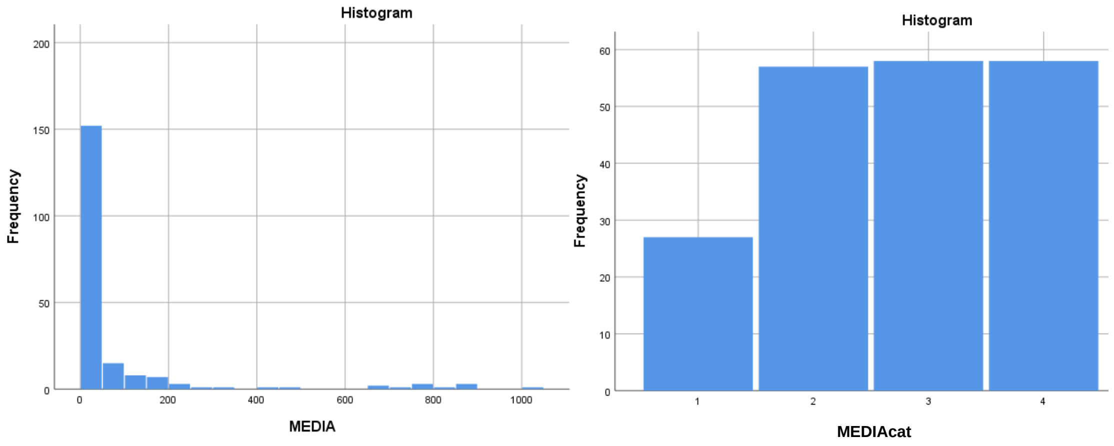

Figure 6.9: Media variable histogram for the full sample (absolute numbers and categories)

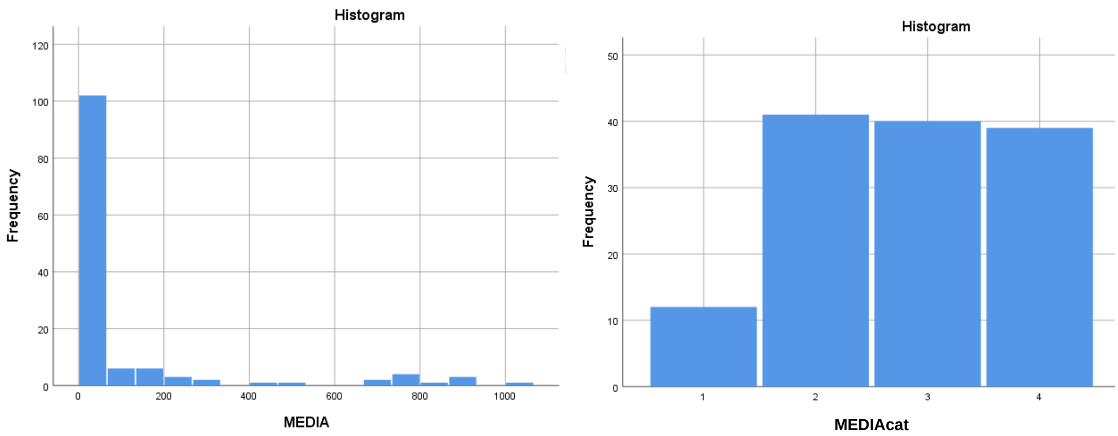

Figure 6.10: Media variable histogram for the sub- sample (absolute numbers and categories)

After confirming that the logistic regression models with the extent of media visibility measure (MEDIAcat) were not unduly biased (Diagnostics in Appendix 9.9.2), results are displayed below, with full SPSS reports available in Appendices 9.9.3 and 9.9.4.

Table 6.17: Logistic regression results employing the risk and MEDIAcat variable (model 1a)

					95% C.I. for Exp(B)	
	B	**Standard error**	**Sig.**	**Exp(B)**	**Lower**	**Upper**
Constant	-2.159	1.933	0.264	0.115		
RISK	0.217	0.079	0.006	1.243	1.063	1.452
MEDIAcat	0.498	0.168	0.003	1.646	1.183	2.290
SIZE	0.095	0.092	0.304	1.099	0.918	1.317
LEVERAGE	-0.001	0.006	0.921	0.999	0.987	1.012

Note: -2LL= 239.727, R^2= 0.080 (Cox & Snell) 0.111 (Nagelkerke), p< 0.01

The tables above, on the logistic regression using media visibility as a categorical variable, confirm that RISK and media visibility are significant predictors of GHG emissions risk disclosure, as presented in the main analysis.

Table 6.18: Logistic regression results employing risk_Mgt and MEDIAcat variables (model 1b)

	B	Standard error	Sig.	Exp(B)	95% C.I. for Exp(B) Lower	95% C.I. for Exp(B) Upper
Constant	-2.275	1.976	0.250	.103		
RISK_MGT	-0.273	0.127	0.032	0.761	0.593	0.977
MEDIAcat	0.471	0.167	0.005	1.602	1.155	2.221
SIZE	0.118	0.097	0.226	1.125	0.930	1.362
LEVERAGE	-0.002	0.006	0.747	0.998	0.986	1.010

Note: -2LL= 242.874, R^2= 0.065 (Cox & Snell) 0.091 (Nagelkerke), p< 0.01

Results above confirm the main analysis: both risk management and media visibility are significant predictors of the presence of GHG emissions risk disclosure, with their significance levels even lower in the model using the categorical variable for media visibility.

Table 6.19: Sensitivity analysis OLS multiple regressions results using media visibility categorical variable

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*(2a)*	*(2b)*	*(3a)*	*(3b)*	*(4a)*	*(4b)*	*(5a)*	*(5b)*
Intercept	172.070	283.480	-53.882	-32.183	118.188	251.297	66.328	74.804**
	(0.565)	(0.903)	(-0.390)	(-0.233)	(0.348)	(0.714)	(2.224)	(2.472)
RISK	53.313***		12.174**		65.487***		3.744***	
	(4.536)		(2.286)		(4.997)		(3.254)	
RISK_Mgt		-63.327***		-15.792*		-79.119***		-4.214**
		(-3.203)		(-1.814)		(-3.569)		(-2.211)
MEDIAcat	27.119	6.491	16.766	12.221	43.885	18.713	1.482	0.005
	(1.089)	(0.259)	(1.486)	(1.106)	(1.581)	(0.665)	(0.608)	(0.002)
SIZE	4.897	5.728	11.119*	11.622*	16.017	17.350	-0.733	-0.729
	(0.344)	(0.378)	(1.722)	(1.742)	(1.008)	(1.021)	(-0.525)	(-0.499)
LEVERAGE	1.808*	1.617	0.448	0.413	2.255*	2.030*	0.078	0.063
	(1.763)	(1.523)	(0.964)	(0.884)	(1.973)	(1.705)	(0.778)	(0.616)
Observations	132	132	132	132	132	132	132	132
Adjusted R^2	0.125	0.088	0.043	0.029	0.150	0.076	0.065	0.024
F-statistics	5.679***	3.062**	2.479**	1.979* p=0.102	6.779***	3.677***	3.260**	1.809

***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. This table reports ordinary least squares coefficient estimates and t-statistics (in parentheses). DISC_Gen refers to general disclosure DISC_Spe refers to specific disclosure and DISC_Tot refers to total disclosure, all of them measured in number of words. DISCgenR refers to the ratio of general disclosure to total disclosure, measured as a percentage. RISK and RISK_Mgt refer to GHG emissions risk and risk management, respectively. MEDIA proxies for GHG media visibility, measured in number of media articles. SIZE refers to company size (natural log of total assets) and leverage refers to financial leverage (ratio of total debt to total assets). Detailed descriptions of all variables are provided in Sections 5.4 and 5.5, and a summary In Section 5.6.

Comparing the results above with the main analysis, risk and risk management are significant predictors of all types of GHG emissions risk disclosure, with the same significance level in both analyses. However, the main analysis suggested that media visibility was a significant predictor of specific disclosure, which is not evidenced by the results from the regression using media visibility as a categorical variable. Some small differences in the significance level of the control variables are also observed.

6.5.2 Media visibility considering printed sources only

The second alternative measure was also collected from ABI/Inform Global, however instead of including online sources such as blogs, websites and wire feeds as in the main analysis, for sensitivity tests the search was done on the traditional media sources only, namely newspapers, trade journals and magazines. Focusing only on printed media follows several papers in the environmental disclosure field (Al-Tuwaijri, Christensen and Hughes, 2004; Rohani, Jabbour and Abdel-Kader, 2021; Tadros and Magnan, 2019), although there is an argument that printed media coverage alone is insufficient to assess media visibility (Dawkins and Fraas, 2011).

Measuring GHG emissions media visibility only based on newspapers, magazines and trade journals resulted in 111 out of 200 companies (55.5%) scoring 0, which means that no mentions of their names in a GHG context was identified in the traditional media channels included in ABI/Inform Global search in 2017 (in the main analysis, only 27 companies, or 13.5%, scored 0 when media visibility was measured also considering online media). Descriptive statistics for the alternative measure of GHG media visibility are available in Appendix 9.9.1. A medium correlation was found between both media visibility variables (0.353), significant at 0.05 level, considering the 200 companies in the sample.

After confirming that the logistic regression models with the alternative measure of media visibility (MEDIAalt) were not unduly biased (Diagnostics in Appendix 9.9.2), results are displayed below, with full SPSS reports available in Appendices 9.9.3 and 9.9.4.

Table 6.20: Sensitivity analysis logistic regression results employing the risk variable (model 1a)

	B	**Standard error**	**Sig.**	**Exp(B)**	**95% C.I. for Exp(B)**	
					Lower	**Upper**
Constant	-2.017	2.017	0.317	0.133		
RISK	0.183	0.077	0.017	1.201	1.033	1.396
MEDIAalt	0.023	0.025	0.371	1.023	0.974	1.075
SIZE	0.135	0.093	0.146	1.145	0.954	1.375
LEVERAGE	0.002	0.006	0.724	1.002	0.990	1.015

Note: -2LL= 247.034, R^2= 0.046 (Cox & Snell) 0.063 (Nagelkerke), p= 0.052

Table 6.21: Sensitivity analysis logistic regression results employing risk management (model 1b)

					95% C.I. for Exp(B)	
	B	**Standard error**	**Sig.**	**Exp(B)**	**Lower**	**Upper**
Constant	-2.013	2.029	0.321	0.134		
RISK_Mgt	-0.243	0.126	0.053	0.784	0.613	1.003
MEDIAalt	0.026	0.027	0.338	1.026	0.973	1.083
SIZE	0.149	0.097	0.122	1.161	0.961	1.403
LEVERAGE	0.001	0.006	0.878	1.001	0.989	1.014

Note: -2LL=249.091, R^2= 0.036 (Cox & Snell) 0.050 (Nagelkerke), p=0.120

For the logistic regressions, the direction of the relationships between the predictors of interest and the presence of GHG emissions risk disclosure is similar to the main analysis. Risk and risk management remain significantly associated with DISC_GHG, however the relationship with the alternative measure of media visibility is not significant. Results from the OLS regressions with the alternative measure of GHG media visibility are presented below. Preliminary analysis and assumptions checking for the OLS regressions are available in Appendix 9.9.5, including the influential cases removed to meet the assumptions.

Table 6.22: Sensitivity analysis OLS multiple regressions results

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*(2a)*	*(2b)*	*(3a)*	*(3b)*	*(4a)*	*(4b)*	*(5a)*	*(5b)*
Intercept	19.061	190.653	-86.273	-39.186	-507.556	-294.557	58.633*	71.593**
	(0.061)	(0.596)	(-0.600)	(-0.296)	(-1.270)	(-0.717)	(1.885)	(2.293)
RISK	49.126***		10.200*		60.212***		3.489***	
	(4.304)		(1.956)		(4.830)		(3.116)	
RISK_Mgt		-60.062***		-15.523*		-76.074***		-4.030**
		(-3.014)		(-1.890)		(-3.414)		(-2.079)
MEDIAalt	-0.797	-0.649	0.019	-1.601	-8.752***	-7.884**	-0.126	-0.112
	(-1.040)	(-.809)	(0.053)	(-1.257)	(-2.635)	(-2.250)	(-0.918)	(-0.786)
SIZE	14.797	10.529	14.239**	13.712**	50.249***	45.069**	-0.234	-0.600
	(1.045)	(0.716)	(2.201)	(2.255)	(2.779)	(2.381)	(-0.167)	(-0.419)
LEVERAGE	1.888*	1.567	0.575	0.335	2.174*	1.816	0.093	0.068
	(1.860)	(1.500)	(1.239)	(0.784)	(1.964)	(1.580)	(0.936)	(0.673)
Observations	132	132	130	130	129	129	131	131
Adjusted R^2	0.124	0.064	0.027	0.034	0.190	0.120	0.071	0.032
F-statistics	5.649***	3.223**	1.895	2.128*	8.504***	5.374***	3.470**	2.082*

***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. This table reports ordinary least squares coefficient estimates and t-statistics (in parentheses). DISC_Gen refers to general disclosure DISC_Spe refers to specific disclosure and DISC_Tot refers to total disclosure, all of them measured in number of words. DISCgenR refers to the ratio of general disclosure to total disclosure, measured as a percentage. RISK and RISK_Mgt refer to GHG emissions risk and risk management, respectively. MEDIA proxies for GHG media visibility, measured in number of media articles. SIZE refers to company size (natural log of total assets) and leverage refers to financial leverage (ratio of total debt to total assets). Detailed descriptions of all variables are provided in Sections 5.4 and 5.5, and a summary in Section 5.6.

OLS regressions confirm the significant associations between risk and risk management and all disclosure variables. In terms of MEDIA, the significant relationship with specific disclosure found in the main analysis were not found in the sensitivity analysis. However, the sensitivity analysis suggests a negative significant association between MEDIAalt and total disclosure. For total disclosure, the explaining power of the model is higher in the sensitivity analysis than in the main analysis (R^2=0.19 vs 0.13). Results suggest that printed and online media coverage together can predict specific disclosure (positive relationship), while printed media coverage can predict total disclosure (negative relationship). In other words, the higher the GHG media visibility considering printed and online channels, the higher the number of words in specific disclosure; while the higher the GHG media visibility considering printed channels only, the lower the number of words in total disclosure, which may be related to using more assertive language.

7 Discussion and conclusion

This chapter starts discussing each hypothesis proposed in Section 4 based on the results from the quantitative analysis presented in the previous chapter. This is followed by an overall discussion, looking at the findings in a broader perspective, going back to the theory and previous studies. The following sub-section covers thesis contribution, split into theoretical, empirical and industry contributions. The chapter also includes the implications of the findings, the limitations of the study and directions for future research, closing with the conclusion.

7.1 Results of hypotheses testing

H_{1a}. The likelihood of disclosing a GHG emissions risk in a company's annual report is higher for companies with higher GHG emissions risk.

Supported. As presented in Table 6.8, there is a significant ($p < 0.01$) and positive relationship between risk and the presence of a GHG emissions risk, evidenced by the odds ratio higher than 1, indicating that a higher level of GHG emissions risk increases the likelihood of a company disclosing at least one GHG emissions risk. Results are aligned with legitimacy theory, which anticipates that companies use disclosure as a legitimation tool when facing legitimacy threats, such as high GHG emissions risk.

H_{1b}. The likelihood of disclosing a GHG emissions risk in a company's annual report is higher for companies with weaker GHG emissions risk management.

Not supported. As shown in Table 6.9, there is a negative relationship between risk management and the presence of GHG emissions risk disclosure, indicating that the weaker the risk management, more likely a company is to disclose a GHG emissions risk. However, this relationship is borderline non-significant ($p=0.055$). Considering weak GHG emissions risk management as a legitimacy threat, increased disclosure is aligned with predictions of legitimacy theory, as disclosure could be used as a legitimation tool.

H_{1c}. The likelihood of disclosing a GHG emissions risk in a company's annual report is higher for companies with higher GHG emissions media visibility.

Supported. As presented in Tables 6.8 and 6.9, a positive and significant relationship ($p < 0.05$) was found between GHG media visibility and the presence of GHG emissions risk disclosure.

The odds ratio higher than 1 suggests that the higher the media visibility, the higher the likelihood of a company disclosing a GHG emissions risk. Results are aligned with legitimacy theory, as high media visibility has been considered in the literature as a legitimacy threat. In addition, results are also aligned with voluntary disclosure theory, as higher media visibility would imply more informed stakeholders, raising the threshold level of disclosure.

H_{2a}. There is a positive relationship between GHG emissions risk and GHG emissions risk general disclosure.

Supported. As observed in Table 6.14, regression model (2a), there is a positive association between GHG emissions risk and GHG emissions risk general disclosure, significant at 0.01 level. Results evidenced that for each 1-point increase in the risk score, general disclosure increases by approximately 49 words (about 3 lines of text). This is aligned with the overall prediction based on legitimacy theory, which posits that companies under greater legitimacy threats (e.g. high risk, low performance or high media visibility) would use increased disclosures as a legitimation tool, which has been evidenced for climate change disclosure (Lemma *et al.*, 2019; Lemma *et al.*, 2020; He, Tang and Wang, 2013), environmental disclosure (Cho *et al.*, 2012; Hughes, Anderson and Golden, 2001; Patten, 2002), and risk disclosure (Abraham and Cox, 2007; Elshandidy, Fraser and Hussainey, 2013).

Specifically looking at the type of disclosure adopted in this hypothesis, general disclosure corresponds to sentences not referencing a company's activities or situation, which could be argued to be a low-quality disclosure as it provides information about the context but not about the company itself. However, it was argued by the author that this type of disclosure could be useful for companies under legitimacy threats pursuing the strategy of diverting stakeholders' attention (Lindblom, 1994), which is apparently the case according to the results. Results suggest that companies with higher GHG emissions risk provide greater amounts of general disclosure than companies with lower GHG emissions risk.

Results are also aligned with the attribution strategy in impression management, evidencing the tendency to attribute negative results to external factors (and positive ones to internal factors). Thus, companies with higher risk level would use more general disclosure discussing the context, instead of their own strengths or weaknesses, to justify their high-risk profile. The findings are aligned with previous studies measuring general disclosure following the same approach, which suggested that higher levels of general disclosures are used by companies under greater legitimacy threats – membership of carbon-intensive sectors in Hrasky (2012), and poor environmental performance in Ingram and Frazier (1980), although the latter with non-significant results.

From the perspective of voluntary disclosure theory, results could be interpreted as low-risk companies, which in general are the best risk managers in the industry, using reduced amount of general disclosure as this kind of disclosure is not useful to showcase good performers' superior capacity or to close the information gap between the company and the market.

H_{2b}. There is a negative relationship between GHG emissions risk management and GHG emissions risk general disclosure.

Supported. As observed in Table 6.14, regression model (2b), the association between GHG emissions risk management and general disclosure is negative, significant at 0.01 level. The coefficients evidenced that the relationship between risk management and general disclosure is even stronger than between risk and general disclosure, suggesting that for each 1-point decrease in the risk management score, general disclosure increases by approximately 62 words (four lines of text).

From the perspective of legitimacy theory, weak risk management could be considered a legitimation threat (i.e. the risk controls in place may not be sufficient to deal with company's risk exposure). Companies under greater legitimacy threats would use more general disclosures, as evidenced by the negative relationship between risk management and general disclosure, potentially pursuing the legitimation strategy of diverting stakeholders' attention towards other GHG-related issues (Lindblom, 1994). Similar to the previous hypothesis, results are also aligned with impression management attribution strategy, as companies with weak risk management would use more general disclosure probably attributing their weakness to external factors.

Higher GHG emissions risk management scores refer to companies with stronger controls to avoid unwanted events (i.e. less probability of having their results negatively affected by high GHG emissions and/or related regulation). In alignment with voluntary disclosure theory, this superior risk management capacity, if showcased, could help differentiate a company from its peers. However general disclosure would not be effective to convey this superiority (i.e. you must mention a company's activities or situation to illustrate its superior capacity), which may explain why stronger risk managers use smaller amounts of general disclosure.

No paper testing the relationship between environmental disclosure or risk disclosure and a company-specific quantitative measure of risk management has been found, therefore the results could not be directly compared with empirical literature. However, several papers suggest that better performers provide higher levels of high-quality disclosure (Al-Tuwaijri, Christensen and Hughes, 2004; Clarkson *et al.*, 2008; Hummel and Schlick, 2016), which is obviously not based on sentences not referencing a company's activities (i.e. general disclosure).

H_{2c}: There is a positive relationship between GHG emissions media visibility and GHG emissions risk general disclosure.

Not supported. As presented in Table 6.14, regression models (2a) and (2b), results consistently evidenced a non-significant relationship between GHG media visibility and general disclosure.

H_{3a}. There is a positive relationship between GHG emissions risk and GHG emissions risk specific disclosure.

Supported. As presented in Table 6.14, model (3a), there is a positive relationship between GHG emissions risk and specific disclosure, significant at 0.05 level. Results suggest that for each 1-point increase in GHG emissions risk level, GHG emissions risk specific disclosure increases by 13 words. This could be explained based on legitimacy theory, which posits that companies under legitimacy threats (e.g. high GHG emissions risk) would use increased levels of disclosure as a legitimation tool. Results do not support predictions based on the attribution strategy in impression management, as companies with lower risk would have more reasons to showcase their capabilities using specific disclosure, attributing to their own competency the positive results (i.e. the low risk level).

Although results apparently contradict the predictions of voluntary disclosure theory, that good performers (i.e. lower risk companies) would have more reasons to provide higher levels of disclosure to inform stakeholders about their superiority, this may not be the case. Considering the measure of disclosure adopted, the same level of specific disclosure may cover different number of topics and in different quality levels (e.g. quantitative vs qualitative, company-specific vs general information). Therefore, results evidenced that lower risk companies use less specific disclosure based on word count (i.e. higher risk companies are more prolix), but they may provide the same level or even more information than higher risk companies when using a more succinct language, following SEC's recommendation that risks should be presented in a concise and logical manner, avoiding discussion in purely generic terms (SEC, 2019).

H_{3b}. There is a negative relationship between GHG emissions risk management and GHG emissions risk specific disclosure.

Not supported. As shown in Table 6.14, model (3b), the relationship between risk management and specific disclosure is only significant at 0.1 level. Results suggest a negative relationship between GHG emissions risk management and specific disclosure, indicating that companies with weaker risk management, which could be considered a legitimacy threat, provide more specific disclosure, probably in a tentative to protect their legitimacy.

Similarly to H_{3a}, the first impression could be that results contradict the predictions based on voluntary disclosure theory and the attribution strategy in impression management, which would anticipate that better performers (i.e. better risk managers) would provide more disclosure to showcase their superiority and differentiate themselves from their peers (Clarkson *et at.,* 2008), attributing the positive results to their own internal factors. However, this could still be done using less words, which is not possible to assess using the measures of general and specific disclosure adopted in this research.

H_{3c}. There is a positive relationship between GHG media visibility and GHG emissions risk specific disclosure.

<u>Supported.</u> As presented in Table 6.14, models (3a) and (3b), the relationship between media visibility and specific disclosure is positive and significant. Results are aligned with predictions from both legitimacy theory and voluntary disclosure theory. Higher media visibility may be seen as a legitimacy threat (i.e. companies under greater scrutiny from society) but also as stakeholders' increased previous knowledge about a company, which would raise the threshold level of disclosure (Verrecchia, 1983), in both cases implying using a higher level of specific disclosure (i.e. sentences referencing a company's activities). The results are aligned with previous studies finding a positive association between environmental media visibility and environmental disclosure (Aerts and Cormier, 2009; Bewley and Li 2000; Li, Richardson and Thornton, 1997; Tadros and Magnan, 2019), which was also confirmed for climate change media visibility and climate change disclosure (Dawkins and Fraas, 2011).

H_{4a}. There is a positive relationship between GHG emissions risk and GHG emissions risk total disclosure.

<u>Supported.</u> As presented in Table 6.14, model (4a), the relationship between risk and total disclosure is positive and significant at 0.01 level. Considering that both hypotheses H_{2a} (positive relationship between risk and general disclosure) and H_{3a} (positive relationship between risk and specific disclosure) are supported, there is no surprise in the results supporting this hypothesis on the positive relationship between risk and total disclosure, which is the sum of general and specific disclosures. This is aligned with the negative relationship found by Ingram and Frazier's (1980), although not significant, between environmental performance and both general and specific environmental disclosure (i.e. worse performers provide more disclosures). Aligned with

legitimacy theory, companies could use disclosures to gain, maintain or repair legitimacy (Suchman, 1995) and would be motivated to provide higher levels of disclosure when facing legitimacy threats (e.g. high GHG emissions risk), as evidenced by the results. Similarly with hypothesis H_{3a}, although a positive relationship has been found between risk and total disclosure, this does not exclude the possibility that companies with lower risk provide the same level or even more information than their peers but using less words.

Results are also aligned with previous studies quantifying the level of disclosure by counting number of words, sentences, lines or pages. Patten (2002) and de Villiers and van Staden (2011) found negative relationships between environmental performance and total environmental disclosure, while Deegan and Gordon (1996) found increased disclosures from companies in environmentally sensitive industries.

H_{4b}. There is a negative relationship between GHG emissions risk management and GHG emissions risk total disclosure.

Supported. As presented in Table 6.14, equation model (4b), the relationship between risk management and total disclosure is negative and significant at 0.01 level. Results suggest that for each 1-point increase in GHG emissions risk management score, there is a decrease of approximately 77 words in total disclosure (about 5 lines of text). This is not surprising considering that results evidenced negative relationships between risk management and both types of disclosure (general and specific, although only significant at 0.1 level for the latter). Results are aligned with legitimacy theory, which posits that companies in misalignment with society's expectation (e.g. weak GHG emissions risk management) would be more motivated to use disclosure for legitimation purposes. Similarly to hypotheses H_{4a}, H_{3a} and H_{3b}, the fact that results evidence that companies with weaker risk management use more words for total disclosure does not mean that they are providing more information than those with high risk management score, as the same amount of information could be disclosed using more concise language.

H_{4c}. There is a positive relationship between GHG media visibility and GHG emissions risk total disclosure.

Not supported. As shown in Table 6.14, models (4a) and (4b), the relationship between media and total disclosure is not significant. However, sensitivity analysis using GHG media visibility not considering online media found a negative and significant relationship between media and total disclosure (Table 6.22), suggesting that reduced GHG media visibility (considering printed media only) is associated with higher levels of total disclosure.

H_{5a}. There is a positive relationship between GHG emissions risk and the ratio of GHG emissions risk general disclosure to total disclosure. Conversely, there is a negative relationship between GHG emissions risk and the ratio of GHG emissions risk specific disclosure to total disclosure.

Supported. As shown in Table 6.14, model (5a), the relationship between risk and ratio of general disclosure to total disclosure is positive and significant at 0.01 level. Results suggest that the higher the risk level, the bigger the proportion of general disclosure in total disclosure, reiterating the argument expressed under H_{2a} that companies under greater legitimacy threats use more general disclosure, potentially adopting a defensive legitimation strategy to divert stakeholders' attention (Lindblom, 1994). Results are aligned with the attribution strategy in impression management, as companies with high risk level would attribute this negative outcome (i.e. weak risk management capacity) to external factors, increasing their level of general disclosure.

H_{5b}. There is a negative relationship between GHG emissions risk management and the ratio of GHG emissions risk general disclosure to total disclosure. Conversely, there is a positive relationship between GHG emissions risk management and the ratio of GHG emissions risk specific disclosure to total disclosure.

Supported. As shown in Table 6.14, model (5b), the relationship is negative and significant. Aligned with legitimacy theory and with hypothesis H_{5a}, companies under greater legitimacy threats (e.g. worse risk management) increase the proportion of general disclosure, potentially pursuing the legitimation strategy of diverting stakeholders' attention towards the GHG emissions context, instead of providing more information about their own activities. This behaviour is also aligned with the attribution strategy in impression management, evidencing the tendency to attribute negative results (e.g. weak risk management) to external factors, using general disclosure.

H_{5c}. There is a negative relationship between GHG emissions media visibility and the ratio of GHG emissions risk general disclosure to total disclosure. Conversely, there is a positive relationship between GHG emissions media visibility and the ratio of GHG emissions risk specific disclosure to total disclosure.

Not supported. As presented in Table 6.14, models (5a) and (5b), a negative relationship between GHG media visibility and ratio of general disclosure to total disclosure was identified, however it is only significant at 0.1 level. Results suggest that increases in GHG media visibility reduces the ratio of general disclosure to total disclosure, which means that more media visibility is associated with specific disclosure occupying a bigger proportion in total disclosure. This is aligned with the previous hypotheses on general and specific disclosure, although not finding significant relationship with media but suggesting that higher media visibility is associated with reduced general disclosure (Table 6.14, models 2a and 2b) and more words in specific disclosure (models 3a and 3b). Results could be interpreted based on both legitimacy and voluntary disclosure theory.

Interpreting increased media visibility as a legitimacy threat, switching from general disclosure to specific disclosure could be associated with changing the legitimation strategy adopted (Figure 2.1). Potentially, the company would be migrating from diverting stakeholders' attention (relying on general disclosure) to one of these other strategies identified by Lindblom (1994): changing stakeholders' perception without changing performance, changing external expectation about a company's performance, or educating stakeholders about a company's intentions to improve performance. From the perspective of voluntary disclosure theory, higher levels of media visibility associated with an increased ratio of specific disclosure to total disclosure could be interpreted as stakeholders' previous knowledge raising the threshold level of disclosure, due to increased expectations on a company's information.

7.1.1 Hypotheses testing summary

The table below summarises whether hypotheses have been supported or not supported.

Table 7.1: Hypotheses testing summary

Hypothesis	Status
H_{1a}. The likelihood of disclosing a GHG emissions risk in a company's annual report is higher for companies with higher GHG emissions risk.	Supported
H_{1b}. The likelihood of disclosing a GHG emissions risk in a company's annual report is higher for companies with weaker GHG emissions risk management.	Not supported ($p=0.55$)
H_{1c}. The likelihood of disclosing a GHG emissions risk in a company's annual report is higher for companies with higher GHG emissions media visibility.	Supported
H_{2a}. There is a positive relationship between GHG emissions risk and GHG emissions risk general disclosure.	Supported
H_{2b}. There is a negative relationship between GHG emissions risk management and GHG emissions risk general disclosure.	Supported
H_{2c}: There is a positive relationship between GHG emissions media visibility and GHG emissions risk general disclosure.	Not supported
H_{3a}. There is a positive relationship between GHG emissions risk and GHG emissions risk specific disclosure.	Supported
H_{3b}. There is a negative relationship between GHG emissions risk management and GHG emissions risk specific disclosure.	Not supported ($p<0.1$)
H_{3c}. There is a positive relationship between GHG media visibility and GHG emissions risk specific disclosure.	Supported
H_{4a}. There is a positive relationship between GHG emissions risk and GHG emissions risk total disclosure.	Supported
H_{4b}. There is a negative relationship between GHG emissions risk management and GHG emissions risk total disclosure.	Supported
H_{4c}. There is a positive relationship between GHG media visibility and GHG emissions risk total disclosure.	Not supported
H_{5a}. There is a positive relationship between GHG emissions risk and the ratio of GHG emissions risk general disclosure to total disclosure. Conversely, there is a negative relationship between GHG emissions risk and the ratio of GHG emissions risk specific disclosure to total disclosure.	Supported
H_{5b}. There is a negative relationship between GHG emissions risk management and the ratio of GHG emissions risk general disclosure to total disclosure. Conversely, there is a positive relationship between GHG emissions risk management and the ratio of GHG emissions risk specific disclosure to total disclosure.	Supported
H_{5c}. There is a negative relationship between GHG emissions media visibility and the ratios of GHG emissions risk general disclosure and specific disclosure to total disclosure. Conversely, there is a positive relationship between GHG emissions media visibility and the ratio of GHG emissions risk specific disclosure to total disclosure.	Not supported ($p<0.1$)

7.2 Discussion

The diagram below summarises the results, showing the significant relationships identified ($p<0.05$) and their direction in brackets, as well as the corresponding hypothesis.

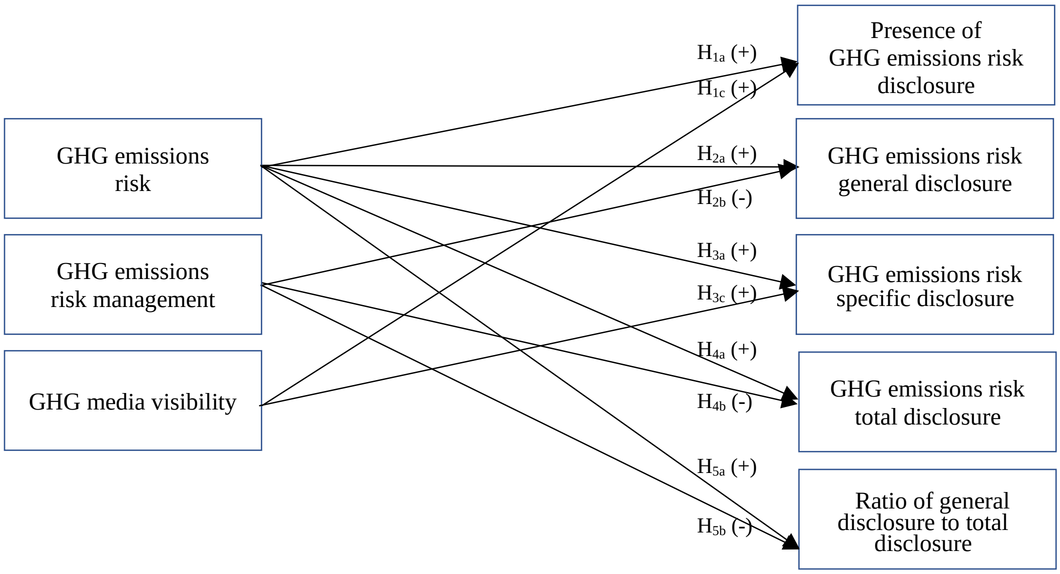

Figure 7.1: Significant relationships identified in the results

As displayed in the diagram above, the presence of GHG emissions risk disclosure is significantly associated with risk and media visibility. There are significant relationships between risk and risk management, and general, specific and total disclosure, as well as the ratios of general/specific disclosure, except between risk management and specific disclosure which is only significant at 0.1 level. In addition, in terms of the different types of disclosure, media visibility is only significantly associated with specific disclosure.

Interpreting GHG emissions risk and risk management from the lenses of legitimacy theory, high risk and weak risk management could be understood as legitimacy threats, as they are associated with a company not properly managing its emissions and contributing to global warming, which occurs in misalignment with society's expectation. This interpretation is aligned with several papers in the environmental disclosure literature considering poor environmental performance (Cho *et al.*, 2012; Patten, 2002) and high environmental risk (Dobler, Lajili and Zéghal, 2015) as legitimacy threats. High GHG emissions risk and weak risk management could motivate a company to increase its disclosure level, using disclosure as a legitimation tool, which is reflected on the results, as predicted by legitimacy theory and in alignment with previous papers measuring volume of disclosure (i.e. counting words, sentences and pages). Significant positive relationships were found between risk and the three different types of disclosure (i.e. higher risk is associated with higher levels of general, specific and total disclosure), while negative relationships were found between risk management and general and total disclosure (i.e. weaker risk management is associated with increased general and total disclosures). Results will be explained for each type of disclosure in the following paragraphs.

General disclosure as defined in this research (i.e. words in sentences not referencing a company's activities or situation) has not been measured in the risk disclosure literature. In the environmental disclosure literature, only two papers have been identified in this regard, with findings aligned with the current results. Both papers found that higher levels of general disclosure are used by companies under greater legitimacy threats, as follows: membership of carbon-intensive sectors associated with increased climate change general disclosure (Hrasky, 2012) and poor environmental performance associated with increased environmental general disclosure, although not-significantly (Ingram and Frazier, 1980). Therefore, one of the contributions of this research is related to this type of disclosure, which measurement is extremely rare in the literature. Using company specific risk measures, this research provides evidence that companies with higher GHG emissions risk and lower risk management provide greater amounts of general disclosure. General disclosure carries minimum or no proprietary costs, and barely help informing about the company, but may divert stakeholders' attention towards the GHG context, in several examples attributing the reason for their risk level to the context (e.g. the evolving regulation to address GHG emissions requiring companies to incur extra costs), which is also aligned with the attribution strategy in impression management (i.e. attributing negative results to external factors). No significant relationship was found between media visibility and general disclosure (i.e. no evidence that the level of exposure on the media impact on the amount of general disclosure provided), although media visibility impacts on the amount of specific disclosure, as it will be discussed in the next paragraph.

Results suggest that risk and media visibility are significantly associated with the amount of specific disclosure. This is aligned with Hrasky (2012) evidencing that companies in GHG emitting sectors use two times more specific disclosure than companies in other sectors. Also in alignment with the current results, several papers using content-analysis indices have found that legitimacy threats are associated with higher levels of disclosure, including high environmental risk (Dobler, Lajili and Zéghal, 2015) and poor environmental performance (Patten, 2002; Wiseman, 1982). However, papers finding relationships in the opposite direction (i.e. better performers providing higher levels of specific disclosure), which is aligned with voluntary disclosure theory and impression management attribution behaviour, are not rare (Al-Tuwaijri, Christensen and Hughes, 2004; Clarkson *et al.*, 2008).

For total disclosure, previous literature measuring the volume of disclosure is also aligned with the current results. Patten (2002) and de Villiers and Van Staden (2011) found higher levels of total disclosure for worse environmental performers, while similar although non-significant results were found by Wiseman (1982) and Ingram and Frazier (1980).

Even though aligned with legitimacy theory, the significant relationships between the risk and risk management and disclosure do not contradict predictions from voluntary disclosure theory. This occurs because the measure of disclosure adopted in this research considers the number of words used in each type of disclosure, without being concerned with the level of information conveyed and its inherent proprietary costs. Therefore, it is not possible to state whether high risk or low risk companies provide more information, but only to state that companies with higher GHG emissions risk use more words in their disclosures than companies with lower GHG emissions risk, in total and in the two types of disclosure measured: general and specific. Low risk and strong risk management could be strengths that evidence a company's superiority in terms of GHG emissions, useful to differentiate superior companies from the worst risk managers in the industry, which could also be done using less words.

In addition, current results also evidenced that risk and risk management are associated with the ratios of general and specific disclosure to total disclosures, i.e. the higher the risk or the worse the risk management, the higher the proportion of general disclosure in total disclosure. Therefore, risk and risk management influence not only the number of words a company will use in each type of disclosure but the dynamics between general and specific disclosure. Interpreting the results in conjunction, when the risk is higher or the risk management is weaker, a company increases the amount of both general and specific disclosure provided, as discussed in the previous paragraphs. However, the increase in general disclosure is more intense, in such as way the proportion of both types of disclosure changes, demonstrating that companies not only increase the volume of disclosure but also adjust the disclosure quality when they are under greater pressure (de Villiers and van Staden, 2006). This increase in the proportion of general to total disclosure for higher risk companies may also be related to an intensification of the legitimation strategy of diverting stakeholders' attention, as opposed to pursuing other legitimation strategies potentially more associated with specific disclosure, namely seeking to educate relevant stakeholders about a company's intentions to improve performance, seeking to change stakeholders' perceptions without changing performance, and seeking to change external expectations about a company's performance (Lindblom, 1994). Intensifying the use of general disclosure when companies face high GHG emission risk or weak GHG emissions risk management is also aligned with the attribution behaviour in impression management, as companies could attribute these negative outcomes to external factors (e.g. the context, regulation etc), which would imply providing more general disclosure.

Looking at the associations with GHG media visibility as the predictor, there are significant positive relationships with the presence of GHG emissions risk disclosure and with specific disclosure, aligned with both legitimacy theory and voluntary disclosure theory. Based on legitimacy theory, high media visibility could be a proxy for increased scrutiny from society, community's concerns or pressure from stakeholders, motivating companies to provide increased disclosures to respond to these legitimacy threats. On the other hand, voluntary disclosure theory posits that shareholders' information expectation and previous knowledge (considering media plays a key role to keep stakeholders informed) influence the threshold level of disclosure, as a "worried stakeholder (…) [would] favour disclosure of high-quality information" (Sinclair-Desgagné and Gozlan, 2003, p. 377). Several studies have found positive associations between news exposure and environmental disclosure (Aerts and Cormier, 2009; Bewley and Li, 2000; Li, Richardson and Thornton, 1997; Tadros and Magnan, 2019), also confirmed for climate change disclosure (Dawkins and Fraas, 2011). Results are corroborated by the comparison between companies disclosing and not disclosing GHG emissions risk in the sample (section 6.1.3 Differences in characteristics of companies that report and do not report GHG information), as the second group presents lower media visibility than the disclosing companies. Building on both theories and previous papers, the current results reiterate the importance of media coverage to drive companies to increase transparency and provide higher-quality disclosure, as the association between media visibility and specific disclosure is significant, while it is not for general disclosure.

Increased risk and weaker risk management associated with increased disclosure is also aligned with the concept of materiality, that guides discretion in reporting. This occurs as higher risks have the potential to cause greater impacts on a company, increasing the materiality of the information to be disclosed. As mentioned in Section 3.1, information is considered material if "a reasonable investor would consider it important in deciding how to vote or make an investment decision" (SEC, 2010, p. 11).

7.3 Thesis Contributions

This section is focused on the theoretical, empirical and industry contributions this thesis has promoted. In terms of theory, results helped advance understanding on how different types of legitimacy threats can predict the presence and the volume of disclosure, pointing that when there is an increased legitimacy threat, companies adjust their legitimation strategy towards diverting stakeholders' attention. Regarding empirical contributions, this study employs new proxies for GHG emissions risk and risk management, which may help overcome the difficulty to access company-specific environmental risk measures, in addition to employing two measures of disclosure rarely seen in the literature: general disclosure and ratio of disclosure. On industry contribution, this research helps understanding how managers exercise discretion on a company's disclosure depending on its GHG emissions risk and risk management level and media visibility. More informed report users will be in a better position to act on the information they receive, including regulators and investors, which will contribute to fight climate change.

7.3.1 Theoretical contributions

This research relies on a framework composed of legitimacy theory and voluntary disclosure theory, employed in an integrated manner, and complemented by impression management, in order to address the research question "4. Can legitimacy and voluntary disclosure theories explain the potential relationships between GHG emissions risk, risk management and media visibility as determinants of GHG emissions risk disclosure?". Both theories have been employed simultaneously in environmental disclosure articles, initially supporting contradicting hypotheses (Al-Tuwaijri, Christensen and Hughes, 2004; Clarkson *et al.*, 2008) and more recently, in a complementary manner (Hummel and Schlick, 2016; Tadros and Magnan, 2019).

Results were mainly explained by legitimacy theory, therefore the contributions to this theory are broader. However, the study also contributes to advance understanding of voluntary disclosure theory and on how both theories complement each other, which was facilitated by the fact that the selected predictors (risk, risk management and media visibility) could be interpreted from the perspective of both theories. Depending on their value, the variables of interest could represent legitimacy threats (e.g. high risk or weak risk management, high media visibility) or an evidence of superiority (e.g. low risk and strong risk management). Despite the fact that the notion of legitimacy dates back to a century ago (Weber, 1922) and legitimacy theory is one of the most prevalent in social and environmental disclosure studies (Gray, Owen and Adams, 2009), it is still considered an under-developed theory, with quite imprecise predictions as they are based on manager's perceptions of the social contract (Deegan, 2002). Conversely, the foundation studies of voluntary disclosure theory were published in early 1980s (Verrecchia, 1983; Dye, 1985), evidencing its relative novelty. The study also illustrates the attribution behaviour in impression management, in parallel with the interpretation based on the legitimation strategy of diverting stakeholders' attention towards the context.

In terms of legitimacy theory, this study contributes in the following ways:

- It contributes to advance understanding on how different types of legitimacy threats (namely high GHG emissions risk and weak GHG emissions risk management, and high GHG emissions media visibility) can predict the presence and the volume of disclosure, building on previous papers finding that low environmental performance and high media visibility (both legitimacy threats) are determinants of disclosure (Aerts and Cormier, 2009; Al-Tuwaijri, Christensen and Hughes, 2004; Clarkson *et al.*, 2008; Dawkins and Fraas, 2011; Tadros and Magnan, 2019). Results evidenced that high risk and weak risk management are associated with increased disclosure in all types of disclosure, while media visibility is only associated with increased specific disclosure.

- When there is an increased legitimacy threat (i.e. higher risk or weaker risk management), results suggest that companies adjust their legitimation strategy towards diverting stakeholders' attention. This was deduced by associating Lindblom's (1994) legitimation strategies with Ingram and Frazier's (1980) types of disclosure based on specificity, enabling understanding which type of disclosure would mainly support each legitimation strategy. The strategy of diverting stakeholders' attention would mainly rely on general disclosure, as the focus would be on GHG emissions-related issues other than the company's activities. This association is summarised in the figure below, already presented in Section 2.2.1, repeated here for readability purposes. For each point increase in risk level, or each point decrease in risk management, results suggest that the increase in the volume of general disclosure is approximately 4 times higher than the increase in specific disclosure.

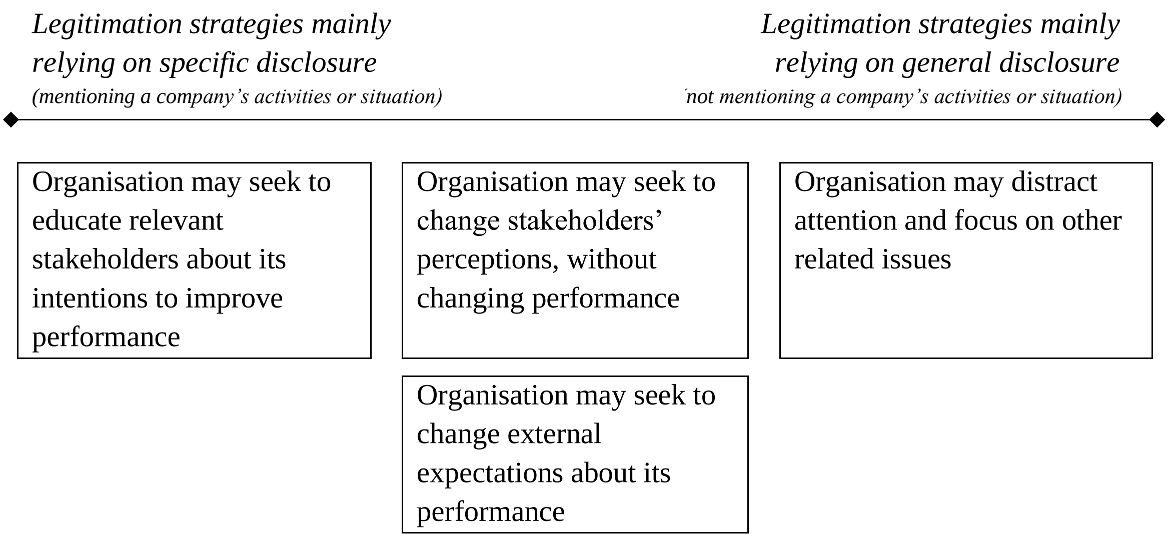

Figure 7.2: Lindblom's (1994) legitimation strategies vs Ingram and Frazier's (1980) specificity disclosure categories

In terms of impression management, this study contributes in the following way:

- Amongst several impression management behaviours that could be employed to promote a more favourable perception about a company, by manipulating the format and the content of the information disclosed, one is particularly associated with the disclosure types selected for this study: the attribution strategy, related to company's tendency to attribute positive results to internal factors (e.g. strategy or management skills) and negative results to external factors (e.g. market, regulation etc). This study suggests that high GHG emissions risk level, or weak GHG emissions risk management, could also be understood as evidence of negative results, as they demonstrate that these companies have not been able to manage their risks properly, therefore the attribution strategy would also be applicable, adding to Lindblom's (1994) legitimation strategy of diverting stakeholders' attention towards the context, as discussed above.

In terms of voluntary disclosure theory:

- As predicted by voluntary disclosure theory and observed in previous papers (Clarkson *et al.*, 2008; Dawkins and Fraas, 2011; Tadros and Magnan, 2019), results reiterate that stakeholders' previous information about the company impacts on the disclosure level. In this research, results evidenced that GHG emissions media visibility predicts whether a company will provide GHG emissions risk disclosure and the level of disclosure mentioning a company's activities (specific disclosure). This corroborates with the view from voluntary disclosure theory that disclosure is a tool to reduce the information gap between the market and the company, therefore managers take into account the level of information about the company available in the market to define the threshold level of disclosure.

In addition, results corroborate with recent papers arguing that both legitimation and economic motivations drive companies' disclosures, as "the two theories [(legitimacy and voluntary disclosure theories)] are not mutually exclusive but dovetail to simultaneously explain the sustainability reporting behaviour" (Hummel and Schlick, 2016, p. 470).

7.3.2 Empirical contributions

Considering carbon disclosure literature (Borghei, 2021), this study contributes to the following research fields: determinants of carbon disclosure, and quality of carbon disclosure, as it supports that risk, risk management and media visibility determine GHG emissions risk disclosure, and they influence the quality of disclosure (general vs specific). This study also contributes to the empirical literature in the disclosure field in general, due to the proxies selected, as explained below.

This study employs a new proxy for GHG emissions risk, extracted from MSCI ESG Ratings database, building on how the market has compared company's environmental, social and governance risk profiles. This can contribute to surpass the difficulty to access company-specific environmental risk measures due to their high proprietary costs (Dobler, Lajili and Zéghal, 2014), helping expand the incipient empirical literature on sustainability risk.

This research employs a company-specific numeric measure of risk management as a potential predictor of disclosure, which has not been identified in the environmental disclosure field or in the risk disclosure field. This represents an advance towards using a more precise proxy for risk management and potentially contributing to increase the explanatory power of the estimation models, building on previous papers employing a binary measure of risk management, such as 'active' or 'not active' (Dobler, Lajili and Zéghal, 2014).

This study adopts a different approach to select disclosure within annual reports: the textual analysis was focused on disclosures on a specific context (GHG emissions risk) within a specific chapter in the report allocated to risk disclosures. This approach is more objective than looking for environmental disclosure throughout the whole annual report, often employed in the literature (Clarkson, Overell and Chapple, 2011; Linsley and Shrives, 2006), which enables working with larger samples as less resources are required for text analysis.

This research contributes to expand the list of types of disclosure that may be used in future studies, highlighting two measures rarely employed in the literature: disclosure not mentioning a company's activity or situation, and ratio of disclosure. Although disclosure not mentioning a company's activity is barely useful to inform a reader about a company, it may indicate the legitimation strategy adopted, as discussed in the previous sub-section on the contributions to legitimacy theory. In addition, this study employs ratios of general and specific disclosure to total disclosure, to understand the interaction between these two types of disclosure that compose total disclosure. The ratios complement the interpretation of the results based on the number of words in each type of disclosure. Using a ratio of disclosure to total disclosure was identified in only one previous paper in the environmental disclosure literature: Clarkson *et al.* (2008), who measured the ratio of soft disclosure (i.e. disclosure lacking substantiation and easily imitated) to total disclosure.

7.3.3 Industry contributions

Comprehensive and reliable GHG emissions disclosures may enable several stakeholders to act on the information they receive, which would contribute to fight climate change. Examples include shareholders directing investment towards low-GHG emission companies, consumers avoiding products or services from high-emitting companies (consumer activism) and the government tightening regulation. However, industry reports have shown that the quality of current disclosures remains low (EY, 2020; TCFD, 2019), therefore there is a potential to strengthen the action against climate change by increasing GHG emissions transparency.

The current study helps annual report users better comprehend GHG emissions risk disclosures, by discussing how managers exercise discretion on a company's disclosure depending on its risk and risk management level and visibility on the media. Results evidenced that, considering companies in high GHG exposure industries, those with greater levels of specific, general and total disclosure are those with higher levels of risk and lower levels of risk management. In light of the difficulty to access a company's risk register due to confidentiality reasons, this finding may help differentiate companies' risk profile. Results also evidenced that high risk companies are those with smaller adherence to SEC guidelines on avoiding non-specific boiler plate statements (SEC, 2010).

For companies, the current study exposes their legitimation and impression management efforts, especially when their risk level reveals an increased level of misalignment with society's expectation. This includes the attempt to divert stakeholders' attention towards the GHG emissions context (e.g. topics such as SEC evolving regulation, U.S. decision to leave the Paris Accord etc) and to attribute negative outcomes to external factors, using general disclosures, which is intensified when risk level increases or risk management deteriorates.

For the media industry, this study reiterates the importance of covering topics related to GHG emissions, as results suggest that the number of media articles citing companies is directly related to the quality of their GHG emissions risk disclosure. Results evidenced that the higher the GHG emissions media visibility, the higher the likelihood of a company disclosing at least one GHG emissions risk and the higher the amount of specific disclosure provided, which is the type of disclosure that really informs readers about a company, as opposed to general disclosure.

7.4 Implications

> "Understanding motivations for disclosure is important when considering whether the disclosures should be relied upon by various stakeholders when they are making their respective decisions about an organisation." (Deegan, 2019, p. 2310)

Annual reports are considered a key channel to provide corporate information to stakeholders as they provide "a common and reliable source of information" (Dobler, Lajili and Zéghal, 2014, p. 4). Understanding company's motivations to provide disclosures enables a more comprehensive interpretation of the information provided on the annual reports. This is particularly useful in light of the risk of mismatch between a company's disclosures and its internal risk register (Abraham and Shrives, 2014), making report readers more alert about the legitimation and impression management strategies that may be implemented.

This research evidenced that increased legitimacy threats, such as higher GHG emissions risk and weaker risk management, which could also be considered negatives outcomes, motivate companies to increase GHG emissions risk disclosure and to change the proportion of general and specific disclosure within total disclosure. Results also provide evidence that amongst the strategies that could be implemented to address legitimacy threats (Lindblom, 1994), the one on distracting stakeholders' attention and focus on other related issues seems to be particularly important for those companies with high GHG emissions risk and weak risk management, which is also aligned with impression management behaviour. This finding may reduce credibility of annual reports as a reliable communications channel, as well as companies' credibility in general, which has already been challenged (Edelman, 2020). However, these findings may also support arguments towards enhancing disclosure regulation.

In 2020, SEC approved a new guidance including changes on annual reports' Risk Factors section, "intended to address the lengthy and generic nature of the risk factor disclosure presented by many registrants" (SEC, 2019, p. 65). Results from this research inform regulators about the type of companies that are prone to provide the kind of disclosure SEC intents to avoid, which may help design targeted initiatives. Results evidenced that companies with higher GHG emissions risk and weaker GHG emissions risk management provide more extensive GHG emissions risk disclosure, including providing a greater number of general statements without even mentioning their activities or situation. This finding stresses the need to address the issue of little readability of the disclosures provided by high-risk companies, as they are the ones that may affect more stakeholders in a more significant manner (i.e. higher emissions with reduced control), potentially significantly contributing to climate change. The amendments published by SEC in 2020 may enhance readability by requiring a summary for risk factors longer than 15 pages, and disclosure of generic risks at the end of the section, however the decision to not set a page limit may not completely address the lengthy-related issue.

This paper supports the argument that regulation provides more relevant information to stakeholders, as it limits managerial discretion, enables comparisons between companies and may motivate a company to adopt more sustainable practices, following the mindset that "what gets measured gets managed", as stated by Peter Drucker. Results evidenced that companies have used disclosure to attribute their high-risk levels to external factors in a tentative to divert stakeholders' attention, instead of explaining their own performance, which could be avoided by increasing regulation. Voluntary disclosure schemes have contributed to enhance disclosure, however research has shown that "it is only when governments mandate disclosure that it becomes widespread, consistent and comparable" (KPMG, 2017, p. 37). Higher levels of disclosure will expose companies to public scrutiny, which will potentially motivate them to improve performance, reducing their emissions and positively impacting on climate change. This behaviour has been observed in the UK and in the U.S., with companies required to report GHG emissions reducing their emissions (Downar *et al.*, 2021; Jouvenot and Krueger, 2019; Muller, Liang and Yang, 2021). More transparent and comprehensive disclosures will hinder high risk companies to disguise their low performance using low quality disclosures to convey that they are committed to the environment, in such a way report readers will be able to access a more realistic view of company's results. Although higher levels of disclosure may imply extras costs on those companies that have not provided GHG-related disclosure on a voluntary basis yet (Morrison, 2022, p. 10), business are the lead GHG producers and fighting climate change is urgent. SEC often invites stakeholders in general to comment on proposed regulation, via a comment letter mechanism, which could be elaborated relying on the results of this study. Results from this study can also contribute to the discussion in voluntary disclosure initiatives, such as CDP and TCFD, indirectly contributing to enhance regulation (TCFD recommendations is included in SEC latest proposal on climate change disclosure).

The positive significant relationships between media visibility and volume of specific disclosure identified in the results reiterate the importance of media coverage to put pressure on companies and consequently, contribute for higher-quality disclosures. Platforms to make GHG-related information publicly available, such as the U.S. Toxic Release Inventory (TRI), the U.S. GHG Reporting Programme (GHGRP) and CDP, are crucial to provide data to generate a greater number of media articles, besides enabling other stakeholders to also act on the information accessed (i.e. putting pressure on institutional investors to direct their capital to low GHG emitters, consumer activism etc). More direct pressure from stakeholders will certainly help bringing corporate GHG emissions disclosure in line with recommended guidelines.

7.5 Limitations

The main limitation in this study refers to the types of disclosure assessed, which do not measure the amount of information disclosed but the number of words used, discussed below. A change in the GHG context in the U.S. in 2017 is also raised, although it potentially does not represent a limitation.

The proxy adopted for specific disclosure, based on Ingram and Frazier (1980), measures the volume of disclosure but not the coverage of the information disclosed (i.e. the amount of GHG emissions risk aspects included in the risk disclosure) or the specificity level of the information disclosed (i.e. whether it is applicable to other companies in general, only to other companies in the same industry, or company-specific). Therefore, the results do not support interpretations on disclosure quality beyond the fact that general disclosures (not mentioning a company's activity or situation) are of lower quality than specific disclosure. A tentative on including a proxy for disclosure specificity is discussed in appendix 9.2 and may inform future studies in this regard.

The current study is based on 2017 annual reports, published in early 2018, which were the most recent reports available when data collection started. In June 2017, President Donald Trump announced that the U.S. would withdraw from the Paris Accord. This decision triggered significant uncertainty on how GHG emissions regulation would evolve at federal level and state level in the U.S., which may have motivated an increase in the amount of general disclosure in the reports. However, as all companies in high GHG exposure sectors were affected by the decision to withdraw from the Accord, it is argued that this change in the GHG context does not represent a limitation, as it equally affected all companies in the same industry.

7.6 Directions for future research

Building on the current results, future research could employ other measures of disclosure to advance understanding on management's behaviour towards disclosure threshold. These include measuring coverage (quantity of aspects related to GHG emissions disclosed), the level of company-specific information provided and whether the disclosures are quantitative or qualitive. A measure of company-specific information was considered for this study, but it was dropped due to reliability issues, as explained in Appendix 9.2. Measuring different aspects of disclosure will help advance understanding of the changes in disclosure extension and quality, motivated by factors such as legitimacy threats and opportunities to differentiate from other players.

Building on the evidence from this research that GHG media visibility is a significant predictor of the volume of specific disclosure, further research could test whether the relationship holds when splitting media visibility into positive, neutral and negative articles (i.e. Do both favourable and unfavourable media coverage impact on specific disclosure level? To what extent?). In addition, the different measures of GHG emissions media visibility employed in the main analysis and in the sensitivity analysis revealed that printed and online media impact on disclosures in different ways, which may be further investigated.

Considering SEC's recent guidance (SEC, 2020), that included improvements in the Risk Factors section, comparing disclosure before and after the new guidance (i.e. reports issued from September 2020 on) could help understanding whether the expectations on improved readability and reduced non-material information have been met.

In addition to annual reports, other communication channels could also be analysed to investigate management's behaviour towards disclosure and their motivations. For example, as annual reports are issued just once a year, other channels such as press releases, websites and even posts on social media may be more appropriate for timely legitimation efforts and for addressing specific stakeholders.

7.7 Conclusion

This study was developed responding to the calls for further empirical research on environmental risk (Dobler, Lajili and Zéghal, 2014), in a context of heightened concern over the effects of climate change and low quality GHG disclosures (EY, 2020; TCFD, 2019). More comprehensive and reliable GHG disclosures may enable several stakeholders, such as investors, activists and the government, to act on the information they receive, collectively contributing to fight climate change.

Adopting a framework that combines legitimacy theory, voluntary disclosure theory and impression management, this research has evidenced that GHG emissions risk and GHG emissions media visibility positively impact on the likelihood of a company to provide GHG emissions risk disclosure. In addition, results evidenced a positive relationship between GHG emissions risk and the number of words a company uses in its GHG emissions risk disclosure, in total and splitting it into general and specific disclosure. Results also evidenced that GHG emissions media visibility positively influences the number of words used in GHG emissions risk specific disclosure. Results are mainly aligned with predictions from legitimacy theory, that posits that companies increase disclosures to face legitimacy threats, such as high GHG emissions risk or weak GHG emissions risk management. But they are also aligned with voluntary disclosure theory, as considering disclosure as a tool to reduce the information gap between the company and the market, stakeholders' previous knowledge about the company (i.e. media visibility) influences the level of specific disclosure. Results also suggest that when there is increased GHG emissions risk level, or reduced risk management level, companies increase their general disclosure four times more than their specific disclosure. This behaviour is potentially associated with a movement towards a legitimation strategy of diverting stakeholders' attention to the context instead of the company itself, which is also aligned with the attribution strategy in impression management, attributing negative outcomes to external factors by using general disclosure.

This study contributes to expand the knowledge on how different legitimacy threats impact on disclosure and innovates by associating disclosure types with legitimation strategies to interpret the results. In addition, it contributes with the argument from recent papers (Hummel and Schlick, 2016; Tadros and Magnan, 2019) that legitimacy and voluntary disclosure theories should be employed in conjunction to explain sustainability disclosure. In terms of empirical contribution, using a measure of GHG emissions risk from the financial market may help overcome the difficult to access company's risk level and inspire further studies in this regard. In terms of industry contributions, the findings may help annual report users to interpret disclosures and differentiate companies' risk profile, besides reiterating the importance of media coverage to push companies to enhance disclosures. Therefore, this research may have implications for companies and annual report users, regulators and media, which has played a key role in helping spread GHG information and contributing to enhance GHG disclosures.

Building on this study, future studies may employ other measures of disclosure to advance understanding of management's behaviour towards disclosures, including measuring coverage and specificity. More reliable and comprehensive GHG disclosures will enable stakeholders to act more effectively on it, such as directing investments towards less polluting companies or avoiding products from the high-polluting ones. Initiatives like these combined will certainly contribute to reduce GHG emissions and consequently, the effects of climate change on all of us.

8 References

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9 Appendices

9.1 Literature review: Empirical papers summary table

Reference	Theory	Main quantitative data analysis technique	Sample / Data collection period	Measure of environmental disclosure or risk disclosure	Measure of environmental performance	Measure of awareness / visibility / legitimacy/ outsiders' knowledge/ stakeholder pressure	Measure of environmental risks and other risks	Key findings considering the variables of interest for this research
Abraham, S. and Cox, P. (2007) 'Analysing the determinants of narrative risk information in UK FTSE 100 annual reports', *The British Accounting Review*, 39, pp. 227-248.	Agency theory and institutional theory	Tobit model	Non-financial companies in the UK FTSE 100 index, year 2002	Risk disclosure: quantity of narrative risk information in corporate annual reports Sentences as the coding unit. Amount of words within the sentences as the variable. Content-analysis, yielding three estimates of risk reporting per sample firm, defined as: . business risk reporting . financial risk reporting, and . internal control risk reporting. Also, the sum of the three above	-	-	Risk: variance of 60-month stock returns	Positive association between risk, measured by the variance of stock returns, and risk disclosures: "firms with higher stock return volatility try to reduce this through greater disclosure" (p. 242) "Corporate ownership by long-term institutions is negatively related to risk reporting,while corporate ownership by short-term institutions is positively related to financial risk reporting" "The number of dependent non-executive directors is not related to the level of risk reporting" Non-dual listed companies provide more risk disclosures in their UK annual reports than dual-listed companies
Aerts, W. and Cormier, D. (2009) 'Media legitimacy and corporate environmental communication', *Accounting, Organizations and Society*, 34(1), pp. 1-27.	Legitimacy theory	Structural/simultaneous equations models Probit/logit analysis to correct potential selection bias towards companies covered by the media	158 North American firms (Canada and the U.S.) in the consumer goods & services; IT, telecom and media; industrials; energy; chemicals & drugs; mining & resources (e.g. pulp & paper) and utilities industries. Data collected for the year 2002, except for the legitimacy measure, computed for 2003, 2002 and 2001	Environmental disclosure: Content analysis of annual reports: index composed by 39 items grouped into: 1) expenditures and risk; 2) laws and regulations; 3) pollution abatement; 4) sustainable development; 5) land remediation; and 6) environmental management. 3 points= item described in monetary or quantitative terms, 2 points= item described specifically, 1 point= item discussed in general	Environmental performance: Sum of all chemicals released in the air and water and on land (from the Toxics Release Inventory) deflated by $1000 of sales	Environmental legitimacy: media articles covering environmental issues: each article coded as neutral/negative/positive news, then annual Janis-Fadner coefficient of imbalance was calculated, ranging from -1.0 to +1.0 (for high presence of favourable articles) Environmental news exposure: number of articles concerning environmental issues	-	No significant relationship between environmental performance and total annual report environmental disclosure."Worse environmental performance is associated with more elaborate social-based environmental disclosures but not with the economic-based variants [(expenditure & risk; compliance; pollution abatement; land remediation & contamination)]." (p. 17) Positive association between environmental news exposure and disclosure. Environmental legitimacy [Janis-Fadner coefficient] is positively associated with the quality of the economic-based segments of annual report environmental disclosures
Al-Tuwaijri, S. A., Christensen, T. E. and Hughes, K. E. (2004) 'The relations among environmental disclosure, environmental performance, and economic performance: A simultaneous equations approach', *Accounting, Organizations and Society*, *29*, pp. 447-471.	Legitimacy theory and voluntary disclosure theory	Compared independent OLS estimation with joint estimation using two-stage and three-stage least squares (2LS and 3SLS) simultaneous equations models	198 U.S. S&P 500 firms exceeding a minimum threshold for exposure to future environmental costs: at least one pound of toxic waste per $10,000 of revenue (1994)	Environmental disclosure: Content analysis of 10-K reports, focused on 4 topics: 1) toxic waste; 2) environmental fines & penalties; 3) Potential Responsible Party (PRP) designation for the cleanup responsibility of hazardous-waste sites; 4) oil and chemical spills. Final disclosure score= quality scores (+3 for quantitative disclosures, +2 non-quantitative but specific information, +1 general qualitative disclosures, 0 for no information) divided by occurence scores (0 or 1), conditioned to polluting activity reported to regulators (denominator +1 when not disclosed)	Environmental performance: Recycling ratio data (toxic waste recycled/ toxic waste generated), published by the Investor Responsibility Research Center (IRRC)	Public visibility is a control variable in the environmental performance equation, measured by the number of Wall Street Journal news announcements about the company during the year	Environmental exposure (company's exposure to future environmental costs) included as a control variable, measured by the amount of toxic waste generated scaled by total revenues (performance)	Environmental performance (recycling ratio data) is positively related to environmental disclosure: good performance is associated with "more extensive quantifiable environmental disclosures of specific polluti.on measures and occurrences" (p. 447) "Firms with greater environmental exposure and greater public visibility respond with higher environmental performance standards than other comparable firms" (p. 462) The relationship between public visibility and disclosure was not tested. No significant relationship between disclosure and environmental exposure

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Baalouch, F., Ayadi, S. D. and Hussainey, K. (2019) 'A study of the determinants of environmental disclosure quality: evidence from French listed companies', *Journal of Management and Governance*, 23, pp. 939-971.	Stakeholders theory, neo institutional theory, resource dependence theory and human capital theory	Panel data fixed effects regression	French listed companies in SBF120 (the most 120 actively traded stocks listed in Paris) over a six-year period (2009-2014), resulting in 570 firm-observations	Environmental disclosure: Self-constructed index to measure quality using five qualitative attributes as provided by IASB, FASB and GRI frameworks. Following an un-weighted approach, each item in the index is classified according to its Relevance, Neutrality, Clarity (Monetary, Quantitative or Declarative), Comparability and Verifiability. An index for each attribute and a synthesis of the five are computed	CO2 emission performance and environmental performance: . Degree of pollution of the company (CO2 emissions) . ASSET4 (Thomson Reuters) Environmental score: "how well a company uses best management practices to avoid environmental risks and capitalize on environmental opportunities to generate long term shareholder value". (p. 953)	-	-	No significant association between CO2 emission and quality of environmental disclosure. Environmental performance measured by the ASSET4 score presents a positive and significant association with the quality of environmental disclosure (better performance, more extensive disclosure)
Bewley, K. and Li, Y. (2000) 'Disclosure of environmental information by Canadian manufacturing companies: A voluntary disclosure perspective', *Advances in Environmental Accounting & Management*, *1*, pp. 201-226.	Voluntary disclosure theory	. OLS multiple regression . Logistic regression (logit model)	70 Canadian manufacturing companies providing non-financial and/or financial environmental information (1993)	Content analysis of annual report measured using Wiseman index: . Non-financial information (qualitative aspects) . Financial information (specific dollar amounts): 1) extent of financial disclosure, and 2) whether or not a company has made any financial disclosure (binary) . Total environmental disclosure	-	Outsiders' knowledge of company's environmental exposure, measured by the number of news articles related to environmental matters for each company. Size considered as a variable of interest (proxy for political exposure)	Pollution propensity: two proxies: industry membership and whether a company is included in the National Pollutant Release Inventory (both binary)	Positive relationship between total environmental disclosure and environmental media coverage, membership of environmentally-sensitive industries, and inclusion in the National Pollutant Release Inventory (both proxies for pollution propensity). These factors are also positively associated with non-financial disclosure. Both proxies for pollution propensity are positively associated with extent of financial disclosure, while the relationship with media visibility is not significant.
Braam, G. J.M, Uit de Weerd, L., Hauck, M., Huijbregts, M. A. J. (2016) 'Determinants of corporate environmental reporting: The importance of environmental performance and assurance', *Journal of Cleaner Production*, 129, pp.724-734.	Legitimacy theory, voluntary disclosure theory and signalling theory	Ordinary Least squares (OLS) regression	100 Dutch public and private companies that voluntarily disclosed corporate environmental reports in accordance with the GRI. Period between 2009 and 2011, comprising 209 observations	Environmental disclosure: Content analysis of companies' sustainability and annual reports, using an index based on the GRI, following Clarkson et al. (2008), incorporating a total of 82 equally weighted disclosure items (dichotomous). Distinction between hard, objective and externally verifiable environmental information versus soft, unverifiable disclosures.	Total amount of greenhouse gas (GHG) emissions (logarithm of the company's scope 1 and 2 emissions, or scope 1 to 3 emissions), waste, and water consumption. Ratios of GHG emissions, waste production, and water consumption to total revenue	Media coverage used as a control variable, measured by the number of articles per year on the main media channels that refer to the specific company. However, as media coverage was collinear with company size (log of total assets), the former was not included in the regressions	-	"Companies with higher amounts of GHG emissions and water consumption are more likely to disclose environmental information" (pp. 729-730) than their peers. "Poorer environmental performers are more likely to disclose hard, objective and verifiable environmental information than better environmental performers" (p. 730). This relationship is not significant for soft disclosure. Media coverage is collinear with size. Size is positively related with both financial and non-financial disclosure (significance depends on the measure of environmental performance)

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Bui, B., Houqe, M. and Zaman, M. (2020) 'Climate governance effects on carbon disclosure and performance', *The British Accounting Review*, *52, pp. 1-16.*	Signalling theory and legitimacy theory	OLS regression	S&P 500, data from 2013 to 2015	Carbon disclosure: CDP Climate Change Disclosure score, based on CDP questionnaire covering many different aspects of climate change issues, including carbon control mechanisms, carbon strategies, carbon accounting and auditing, carbon initiatives, carbon risks and opportunities, and carbon communication and engagement	Carbon performance: . emissions intensity (total carbon emissions divided by the firm's sales revenue) . the difference between current year and previous year emissions intensity . whether firms have reduced emissions intensity compared to the previous year (dummy variable)	-	-	Positive association between carbon performance and disclosure: "to distinguish themselves from industry peers, high-performing firms leverage their carbon performance by actively communicating to stakeholders" while "carbon-intensive firms are likely to be sensitive to their environmental responsibility image, hence reducing [...] carbon disclosure to hide poor performance" (p. 8) Results hold when splitting CDP disclosure items into hard and soft Stronger climate governance mechanisms strengthens the link between carbon disclosure and carbon performance and reduces managerial discretion over carbon disclosure
Chithambo, L. and Tauringana, V. (2014) 'Company specific determinants of greenhouse gases disclosures', Journal of Applied Accounting Research, 15(3), pp. 323-338.	Theories focusing on information asymmetry (agency and signalling theories) and social political perspective (legitimacy and stakeholder theories)	OLS regression	210 FTSE 350 companies (excluding financial sector companies), in 2011 The sample includes companies disclosing and not disclosing GHG information	Un-weighted disclosure index to quantify GHG disclosures made in the annual reports, sustainability reports and web sites: 60 items consisting of 34 items relating to qualitative disclosures and 26 quantitative disclosures	-	-	-	Company size, gearing, financial slack and two industries (consumer services and industrials) are significantly associated with GHG disclosures while profitability, liquidity and capital expenditure are not.
Cho, C. H. and Patten, D. M. (2007) 'The role of environmental disclosures as tools of legitimacy: A research note', *Accounting, Organizations and Society*, 32, pp. 639-647.	Legitimacy theory	T-tests on the differences in mean size across size-matched groups based on industry membership (environmentally sensitive vs non-environmentally sensitive) and environmental performance (worse performers vs better performers)	100 U.S. companies. 2002 KLD rating and 2001 fiscal year 10-K report	Environmental disclosure: Content analysis of 10-K forms, following Patten (2002), focusing on non-litigation-related environmental disclosure, looking at 8 items, being 4 monetary and 4 non-monetary (total and separated scores)	Environmental performance: KLD environmental concern rating (poor compliance with regulations, emissions, no preventive measures to reduce environmental impact, and portion of revenues from products or services negatively affecting the environment). One or more KLD environmental concern: worse performers; no KLD environmental concern: better performers	-	-	"Poorer environmental performance leads to higher levels of disclosure" (p. 646) . Considering companies in enviromentally-sensitive industries, no significant difference in non-monetary env disclosure level was found, however the extent of monetary env disclosure by worse performers was significantly higher than those made by better performers

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Cho, C. H. and Roberts, R. W. (2010) 'Environmental reporting on the internet by America's Toxic 100: Legitimacy and self-presentation', *International Journal of Accounting Information Systems*, 11, pp. 1-16.	Legitimacy theory and Goffman's self-presentation theory	Multivariate analysis of covariance (MANCOVA) T-tests	76 U.S. companies from environmentally-sensitive and non-environmentally sensitive sectors	Environmental disclosure: Content analysis of corporate website environmental disclosures. Index composed by two sections: content score (21 items) and presentation score (20 items), all of the items measured on a yes/no basis, quantified as 1 and 0. Content scores could range from zero to 21 and presentation scores could vary from zero to 20	Environmental performance: Toxic 100 firms: measure based on the TRI data and provided by the Political Economy Research Institute (PERI), taking into account both the toxicity of specific chemicals and the population exposure. Dichotomous category: 1 if the company belongs to the Toxic 100 (worse performing firms), zero otherwise	-	-	"Worse environmental performers provide more extensive disclosure in terms of content and website presentation." (p. 1) "Environmental sensitivity of firm industry did not have a significant effect on website environmental disclosure content and presentation" (p. 12)
Cho, C. H., Guidry, R. P., Hageman, A. M. and Patten, D. M. (2012) 'Do actions speak louder than words? An empirical investigation of corporate environmental reputation', *Accounting, Organizations and Society*, 37, pp. 14-25.	Legitimacy theory and voluntary disclosure theory	path analysis	92 U.S. companies from the basic materials, oil and gas, and utility industries from Newsweek magazine ranking of 500 large US companies ‘‘on their actual environmental performance, policies, and reputation’’. Data from 2007 until 2009	Environmental disclosure: Content analysis of 10-K report, separate annual report and stand-alone CSR report. Extent of environmental reporting measured using Clarkson et al.'s (2008) environmental disclosure scale: 95-point index based on GRI, composed by ‘‘hard disclosure items’’ and ‘‘soft disclosure items’’ (maximum possible score is 95; of which 60 are potentially generated by the "hard disclosure" environmental performance indicators sub-section). "Total disclosure’’ score integrates financial and CSR report	Environmental Impact Score, reported by Newsweek and calculated by Trucost. KLD environmental concern scores for sensitivity tests	Media exposure: Janis–Fadner measure, "based on the proportion of favorable and unfavorable news articles published about a given firm and can range from -1 to 1 with a more positive rating indicating more positive media exposure" (p. 19)	-	Poorer environmental performers make more extensive environmental disclosures. Negative relationship between environmental performance and reputation [environmental reputation scores reported by Newsweek]: worse performers have stronger reputation. Positive relationship between disclosure and reputation. Relationship between media exposure and reputation is not significant. Direct relationship between media exposure and disclosure is not tested
Cho, C. H., Roberts, R. W. and Patten, D. M. (2010) 'The language of US corporate environmental disclosure', *Accounting, Organizations and Society*, 35, pp. 431-443.	Merkl-Davies and Brennan (2007) impression management framework	OLS multiple regression	190 U.S. companies (43 from environmentally sensitive industries)	Content analysis of environmental disclosure on 10-K reports to calculate "optmism" and "uncertainty" scores, using Diction software	Environmental performance: KLD concern score, assigned to companies with (1) poor compliance with environmental regulation; (2) emit toxic substances and waste in large quantities; (3) fall behind their industry competitors in reducing environmental impact; and/or (4) significant portion of revenues from products that negatively affect the environment. Scores: 0 (no concern) to 4 (high concern)	-	-	"Disclosures of worse environmental performers exhibit significantly more ‘‘optimism’’ and less ‘‘certainty’’ than their better-performing counterparts" (p. 431)

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Clarkson, P. M., Li, Y., Richardson, G. D. and Vasvari, F. P. (2008) 'Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis', *Accounting, Organizations and Society* , 33, pp. 303-327.	Stakeholder and legitimacy theories Voluntary disclosure theory	Multiple regression (inter-industry and intra-industry), two-tailed t-tests, Pearson correlation	191 U.S. companies from pulp & paper, chemicals, oil & gas, metals & mining, and utilities industries. Data from 2003	Environmental disclosure: Content analysis of companies' websites and environmental reports (discretionary disclosure channels only). Index with 95 items: 79 ''hard'' disclosure measures - difficult to be imitated by poor performers -, and 16 ''soft'' disclosure items. Most items may score 1 or 0 (absent), while performance scores follow a scale from 0 to 6, depending on comparison with industry, previous performance and target, disaggregated data etc Ratio of soft disclosure scores to total awarded scores	Environmental performance: 1) total toxic waste that is treated, recycled or processed as a percentage of the total toxic waste generated by each firm (% recycled) 2) ratio of toxic releases to total firm sales. Data from the US Environmental Protection Agency's (EPA) TRI database	Favourable media coverage (environmental news) used as a control variable, measured based on Janis-Fadner coefficient	-	"Positive association between environmental performance and the level of discretionary disclosures in environmental and social reports or related web disclosures" (p. 305): "firms with better environmental performance have more voluntary disclosures about their environmental impact." (p. 320). Poor environmental performer score significantly lower on hard measures (verifiable, difficult to mimick). Ratio of soft to total disclosure, proxy for legitimisation, is higher for poor performers and for those with unfavourable media coverage
Clarkson, P.M., Overell, M. B. and Chapple, L. (2011) 'Environmental Reporting and its Relation to Corporate Environmental Performance', *Abacus* , 47(1), pp. 27-60.	Stakeholder and legitimacy theories Voluntary disclosure theory	Multiple regression	51 Australian firms that reported to the National Pollutant Inventory (NPI) in both 2002 and 2006, and which did not experience a significant event over the study period	Environmental disclosure: Content analysis of voluntary disclosure, in annual reports and sustainability reports. Index developed by Clarkson et al. (2008) based on GRI 2002 Guidelines. Total disclosure and ratio of "hard" to total disclosure	Environmental performance: Emission data available from the National Pollutant Inventory (NPI), multiplying the quantity of each substance emitted by its risk score to arrive at a weighted aggregation	-	-	Poorer environmental performers disclose a greater quantity of environmental information and also rely relatively more on hard [(verifiable)] environmental disclosures than do companies with better environment performance
Cong, Y. and Freedman, M. (2011) 'Corporate governance and environmental performance and disclosures', *Advances in Accounting, incorporating Advances in International Accounting* , 27, pp. 223-232.	Legitimacy theory, stakeholder theory and voluntary disclosure theory	Multiple regression, Spearman and Pearson correlation	50 major emitters of toxic emissions in the U.S., from 2003 to 2005	Environmental disclosure: Content-analysis on companies' CSR/environmental reports and websites. Disclosure index, from 0 to 5, one point for each category found in the disclosures: 1) TRI amount for each reporting year, 2) releases by specific compound, 3) emission by plant, 4) TRI amount for 3 recent years, 5) releases by method	Environmental performance: TRI data: 1) RRR risk-related metric: "composite measure of chemical release, pollution pathway, toxicity, surrogate dose and the exposed population". 2) MHPR hazard-based measure, considering chemical release, toxicity and the exposed population 3) PBR: the total pound of chemicals released	-	-	No relationship between pollution performance and pollution disclosure was identified

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Dawkins, C. and Fraas, J. W. (2011) 'Coming clean: The impact of environmental performance and visibility on corporate climate change disclosure', *Journal of Business Ethics*, 100, pp. 303-322.	Legitimacy theory, voluntary disclosure theory and resource-based view	Ordinal regression (no disclosure, partial disclosure, and full disclosure) Principal component factor analysis	344 U.S. companies in the S&P 500 Data on 2008 activities (except for media visibility: 2007 and 2008)	Climate change disclosure: responses to the climate change mitigation questionnaire of the Carbon Disclosure Project (CDP), categorised in: (a) no disclosure; (b) different disclosure (companies referred CDP to other sources) or incomplete disclosure; or (c) full disclosure	Environmental performance: Two ratings combined (50% weight each): KLD environmental strengths and concerns, and Trucost total carbon emissions	Using Lexis-Nexis and Google News Archive: . General visibility: company's mentions in mainstream media, considering relevance (mentioned within the headline) and prominence (appearance on the front page) . Issue visibility: company's mentions including "climate change"	-	Companies are more likely to provide voluntary climate change disclosure if they have favourable environmental performance and higher levels of issue-related visibility. Company visibility and issue visibility interact with environmental performance to influence the level of voluntary climate change disclosure, in such a way companies with lower visibility are less likely to provide voluntary climate change disclosure
de Villiers, C. and van Staden, C. J. (2011) 'Where firms choose to disclose voluntary environmental information', *Journal of Accounting and Public Policy*, *30* (6), pp.504-525.	Agency theory and political cost argument	t-tests of means OLS regression	120 U.S. companies: "60 crisis firms and 60 non-crisis firms, and simultaneously consisting of 60 bad environmental reputation firms and 60 firms that do not have a bad environmental reputation" (p. 512); 2004 environmental performance, 2005 annual reports	Environmental disclosure: Content-analysis on annual reports and on corporate websites: volume of environmental disclosures measured by sentences	Environmental performance: KLD rating (long-term, reputation-based), summing up the 5 strengths and the 7 concerns (KLD awards 0 or 1 to each of them) . TRI data (short-term, crisis-based): total quantity of toxic chemicals released not associated with routine production processes	-	-	Companies with worse environmental performance, measured by KLD rating, report significantly more environmental information in their annual reports. Companies with worse environmental performance, measured by TRI, report significantly more environmental information in their websites
Deegan, C. and Gordon, B. (1996) 'A study of the environmental disclosure practices of Australian corporations', Accounting and Business Research, *26* (3), pp. 187-199.	Legitimacy theory Although not mentioning it, the paper touches the concept of disclosure threshold from the voluntary disclosure theory (suggesting that managers consider the benefits from appearing to be objective higher	. T-test and Wilcoxon . Pearson product-moment correlation coefficients . Spearman correlation coefficients	1st and 3rd studies: . 197 Australian companies within the top 500 by market capitalisation. For the positive and negative disclosures, 71 companies were identified voluntarily producing environmental information . 1991 annual reports 2nd study: . 25 Australian companies . 1980, 1985, 1988 and 1991 annual reports	. Word count of environmental disclosures . Amount of words in positive and negative environmental disclosures (company operating in harmony/in detriment of the environment)	-	. Environmental group membership, reflecting change in community values and increased risk of environmental lobbying groups negatively affecting business . Industry's environmental sensitivity, measured by the extent to which environmental groups had targeted each industry (obtained via questionnaire) and corresponding membership	-	. Environmental disclosures are largely qualitative and mainly self-laudatory . Increase in environmental disclosures comparing 1988 and 1991, positively associated with increase in environmental group membership . Industries of concern to environmental groups disclose more positive information than other industries . In environmentally sensitive industries, there is a positive relationship between size and the amount of positive environmental disclosures

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Dobler, M., Lajili, K. and Zéghal, D. (2015) 'Corporate environmental sustainability disclosures and environmental risk: Alternative tests of socio-political theories', *Journal of Accounting & Organizational Change* , *11* (3), pp. 301-332.	Legitimacy theory, stakeholder theory and political economy theory	Multiple regressions	88 U.S. S&P 500 companies in energy, industrials, materials and utilities sectors (2010)	Content analysis of 10-K reports based on a 33-item disclosure index (items in 5 categories: vision and profile, governance, financials, performance, credibility) that weights items according to their specificity (3= item described in quantitative or monetary terms, 2= presented in a firm-specific way in non-quantitative terms, 1= presented in general terms, 0= absent)	Derived from Toxics Release Inventory (TRI) data: total releases in grams per US dollar of sales, and total waste that is treated, recycled or recovered compared to total waste generated	-	Risk exposure and risk consequence calculated and multiplied to generate a single measure, for risk from regulations and from operations, based on content analysis of 10-K reports	The level of environmental disclosures is positively associated with a firm's environmental risk – which is stronger for risk from regulation than from operations.Results hold when splitting disclosure into economic-based disclosure (often presented in quantitative terms) and management-related disclosure. Environmental disclosure is unrelated to environmental performance (negative sign but insignificant) Negative correlation between environmental risk and environmental disclosure
Dragomir, V.D. (2010) "Environmentally sensitive disclosures and financial performance in a European setting", *Journal of Accounting & Organizational Change* , Vol. 6 No. 3, pp. 359-388.	Legitimacy theory and stakeholder theory	Multiple regression	60 of the largest European industrial business groups, extracted from the FTSEuroFirst 300. Period between 2005 and 2007	Environmental disclosure: content analysis of the most recent annual and sustainability reports published before the end of 2008 (2006 or 2007). Index based on GRI: five-level ordinal scale to measure the degree of voluntary environmental disclosure (0=data not present, 1= present only for the current period, 2= year-to-year basis, 3= calculations described, 4= enable benchmarking), for 26 environmental performance items, for a possible 62 points (some topics were worth four points, while others only one point)	Group-level greenhouse gas emissions scaled by employees and by total asset. Group-level direct and indirect energy consumption scaled by employees and by total assets.	-	-	Negative relationship between environmental disclosure and environmental performance (measured by GHG emissions or energy consumption): "bigger polluters tend to disclose more on their activities" (p. 359)
Elijido-Ten, E. O. (2017) 'Does recognition of climate change related risks and opportunities determine sustainability performance?', *Journal of Cleaner Production* , 141, pp. 956-966.	Prospect theory and resource-based view framework	Logistic regression	152 companies: 76 companies, amongst the Top500 (world's largest 500 listed companies, based on sales turnover) that made the G100 list (Global 100 Most Sustainable Corporations in the World) from 2005 to 2010, excluding insurance, banking and financial industries. Matched one-to-one with other non-G100 similar firms in the Top500	Recognition of climate change risks and opportunities, based on 2010 Carbon Disclosure Project (CDP) survey responses to 6 questions on climate change (Yes/No): current or anticipated 1) regulatory risks, 2) physical risks, 3) other risks, 4) regulatory opportunities, 5) physical opportunities, 6) other opportunities: . Climate Change Net Risk (amount of risks minus opportunities): -3 to +3 . The three types of climate change risks and opportunities separately	Sustainability performance: dichotomous variable wheter a company is in the G-100 list or not, from 2005 to 2010 (either once or perennially). Global 100 list, elaborated by Corporate Knights, identify firms "deemed to have the best developed capabilities, relative to their industry peers, to manage environmental, social and governance risks, and to take advantage of new opportunities in these areas." (p. 957)	-	-	"Recognition of climate change as a net risk, and in particular, the regulatory risk, is significant and negatively correlated to sustainability performance" (p. 965): "the more a firm frames climate change as a net risk, the less likely it is going to have superior sustainability performance." (p. 964)

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Elshandidy, T., Fraser, I. and Hussainey, K. (2013) 'Aggregated, voluntary, and mandatory risk disclosure incentives: Evidence from UK FTSE all-share companies', *International Review of Financial Analysis* , 30, pp. 320-333.	Theories of mandatory and voluntary risk disclosures: regulatory theory and managers' incentive theories (agency and signalling theories)	Linear Mixed Model (LMM)	290 UK non-financial listed companies four-year period (2005 to 2009)	Aggregated (total), voluntary and mandatory risk disclosures in the annual report narratives (number of sentences). Automated content analysis using Nudist 6, sentence as the unit of analysis, based on a risk word list. "To differentiate between voluntary and mandatory statements, we correlate all aggregated risk statements with mandated risk topics or themes" (p. 324), identified based on the UK regulatory and professional literature	-	-	Corporate risk levels: . four market-risk measures (volatility of market returns, beta, volatility of the standard error of the CAPM and the Sharpe ratio) . two accounting-risk measures (leverage and current ratio) ... to capture six risk categories (total, systematic, unsystematic,risk-adjusted returns, financing and liquidity risks, respectively)	In general, high-risk firms provide more disclosure of both voluntary and mandatory risk information than low-risk firms. Companies characterised by: . higher levels of systematic (beta) and financing risks (leverage), . lower stock return variability, . large size, high dividend-yield, . high board independence, . low insider ownership, and . effective audit environments ... are likely to exhibit higher levels of aggregated and voluntary risk disclosures than other firms Similarly, mandatory risk disclosures are influenced positively by firm size, dividend-yield and board independence and negatively by high leverage
Elzahar, H. and Hussainey, K. (2012) 'Determinants of narrative risk disclosures in UK interim reports', *The Journal of Risk Finance* , 13(2), pp. 133-147.	Signalling theory, agency theory,	OLS regression analysis	72 UK non-financial companies from FTSE 100 UK. Interim reports published between 1 June 2009 and 31 May 2010	Risk disclosure: number of risk-related sentences on interim reports, measured using content-analysis	-	-	. financing risk: gearing ratio . liquidity risk: liquidity ratios	"Large firms are more likely to disclose more risk information in the narrative sections of interim reports." (p. 133) Industry is positively associated with levels of narrative risk disclosure "Statistically insignificant impact of other firm-specific characteristics (liquidity, gearing, profitability, and cross-listing) and corporate governance mechanisms on narrative risk disclosure."
Fekrat, M. A., Inclan, C. and Petroni, D. (1996) 'Corporate environmental disclosures: Competitive disclosure hypothesis using 1991 annual report data', *The International Journal of Accounting* , *31* (2), pp. 175-195.	Voluntary disclosure theory	Correlation (Spearman rank) For the bigger sample, analysis of variance (ANOVA) and regression	26 of the largest U.S. firms (1991 annual reports, 1988 toxic releases made available in 1990) A bigger sample of 168 companies was used to investigate differences in disclosure by industry and country	Content analysis of environmental disclosure in annual reports, based on Wiseman's (1982) model	Environmental performance: CEP rankings generated from the data on toxic releases and the Superfund Potentially Responsible Party (PRP): Toxic Releases per $1,000 Sales Rank, # of PRP Sites Rank, Annual Report Survey Score Rank, and Average Toxic /PRP Rank	-	-	"No apparent association between disclosure and environmental performance" (p. 184). Negative correlations between environmental performance and disclosure, but not statistically significant For the 2nd study: "significant variations among companies in different industries and countries in how much information on their environmental performance they disclose in their annual reports" (p. 186)

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Fontana, S., D'Amico, E., Coluccia, D. and Solimene, S. (2015) 'Does environmental performance affect companies' environmental disclosure?', *Measuring Business Excellence*, 19(3), pp. 42-57.	Voluntary disclosure theory and agency theory	OLS multiple regression	44 listed Italian firms. Reports from 2006 and 2009	Environmental disclosure: Content analysis of annual financial reports, the report on management, the sustainability report and the report on corporate governance, looking at 31 elements from GRI and European disclosure regulation, assigning score=1 (Detailed information), 0.5 (Generic information) and 0 (no data) for each item, then dividing by 31	CO2 intensity: Carbon dioxide emission divided by company's sales	-	-	Apparently, "environmental performance has no statistical significance on the environmental disclosure index" (p. 51). However, based on the interrelation between firm size and environmental performance, "we can deduce that [...] companies tend to have greater environmental disclosure if they produce less carbon dioxide pollution"
Freedman, M. and Jaggi, B. (1982) 'Pollution disclosure, pollution performance and economic performance', *Omega*, 10(2), pp. 167-176.	Not mentioned. Null hypothesis: "There is no association between the extensiveness of pollution disclosure and the pollution performance of firms." (p. 170)	Correlation (Spearman Rank and Pearson product-moment)	31 companies from the steel, oil refining, and paper and pulp industries, observed in 1972 and for the steel industry, also in 1977 (totalling 37 observations)	Environmental disclosure: Content analysis of annual statements and 10-K reports. Pollution disclosure index assigning different weights for each item identified: EPA standards for current emissions and firm's performance (weight: 2.5), Future capital expenditures (2.0), Current capital expenditures (1.5), Past capital expenditures (1.5), Descriptive with percentage (0.5), Descriptive (0.5)	Environmental performance: CEP pollution index	-	-	No significant relationship between environmental disclosures and environmental performance, in other words, "pollution disclosures do not reflect actual pollution performance." (p. 171)
Freedman, M. and Jaggi, B. (2011) 'Global warming disclosures: Impact of Kyoto Protocol across countries', *Journal of International Financial Management and Accounting*, 22(1), pp. 46-90.	Stakeholder and legitimacy theories	Multiple regression	Sample composed by 173 companies from the U.S., EU, Japan and Canada. For the main research question (on the impact of the Kyoto protocol), 510 companies included in the Forbes 2000 listing headquartered in the EU, Japan, Canada, India or the U.S.. 2006 data	Global warming disclosure, based on content analysis of disclosures from the websites, annual reports, sustainability reports and from CDP questionnaire, using a self-constructed index following an equal weighting scheme (each item is scored zero, if absent, or one). Index items include: Mentioning of the Kyoto Protocol, GHG (or carbon) emissions, energy used etc.	Carbon performance: emissions intensity (emissions scaled by revenue)	-	-	"There is no significant association between carbon emissions and GHG disclosures" (p. 87) "Pollution disclosures by U.S. and Indian firms are comparatively less than pollution disclosures by firms from Canada, Japan and some EU countries." (p. 87)
Freedman, M. and Wasley, C. (1990) 'The association between environmental performance and environmental disclosure in annual reports and 10Ks', *Advances in Public Interest Accounting*, 3, pp. 183-193.	Not mentioned. Objetive similar to the previous studies	Correlation (Spearman rank)	50 U.S. firms from oil (1974), steel (1972, 1973 and 1976), paper (1972, 1973) and electric utilities (1975) industries	Environmental disclosure: Content analysis applied to voluntary annual reports and mandated 10-K reports, similar to Wiseman (1982)	Environmental performance: CEP scores	-	-	Voluntary annual report and mandatory 10-K report are not "indicative of actual firm environmental performance" (p. 191), as only two of 50 comparisons were significant correlations (positive association between economic disclosure and performance in the oil industry in annual reports; negative association between litigation disclosure and performance in the steel industry in 10-K reports)

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Giannarakis, G., Konteos, G. and Sariannidis, N. (2014) 'Financial, governance and environmental determinants of corporate social responsible disclosure', *Management Decision*, 52(10), pp. 1928-1951.	Legitimacy theory	Least squares dummy variable model (LSDV)	100 U.S. companies listed on S&P 500 Index for the period 2009-2012	Sustainability and environmental disclosure: Bloomberg ESG disclosure score, and Bloomberg Environmental, Social and Governance scores separately	GHG emissions Presence of emission reduction initiatives (binary: company implements them or not)	-	-	No significant relationship has been found between GHG emissions and extent of environmental disclosure Significant positive relationship between GHG emission and total ESG disclosure: "more polluting companies[...] tend to enclose more information on CSR disclosures [...] in order to eliminate the stakeholders' pressure [...] and enhancing a corporate image" (p. 1945) Positive association between the presence of emission reduction initiatives and the extent of environmental disclosure
Giannarakis, G., Zafeiriou, E. and Sariannidis, N. (2017) "The impact of carbon performance on climate change disclosure", Business Strategy and the Environment, 26, pp. 1078-1094.	Legitimacy theory and voluntary disclosure theory	Ordered logit regression	119 companies listed on FTSE 350 for the year 2014, mainly from the financial industry, the consumer discretionary industry and the material industry.	Climate change disclosure: Climate Performance Leadership Index (CPLI), estimated by CDP. "CPLI not only provides an indication of the corporate transparency level of firms, but also provides evidence for their contribution to climate change mitigation and adaptation as well" (p. 1080). "It reflects the comprehensiveness of a firm's response in terms of the depth and breadth of its answers to the CDP requirements" and "incorporates four main aspects: management, risk and opportunities, emissions and sign-off" (p. 1082)	GHG emission performance: . emission intensity: direct and indirect GHG emissions, divided by total sales and industry-adjusted . environmental intention of mitigating climate change: whether a firm has incorporated Climate change policy, and emission reduction initiatives (binary)	-	-	GHG emission performance (both emission intensity and intention to mitigate climate change) entails a positive effect on climate change disclosure, consistent with voluntary disclosure theory: "Scope 1 [...] affects in a negative [...] way [...] the level of transparency on company mitigation of and adaption to climate change." (p. 1087) "climate change disclosure is illustrated to be a reliable signal of the actual environmental performance." (p. 1080)
Guenther, E., Guenther, T., Schiemann, F. and Weber, G. (2016) 'Stakeholder relevance for reporting: Explanatory factors of carbon disclosure', *Business & Society*, 55(3), pp. 361-397.	Voluntary disclosure theory	Tobit regressions	1,120 firms from Global 500, S&P 500 and FTSE 350 (biased toward U.S. and U.K.), from 2008 to 2011	Carbon disclosure: CDP Carbon Disclosure Score	Carbon performance: emission intensity: value of the estimated CO2 emissions (Scope 1 and Scope 2) divided by total assets in the year prior to the CDP disclosure, standardised by industry	Stakeholder relevance (based on the year prior to disclosure): . general public - Voice and Accountability measure as provided by the World Governance Index (WGI) . Media: sum of all controversies faced by a firm as reported in Thomson Reuters Asset4 . government - GHG politics: score of climate protection oriented policies dimension in Germanwatch index . Employees - workforce/ employee quality score obtained from the Thomson Reuters Asset4 Database . customers - client management score (from Thomson Reuters Asset4)	-	"In addition to carbon performance, all stakeholders [government, general public, media, employees, and customers] are associated with carbon disclosure" (p. 361) The carbon disclosure score is positively associated with carbon performance (better performers, measured based on GHG emission intensity in relation to the industry, score higher on CDP) The companies that experience more media pressure are likely to increase their carbon-related disclosure. The interaction between carbon performance (GHG-intensity) and controversies (proxy for media relevance) is not significant to predict carbon disclosure (CDP score)

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Guidry, R.P. and Patten, D.M. (2012) 'Voluntary disclosure theory and financial control variables: An assessment of recent environmental disclosure research', *Accounting Forum*, 36(2), pp. 81-90.	Legitimacy theory and voluntary disclosure theory	Multivariate regression	95 U.S. companies. 2002 KLD rating and 2001 fiscal year 10-K report Sample and variables, except for control variables, similar to Cho and Patten (2007)	Environmental disclosure: Content analysis of 10-K forms, following Patten (2002), focusing on non-litigation-related environmental disclosure, looking at 8 items, being 4 monetary and 4 non-monetary (total and separated scores)	Environmental performance: KLD environmental concern rating	Media exposure (Janis-Fadner coefficient) included as a control variable	-	Even with the voluntary disclosure theory financial control variables, a negative association between performance and disclosure still exists in Cho & Patten's (2007) study (also reviewed in this study) With the exception of firm size, authors failed to find evidence suggesting any systemic associations with other financial control variables No significant relationship between media exposure and environmental disclosure
Hassan, O.A.G. and Romilly, P. (2018) 'Relations between corporate economic performance, environmental disclosure and greenhouse gas emissions: New insights', *Business Strategy and The Environment*, 27(7), pp. 1-17.	Voluntary disclosure, signalling and legitimacy theories	Simultaneous equation model Granger causality tests	1,607 firms operating in developed and developing countries, with 9,120 firm-year observations from 45 countries (1,392 firms from developed countries and 215 firms from developing countries).	Sustainability disclosure: Bloomberg ESG disclosure score, which "quantifies a company's transparency in reporting environmental, social and governance data", from zero (no disclosure) to 100	Amount of greenhouse gas (GHG) emissions or, if unavailable, carbon dioxide (CO_2) emissions	-	-	For developed countries GHG emission performance is positively and significantly related to disclosure (better environmental performance is associated with more disclosure). For developing countries, the sign is reversed: worse environmental performance is associated with more environmental disclosure
He, Y., Tang, Q. and Wang, K. (2013) 'Carbon disclosure, carbon performance, and cost of capital', China Journal of Accounting Studies, 1(3-4), pp. 190-220.	Legitimacy theory and voluntary disclosure theory	Three-stage least squares (3SLS) simultaneous equations models (also employed OLS for additional analysis and the relationship between performance and disclosure was no longer significant)	181 companies from S&P 500, that participated in the Carbon Disclosure Project (CDP) in 2010	Carbon disclosure: Carbon Disclosure Score Index, calculated by CDP based on company's responses to the climate change annual questtionaire (although namely as carbon disclosure on this paper, the adopted proxy measures climate change disclosure as CDP questionnaire also includes physical risks from climate change)	Carbon performance: carbon intensity: . inverse of total GHG emission per million dollars of sales turnover (net) . Inverse of Scope 1 GHG emission per million dollars of sales turnover (net)	-	-	Inverse significant relationship between carbon disclosure and carbon performance: poor performers disclose more. Results are consistent with legitimacy theory: companies with higher carbon-intensity score higher on CDP. Leverage is positively associated with CDP disclosure score
Hollindale, J., Kent, P., Routledge, J. and Chapple, L. (2019) 'Women on boards and greenhouse gas emission disclosures', *Accounting and Finance,* 59, pp. 277-308.	Institutional and board capital theory, to investigate the governance aspect, and legitimacy theory	Logistic regression and Tobit regression	406 Australian listed companies, with 203 companies that disclosed GHG emissions data, and 203 matched non-disclosing companies. Sample period of 2007	GHG emission-related disclosure: . dichotomous variable for the existence of disclosure . quality measured by content-analysis index, based on Clarkson et al. (2008) and the GRI, divided into 18 hard and 16 software disclosure items, non-weighted (one indicating the presence of an item, zero otherwise): total disclosure, soft disclosure and hard disclosure	-	Presence of unfavourable media reports regarding the environment: dummy variable (considered a control variable)	-	Although not significant, the relationship between negative media coverage regarding the environment and GHG emission disclosures is positive for total disclosures, negative for hard disclosures and positive for soft disclosures (the present of negative media coverage would imply more soft disclosure and less hard disclosure) The presence of multiple female directors on the board is significantly and positively associated with total disclosure, hard disclosure and soft disclosure

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Hrasky, S. (2012) "Carbon footprints and legitimation strategies: Symbolism or action?", *Accounting, Auditing & Accountability Journal*, 25(1), pp. 174-198.	Legitimacy theory	Independent Samples T-Test	50 largest listed Australian companies, being 22 from more carbon-intensive sectors (materials, industrials, energy, utilities) and 28 from less carbon-intensive sectors (financials and others). Reports from 2005 and 2008	Content analysis of the sustainability and annual reports looking for carbon disclosure: extent (number of sentences) and nature of disclosure, which can be action or symbolism (rhetorical statements, not necessarily accompanied by relevant action). A specific disclosure type, on general statements not referring to the company, was also measured	-	-	-	Carbon-intensive sectors rely more heavily on substantive action disclosure, while less carbon-intensive sectors rely more heavily on symbolic disclosure. Carbon-intensive companies use 6 times more of this type of disclosure than less carbon-intensive companies: general statements related to carbon footprints but not directly related to the company or its activities. (p. 183)
Hughes, S. B., Anderson, A. and Golden, S. (2001) 'Corporate environmental disclosures: Are they useful in determining environmental performance?', *Journal of Accounting and Public Policy*, *20*, pp. 217-240.	Legitimacy, political economy and stakeholder theory mentioned in the literature review, but none used to set the hypotheses	One-way ANOVA Step-wise discriminant analysis	51 US manufacturing firms (1992 and 1993)	Environmental disclosure: Content analysis of annual reports (23 items that included most of the items in Wiseman's (1982) study); within the president's letter, the management's discussion and analysis (MD&A), and note sections. Weighted sentence: content classified in quantitative (4), descriptive (3), vague (2) and inmaterial (1)	Environmental performance: CEP environmental ratings: good, mixed or poor performers, based on their environmental activities	-	-	Higher disclosures for poor performers were observed, mainly in the Management Discussion and Analysis (MD&A) and notes (mandatory disclosure) No significant differences in the president's letter (non-mandatory disclosure) across performance groups
Hughes, S. B., Sander, J. F. and Reier, J. C. (2000) 'Do environmental disclosures in U.S. annual reports differ by environmental performance?', *Advances in Environmental Accounting & Management*, 1, pp. 141-161.	Stakeholder theory and political economy theory	Analysis of Variance (ANOVA) and non-parametric tests (Wilcoxon U) Correlation (Spearman rank) and step-wise discriminant analyses	20 U.S. firms with environmental performance classified by the Fortune magazine relying on input from the CEP (10 leaders and 10 laggards) in 1993 (1992 annual report)	Content analysis of environmental disclosure in four sections of annual reports (mandatory: MD&A and notes to financial statements; non-mandatory: president's letter and general narattive), similar to Wiseman's index: 16 environmental topics with weighted sentence disclosure (quantitative=2, descriptive=1, no mention=0)	Fortune magazine ranking, classifying companies as either leaders or laggards environmental performers	-	-	Laggards (worse) environmental performers made significantly more mandatory environmental disclosure than leaders. Results did not evidence significant differences in voluntary disclosure.
Hummel, K. and Schlick, C. (2016) 'The relationship between sustainability performance and sustainability disclosure: Reconciling voluntary disclosure theory and legitimacy theory', *Journal of Accounting and Public Policy*, 35, pp. 455-476.	Legitimacy theory and voluntary disclosure theory	Multivariate regression	195 European companies, reporting year 2011	Sustainability disclosure collected from sustainability reports, annual report and any web-based sustainability disclosures, based on 7 GRI core indicators (such as materials used and water withdrawal), the disclosure of each of them classified in: high-quality disclosure (fulfilling or exceeding GRI minimum requirements), low-quality disclosure or nondisclosure, combined with 7 social GRI indicators, composing a high-quality sustainability disclosure score and a low-quality sustainability disclosure score	Sustainability performance: 4 environmental performance GRI indicators, combined with 4 social performance indicators to form a sustainability performance score	-	-	Positive association between performance and high-quality disclosure: superior performers choose high-quality disclosure to signal their superior performance to the market Negative relationship between performance and low-quality disclosure: poor performers prefer low-quality disclosure "to disguise their true performance and to simultaneously protect their legitimacy" (p. 455) "The two theories are not mutually exclusive but dovetail to explain sustainability reporting behavior" (p. 470)

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Ingram, R. W. and Frazier, K. B. (1980) 'Environmental Performance and Corporate Disclosure', *Journal of Accounting Research* , 18(2), pp. 614-622.	Not mentioned. Assumption: firms' environmental disclosures are reflective of their environmental activities	. Correlation . Multiple regression, after factor analysis	40 US firms from electric utilities, iron and steel, petroleum refining, and pulp and paper industries Cross-sectional, with distinct data collection timings, from 1970 to 1974 (all firms in the same industry evaluated in the same year)	Environmental disclosure: Content analysis of annual report (mostly voluntary and unaudited environmental disclosure, except for litigation): each sentence was tested in four dimensions (evidence, time, specificity and theme, sub-divided in 20 categories, e.g. time is divided in past, present and future)	Environmental performance: Council on Economic Priorities (CEP) scores, on a 0 (best) to 10 (worst)	-	-	Insignificant results in the regression analysis, however correlations suggest that "on average, the poorer performers made slightly more disclosures than the better performers in all categories except litigation" (p. 618), being litigation "the only category of environmental disclosure contained in the audited financial statements. In contrast, the greater amount of disclosure by the poorer performers appears in the narrative, discretionary section of the annual report." (p. 620)
Lemma, T., Feedman, M., Mlilo, M. and Park, J. (2019) 'Corporate carbon risk, voluntary disclosure, and cost of capital: South African evidence', *Business Strategy and the Environment* , 28, pp. 111-126.	Legitimacy theory and voluntary disclosure	Simultaneous equations models, using the three-stage least squares procedure	100 top companies listed on the Johannesburg Stock Exchange (JSE), for the period 2010 to 2015	Voluntary carbon disclosure: CDP's company's carbon disclosure score (quality and comprehensiveness of information disclosed in a company's response to CDP's annual climate change survey)	Although named corporate carbon risk exposure, according to the literature, GHG intensity is a proxy for performance: the inverse of Scope 1 GHG emissions scaled by total sales revenue (transformed measure of carbon emissions intensity)	-	Althought it is named carbon risk exposure, the proxy used is more strongly associated with performance in the literature	Companies with higher carbon intensity tend to provide a higher level of carbon disclosure and "signal the possibility of high carbon risk to avoid negative market reactions resulting from concealing carbon information." (p. 112)
Lemma, T., Shabestari, M., Freedman, M. and Mlilo, M. (2020) 'Corporate carbon risk exposure, voluntary disclosure, and financial reporting quality', *Business Strategy and the Environment* , 29, pp. 2130-2143.	Legitimacy theory, voluntary disclosure theory, signalling theory, agency theory	Least-squares dummy variable (LSDV) regression	100 top companies listed on the Johannesburg Stock Exchange (JSE), for the period 2011 to 2015	Carbon disclosure quality: company's carbon disclosure score from CDP (quality and comprehensiveness of information disclosed in a company's response to CDP's annual climate change survey)	Although named corporate carbon risk exposure, according to the literature, GHG intensity is a proxy for performance: the inverse of Scope 1 GHG emissions scaled by total sales revenue (transformed measure of carbon emissions intensity)	-	Althought it is named carbon risk exposure, the proxy used is more strongly associated with performance in the literature	"Positive association between corporate carbon risk exposure and quality of a firm's carbon disclosure, which supports the conjecture based on sociopolitical theories [(i.e. the more GHG a company emits per ZAR 1,000 revenue, the higher its disclosure score)]. That is, it corroborates the proposition that firms with high carbon risk exposure with threatened legitimacy would voluntarily engage in disclosure of carbon-related information to deflect or nullify suspicion or doubt about their environmental activities" (p. 2137).
Li, Y., Richardson, G. and Thornton, D. (1997) 'Corporate disclosure of environmental liability information: Theory and evidence', *Contemporary Accounting Research* , 14(3), pp. 435-474.	Voluntary disclosure theory, with a game-theory model of environmental disclosure	Logistic regression (logit model)	21 TSE (Toronto Stock Exchange)-traded companies, involved in administrative orders from the Ontario Ministry of the Environment and Energy, environmental prosecutions and major spills, between 1982 and 1992	Environmental disclosure: whether companies had disclosures about the liabilities related to specific incidents (dummy variable: 1 if a firm discussed the incident, and 0 otherwise), based on content analysis of annual reports, Annual Information Forms, MD&A, quarterly reports and press releases	-	Outsiders' knowledge of company's environmental liabilities: percentage of media articles related to a company's environmental aspects for the calendar year in which an incident occurred	Pollution propensity: whether a company is monitored by the Municipal and Industrial Strategy for Abatement (MISA) law related to discharging polluting effluents directly to surface water in Ontario (0 or 1)	Significant positive relationship between a company’s decision to disclose and its propensity to pollute and also its ratio of environmental media articles: "when outsiders think it is more likely that management has knowledge of the amount of the liability, and as the firm becomes more pollution-prone, disclosure becomes more likely" (p. 457)

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Liesen, A., Hoepner, A., Patten, D. and Figge, F. (2015) 'Does stakeholder pressure influence corporate GHG emissions reporting? Empirical evidence from Europe', *Accounting, Auditing & Accountability Journal* , 28(7), pp. 1047-1074.	Legitimacy theory and stakeholder theory	Logistic regression	431 European companies (excluding those in the financial services industry), from 2005 to 2009	Measures based on corporate reports and company's web sites: . existence of GHG emissions disclosure: whether a company reported absolute levels of GHG emissions on at least the majority of corporate activities (dummy) . completeness of GHG emissions disclosure, with regard to the scope, type and reporting boundary : only companies classified as complete disclosers in all three areas as having complete GHG emissions disclosure (dummy)	-	Exposure to climate change concerns/pressure from different stakeholder groups: 1) state: implicit energy tax level 2) NGOs: mentions in negative climate change-related NGO press releases and featured news articles (WWF, Greenpeace etc) 3) providers of capital: leverage and whether pension fund holdings > 5% 4) public: membership to high-carbon industries (utilities, basic materials, industrials, and oil and gas)	-	External stakeholder pressure (from the state, measured based on implicit energy tax level, and from the public, based on membership of carbon-intense industries) is a determinant of the existence but not the completeness of emissions disclosure, suggesting incomplete disclosure as a symbolic gesture to enhance legitimacy Only 15% of companies that disclose GHG emissions report them in a complete manner (based on scope, type and reporting boundary)
Linsley, P. and Shrives, P. (2006) 'Risk reporting: A study of risk disclosures in the annual reports of UK companies', *The British Accounting Review* , 38 (2006) , pp. 387-404.	-	Pearson correlation	79 UK non-financial companies listed in the FTSE 100 Index. Annual reports from year-end date nearest to 1 January 2001	Risk disclosure sentences: content analysis on all narrative sections of the annual report, including the notes to the accounts, looking for sentences where "the reader is informed of any opportunity or prospect, or of any hazard, danger, harm, threat or exposure, that has already impacted upon the company or may impact upon the company in the future or of the management of any such opportunity, prospect, hazard, harm, threat or exposure" (p. 389). Sentences classified as monetary/non-Monetary; Good/bad/neutral news and future/past/non-time specific	-	-	Business in the Community Index of Corporate Environmental Engagement (BiE Index) and Innovest EcoValue'21TM Ratings (historical contingent liabilities, operating risk exposure, sustainability risk and financial risk and the company's capacity to manage risk successfully). Five other measures of risk: gearing ratio, asset cover, beta factor, quiscore (likelihood of company failure), book to market value of equity	"Companies with lower levels of environmental risk are disclosing greater amounts of risk information" (p. 399) Significant association between the number of risk disclosures and company size "Uncommon to find monetary assessments of risk information" (p. 387) "No association is found between the number of risk disclosures and five other measures of risk: gearing ratio, asset cover, quiscore, book to market value of equity and beta factor" (p. 387)
Luo, L. and Tang, Q. (2014) 'Does voluntary carbon disclosure reflect underlying carbon performance?' *Journal of Contemporary Accounting and Economics* , 10(3), pp. 191-205.	Voluntary disclosure theory and signalling theory	Ordinary least squares (OLS) regression models	474 large companies from the U.S., UK and Australia, which participated in the CDP S&P 500, FTSE 350 or ASX 200 lists. CDP 2010 annual survey and environmental performance data for 2009 and 2010	Carbon disclosure scores reported by the CDP	Carbon performance: . emissions intensity (ratio of total Scope 1 and Scope 2 GHG emissions to total sales) . sector-adjusted GHG emission intensity . Index to measure whether a firm lowered its emissions relative to historical levels or other benchmarks	-	-	"Significant positive association between carbon disclosure and performance [worse performance, or higher carbon-intensity, is associated with lower disclosure level] suggesting that firms' voluntary carbon disclosure in the CDP is indicative of their underlying actual carbon performance" (p. 191)

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Meng, X. H., Zeng, S.X., Shi, J. J., Qi, G.Y. and Zhang, Z.B. (2014) 'The relationship between corporate environmental performance and environmental disclosure: An empirical study in China', *Journal of Environmental Management*, 145, pp.357-367.	Legitimacy theory and voluntary disclosure theory	Multiple regression	533 Chinese listed companies (80 good environmental performers, 405 mixed performers and 48 poor performers). 2010 and 2009 data	Environmental disclosure: Content analysis of annual reports, CSR or environmental reports, and bulletins related to the environment, using an index composed by 43 items across eight categories based on environmental disclosure regulation. Each item scored based on its level of disclosure: 3 (described in monetary or other quantitative terms); 2 (described specifically); 1 (discussed in general); and 0 (no information provided). Variables: total level of disclosure and each of the eight categories	Environmental performance: "Firms who have been involved in environmental violations are classified as poor performers" (p. 359) Good performers were identified "based on Ministry of Environment of China designation or the meeting of various performance criteria" (p. 358)	-	-	"Good performers disclosed significantly more environmental information than poor ones" (p. 361). "Both poor and good performers disclosed more environmental information than mixed performers" (p. 361), suggesting a nonlinear relationship. "Poor performers disclose more soft information than good performers, and good performers disclose more solid information" (p. 357), but both of them use both kinds of information.
Neri, L., Elshandidy, T. and Guo, Y. (2018) 'Determinants and impacts of risk disclosure quality: Evidence from China, *Journal of Applied Accounting Research*, 19(4), pp. 518-536.	Agency theory and signalling theory	OLS and fixed-effects estimations	100 financial companies listed in the Shanghai A-shares market, for the period 2013–2015	. Risk disclosure quantity. number of sentences concerning risk disclosure that appear in the annual report. . Risk disclosure coverage: concentration of risk topics within corporate disclosures. . Risk disclosure depth: whether sentences contain: 1) qualitative or 2) quantitative information about expected future performance . Risk disclosure outlook profile: whether sentences contain information about the risk management approach. . Quality: composite of the measures above	-	-	Risk: beta, which is the covariance expressing a firm's market return compared with a 23- to 25-month market index	. Firm size: the most significant factor influencing risk disclosure: With the exception of coverage, firm size is positively associated with all the other dimensions of risk disclosure . Quantitative information contained in risk disclosures is positively associated with risk (beta) (i.e. "high-risk firms are more likely to disclose more risk information" (p. 527)) and negatively related with leverage (i.e. higher risk of bankruptcy explains avoiding transparency). Book to market ratio is positively associated with quantity, with qualitative and quantitative risk disclosures. . Size of the board of directors affect risk disclosure quantity and quality
Patten, D. M. (2002) 'The relation between environmental performance and environmental disclosure: a research note', *Accounting, Organizations and Society, 27*, pp. 763-773.	Legitimacy theory	OLS multiple regression	131 U.S. companies, included in the top 500 releasing firms according to the Toxic Release Inventory (63 in environmentally sensitive indsutries: (chemical, metals, paper, petroleum). 1990 annual report and toxic release data from 1988 (made available in 1990)	Environmental disclosure: Content analysis of 10-K annual reports: 8 aspects of environmental concerns, excluding litigation-related disclosures: one point awarded for each area of disclosure included in the annnual report. Line count	Environmental performance: Data provided by the Environmental Protection Agency's 1988 Toxics Release Inventory (TRI): amount of toxics released divided by company's 1988 revenue level	-	-	Significant negative relationship between performance and disclosure, measured using content analysis and line count of discretionary disclosure.

Reference	Theory	Main quantitative data analysis technique	Sample / Data collection period	Measure of environmental disclosure or risk disclosure	Measure of environmental performance	Measure of awareness / visibility / legitimacy/ outsiders' knowledge/ stakeholder pressure	Measure of environmental risks and other risks	Key findings considering the variables of interest for this research
Peters, G. F. and Romi, A. M. (2014) 'Does the voluntary adoption of corporate governance mechanisms improve environmental risk disclosures? Evidence from Greenhouse Gas Emission accounting', *Journal of Business Ethics*, 125, pp. 637-666.	Legitimacy theory and resource dependency theory	Probit regression Multivariate regression	1,238 firm year observations. Sample includes all U.S. companies in the FT500 (composed of 500 of the largest companies in the world) from 2002 until 2004, and the S&P 500 companies from 2005 and 2006. Excludes banking/financing industry	CDP own disclosure transparency score, from 2002 to 2006 Whether a company disclosed company-specific GHG emission to CDP (binary)	KLD Analytics environmental strength score (control variable)	-	-	"Firms with greater environmental performance are significantly more likely to disclose GHG emission information and provide more transparent disclosures" (p. 653)
Radu, C. and Francoeur, C. (2017) 'Does innovation drive environmental disclosure? A new insight into sustainable development', *Business Strategy and the Environment*, 26(7), pp. 893-911.	Signalling theory	Multivariate regression	210 U.S.-listed firms from environmentally sensitive industries (materials, industrials, energy and utilities)	Environmental disclosure: Content analysis of 10-K forms, sustainability/CSR reports " and any other information available on the firms' websites"(p. 897), based on an index composed by 39 environmental items, each item scored 1 for "an item described in monetary or other quantitative or qualitative terms and zero for an item that is not discussed" (p. 899)	Environmental performance: Sustainalytics' environmental performance rating, "which evaluates exposure to environmental issues, management systems, public reporting, impact and initiatives, regulatory compliance, the environmental impact of products/services and miscellaneous environmental data" (p. 899-900)	-	-	"Positive and statistically significant association between environmental performance and environmental disclosure." (p. 905) "Environmental performance and environmental innovation jointly determine environmental disclosure. At low levels of environmental performance, innovative firms tend to disclose more than their non-innovative counterparts [...]. This disclosure gap tends to diminish as innovative firms become better environmental performers. The higher levels of environmental disclosure are closely associated with firms' environmental performance for both groups" (p. 893)
Rockness, J. W. (1985) 'An assessment of the relationship between US corporate environmental performance and disclosure', *Journal of Business Finance & Accounting*, 12(3), pp. 339-354.	Not mentioned. Objective: "whether social disclosures made voluntarily in annual reports are a reliable representation of performance" (p. 341)	Correlation (Spearman's Rho)	26 U.S. companies in the steel (1972 and 1976), oil (1974), and pulp and paper (1972) industries	Perception of 128 participants (financial analysts, MBA students, environmental activists and environmental regulators) on companies' overall environmental performance based on the disclosed information (environmental disclosure extracted from annual report: President's letter, the body of the annual report and the audited financial statements)	Environmental performance: CEP scores	-	-	"The subject rankings of environmental performance were rarely associated with the corresponding CEP rankings of actual performance", supporting "no association between the contents of annual report environmental disclosures and actual environmental performance" (p. 350). Although significant in just a few cases, most coefficient correlations were negative, "which suggest that they may have been misled by the disclosures" (p. 349)

Reference	Theory	Main quantitative data analysis technique	Sample / Data collection period	Measure of environmental disclosure or risk disclosure	Measure of environmental performance	Measure of awareness / visibility / legitimacy/ outsiders' knowledge/ stakeholder pressure	Measure of environmental risks and other risks	Key findings considering the variables of interest for this research
Rohani, A., Jabbour, M. and Abdel-Kader, M. (2021) 'Carbon performance, carbon disclosure, and economic performance: the mediating role of carbon (media) legitimacy in the UK', *International Journal of Accounting and Economics Studies* , 9 (1), pp. 8-20.	Legitimacy theory and voluntary disclosure theory	Path analysis based on a balanced panel data	95 UK firms from UK FTSE350 (only those that consistently reported their carbon emission to CDP), between 2009 and 2014	Density of carbon-related information: ratio of the number of carbon-related sentences over the total number of sentences of the stand-alone sustainability report or the voluntary CSR section of the annual report	Carbon performance: ratio of total direct (Scope 1) and indirect (scope 2) emissions to total sales	Carbon legitimacy: Janis–Fadner coefficient of imbalance, based on newspapers' articles	-	Althought not significant, the relationship between GHG emission performance and carbon disclosure is aligned with legitimacy theory: higher carbon-emitters per dollar revenue provide a higher ratio of carbon disclosure While carbon disclosure does not directly improve economic performance, it indirectly does so via carbon (media) legitimacy
Tadros, H. and Magnan, M. (2019) 'How does environmental performance map into environmental disclosure? A look at underlying economic incentives and legitimacy aims', *Sustainability Accounting, Management and Policy Journal* , 10(1), pp. 62-96.	Legitimacy theory and voluntary disclosure theory	Panel data analysis	78 U.S. companies from environmentally sensitive industries, over a period of 14 years (between 1997 and 2010)	Environmental disclosure: Content analysis of annual, 10-K and sustainability reports. Disclosure index comprised by 63 themes under ten categories. Variables: . Total disclosure . Verifiable versus non-verifiable information (hard vs. soft info); . Negative versus positive information; . Quantitative, Firm Specific Qualitative, or Qualitative Disclosure information; . Economic information (hard, quantitative disclosures)	Environmental performance: KLD ratings, combining the strengths and concerns. Used as a continuous and as a dichotomous variable: "A firm is classified as low performer if its average performance over the period from 1997 to 2010 is below the median of the average performance of all firms." (p. 75), therefore 50% of the sample is composed of low-performers and 50%, high-performers	Based on content of magazines and newspapers' articles (such as New York Times, WA Post, Wall Street Journal): . Media Legitimacy: Janis–Fadner coefficient; . Negative News: "number of articles containing negative criticism of the firm's environmental operations" (p. 74); . Total News: "total number of articles published about the firm's environmental operations" (p. 74)	-	Significant positive relationship between environmental performance and total disclosure: high-performers disclose more environmental information in annual report, 10-K and sustainability reports combined. Both economic (e.g. Reliance on the capital market and insider holding) and legitimacy factors (e.g. media coverage) influence environmental disclosures, moderated by company's environmental performance. Positive relationship between economic disclosure and total news and media legitimacy. Environmental news positively associated with total environmental disclosure and hard disclosure. Not enough evidence that poor performers use disclosure as a legitimation tool (in fact, they disclose more economic information in response to legitimacy threats)
Tavakolifar, M., Omar, A., Lemma, T. and Samkin, G. (2021) 'Media attention and its impact on corporate commitment to climate change action', *Journal of Cleaner Production* , 313, pp. 127833.	Agenda-setting, legitimacy and stakeholder theories	Ordinal logistic regression model	482 companies from S&P 1500 companies (utilities (78% from utilities), for the years 2015 - 2019	CDP disclosure score, from F to A, the latest assigned to "elite firms that exemplify the highest level of commitment to climate change action that have attained "leadership" position through engagements in best practices" (p. 5)	-	Media visibility: "Average number of stories in a typical day pertaining to a company, published on all media outlets" (p. 5)	-	"We provide robust evidence that heightened media attention accentuates the odds of a firm committing to take more action on climate change" (p. 1), i.e.: "Companies receiving heightened media attention respond by increasing the level of climate change commitment" (p. 10)

Reference	Theory	Main quantitative data analysis technique	Sample / Data collection period	Measure of environmental disclosure or risk disclosure	Measure of environmental performance	Measure of awareness / visibility / legitimacy/ outsiders' knowledge/ stakeholder pressure	Measure of environmental risks and other risks	Key findings considering the variables of interest for this research
Wedari, L. K., Jubb, C. and Moradi-Motlagh, Amir (2021) 'Corporate climate-related voluntary disclosures: Does potential greenwash exist among Australian high emitters reports?', *Business Strategy and the Environment*.	Legitimacy and voluntary disclosure theories	OLS regression	119 Australian listed-companies, data for Years 2016 and 2017	Self-constructed climate-related disclosure index based on four frameworks (G20 recommendations, GRI-04, ISO 14064, and the Refinitiv ASSET4 environmental pillar) applied to stand-alone sustainability reports, annual reports, and corporate websites	1-year lagged change in carbon emissions from one year to the next (Scope 1 plus Scope 2) deflated by sales from the previous period. When this change is positive, increased carbon has been released. A negative number indicates carbon reduction	-	-	1-year lagged carbon change deflated by sales is associated positively with climate-related disclosure for the full-sampel and for the sample composed of companies that increased emissions in the last year, supporting the hypothesis aligned with legitimacy theory about the likelihood of greenwashing practices by underperformers, i.e. underperformers engage in 'greenwashing' by disclosing more information when they experience a carbon increase
Wiseman, J. (1982) 'An evaluation of environmental disclosures made in Corporate annual reports', *Accounting, Organizations and Society*, 7(1), pp. 53-63.	Not mentioned. Objective: test the relationships between firm's environmental disclosure and its actual environmental performance	Correlation	26 U.S. firms from the oil (data from 1974), iron and steel (1972 and 1976), and paper industries (1972)	Environmental disclosure: Content analysis of annual report: measured the extent of disclosure of 18 environmental index items in 4 categories (economic, litigation, pollution and other factors; score of 3= monetary or quantitative description, 2= specific non - quantitative, 1= general terms, 0= absent), resulting in an index score for each category and a total disclosure score	Environmental performance: CEP scores	-	-	"No relationship existed between the measured contents of the firms' environmental disclosures and the firms' environmental performance." (p. 62)

9.2 Multi-stakeholder climate change initiatives

In addition to CDP and TCFD, presented in section 3.2, other multi-stakeholder climate change initiatives are presented below.

- The Greenhouse Gas Protocol: Launched in 1998 as a partnership of businesses, NGOs and governments, the Greenhouse Gas Protocol provides the world's most widely used greenhouse gas accounting standard for companies (The Greenhouse Gas Protocol, 2015). Published in 2001, the GHG Protocol Corporate Standard covers accounting and reporting of the greenhouse gases in the Kyoto Protocol and has been extensively used not only to prepare a GHG emissions inventory and report emissions, but also to participate in emissions trading programmes. An illustration of its relevance is that the GHG Protocol introduced the concept of "scope", widely used to identify direct and indirect emissions. Although the Greenhouse Gas Protocol is not specifically focused on climate change risk, calculating emissions is key to identify and manage climate change risks, besides the fact that the Protocol is the basis of the emission data in the initiatives discussed in the next paragraphs.

- Global Reporting Initiative (GRI): The most widely used voluntary standard for sustainability reporting is provided by the Global Reporting Initiative (GRI), with its first guidelines published in 2000. In 2020, 73% of world's 250 largest companies produced sustainability reports following GRI (KPMG, 2020). GRI guidelines are aimed at ensuring sustainability reports present a balanced account of economic, environmental and social performance, facilitating comparison over time and across organisations. There is a specific GRI indicator requiring companies to disclose material risks (Disclosure 102-15 Key impacts, risks, and opportunities), which is mandatory for all organisations publishing sustainability reports in accordance with GRI.

- Global Framework for Climate Risk Disclosure: The Global Framework for Climate Risk Disclosure was published in 2006 by a partnership of leading institutional investors and organisations, including the United Nations (Climate Risk Disclosure Initiative, 2006). Based on four elements (emissions, climate risk & emissions management, physical risks of climate change, and risk related to emission regulation), the Framework should be applied through existing reporting mechanisms, such as mandatory financial reports, CDP questionnaires and GRI reports. Interesting to note that this Framework, published more than 10 years ago, ignored the other climate-related transition risks beyond regulatory risks, such as technology (e.g. lower emissions products and services), market (e.g. cost of raw materials) and reputation risks. In an industry report using the Global Framework to measure climate risk disclosure in the U.S., Kelly (2007) found that companies provide more qualitative measures than quantitative measures, with the highest greenhouse gas emitting sectors showing the more detailed disclosures.

- Climate Disclosure Standards Board (CDSB): Also aiming at standardising climate-related information reporting by advancing global mainstream corporate reporting, the Climate Disclosure Standards Board (CDSB) is a consortium of business and environmental organisations formed in 2007. CDSB members include CDP, The Sustainability Accounting Standards Board (SASB) and The World Economic Forum (WEF). CDSB initial framework, the Climate Change Reporting Framework, was released in 2010 and was focused on the risks and opportunities presented by climate change. In 2015, CBSD launched a new framework, the CSBD Framework, expanding the scope to environmental and natural capital information. The new Framework includes a requirement on risks and opportunities, stating that risk information is useful if it analyses potential sources of risk, implications, estimated timeframe and is linked to other parts of the mainstream report (CDSB, 2019).

9.3 Company-specific disclosure vs. general disclosure

As mentioned in Section 5.4.2, an additional measure of GHG emissions risk disclosure was evaluated for this research: company-specific disclosure, following Abraham and Shrives (2014). Unfortunately, inter-coder reliability for this measure was not within the expected thresholds and therefore, the variable was dropped from this research, resulting in some adjustments to the conceptual model. The attempt to include a company-specific disclosure variable is described here as it maybe be useful for other researchers.

Abraham and Shrives (2014) classified risk disclosures in two broad groups: factors that are general in nature, applicable to any business or any business within the industry; and company-specific factors. They provided examples, extracted from the food & beverage industry, to illustrate the differences between these disclosure types, presented below.

Table 9.1: Examples of general and company-specific disclosure (Abraham and Shrives, 2014, p. 98)

Disclosure type	Definition	Disclosure
General	Disclosure applies to any business	"The Group's operations are also subject to the risks and uncertainties inherent in doing business in numerous countries." (Cadbury Schweppes, 2003, p. 12)
	Disclosure applies to any business within the industry	"Despite safety measures adopted by the Group, our products could become contaminated. We use many ingredients in manufacturing beverages and confectionery, which increases the risk of contamination, either accidental or malicious. While we believe that incidents of this type are generally localised, any contamination may be expensive to remedy, and could cause delays in manufacturing and adverse effects on our reputation and financial condition." (Cadbury Schweppes, 2003, p. 173)
Company-specific	Disclosure that is specific to the company	"The sensitivity analysis below shows forward-looking projections of market risk assuming certain adverse market conditions occur. This is a method of analysis used to assess and mitigate risk and should not be considered a projection of likely future events and losses." (Cadbury Schweppes, 2003, p. 42)

The text below presents an example of coding GHG emissions risk disclosure following Abraham and Shrives (2014)'s approach to specificity. The sentence classified as company-specific disclosure is in italic.

> **"Concerns about climate change and other air quality issues may affect our operations or results.**
>
> Concerns about climate change and regulation of GHGs and other air quality issues may materially affect our business in many ways, including increasing the costs to provide our products and services, and reducing demand for, and consumption of, our products and services, and we may be unable to recover or pass through a significant portion of our costs. In addition, legislative and regulatory responses to such issues may increase our operating costs and render certain wells or projects uneconomic, and potentially lower the value of our reserves and other assets. As these requirements become more stringent, we may be unable to implement them in a cost-effective manner. To the extent financial markets view climate change and GHG emissions as a financial risk, this could adversely impact our cost of, and access to, capital. Both the EPA and California

> have implemented laws, regulations and policies that seek to reduce GHG emissions. *In 2017, we incurred costs of approximately $27 million for mandatory GHG emissions allowances in California, and costs of such allowances per metric ton of GHG emissions are expected to increase in the future as CARB tightens program requirements or as the minimum state auction price of such allowances is increased."* (California Resources Corporation, 2018, p. 23).

A detailed set of coding rules have been developed aimed at ensuring consistent coding. Quantitative information, as exemplified above, is easily-identifiable whether it is general (e.g. figures on the Paris Accord or on the U.S. legislation) or company specific (e.g. company's investments and emissions). However, considering the scarcity of quantitative information in companies' disclosures, the coding rules were especially aimed at helping differentiate company-specific qualitative disclosure from general qualitive disclosure, including examples, as presented below, highlighting subtle differences (in italic) that could transform general disclosures into company-specific disclosures.

Table 9.2: Examples of general and company-specific disclosures included in the coding rules

General disclosure	Company-specific disclosure
We may be involved in climate change lawsuits.	*We have been involved* in climate change lawsuits.
We could be named in actions making allegations on private individuals alleging personal injury or other liabilities against utilities companies.	While *our business is not a party* to any such litigation, we could be named in actions making similar allegations.
Compliance with future methane regulations may require us to obtain additional permits and install new emission controls on some of our equipment.	Compliance with future methane regulations *will require us* to obtain additional permits and install new emission controls on some of our equipment.
The EPA has adopted rules requiring the monitoring and reporting of GHG emissions from specified oil and gas production sources in the U.S..	The EPA has adopted rules requiring the monitoring and reporting of GHG emissions from specified oil and gas production sources in the U.S., which *include certain of our operations.*

Two coders with professional experience in environmental risk were invited to code disclosures from companies included in the sample, and an additional coder was invited to specifically focus on Abraham and Shrives (2014) approach to company-specific information. As mentioned in Section 5.8, two measures of inter-rater reliability calculated by NVivo were used: percentage agreement (the number of units of agreement divided by the total units of measure) and Kappa coefficient (which considers the amount of agreement that could be expected to occur through chance). Unfortunately, several differences were found and although percentage agreement was generally high (as the amount of company-specific information is considerably small when compared with total disclosure), Kappa coefficient was lower than expected in most cases (as the amount of company-specific information is extremely reduced, any difference has a high impact on kappa coefficient), including kappa coefficient equals to zero in some cases, which occurs when there is no agreement among the coders. In some cases, even the presence or lack of company-specific information was not agreed, which resulted in dropping the company-specific disclosure variable from the research model.

Examples of sentences where there was no agreement about whether they are company-specific or applicable to other companies in the industry include:

- "To the extent that state or federal legislation is passed or regulations are imposed to reduce or regulate GHG emissions, we may experience delays in the construction and installation of new facilities due to more stringent permitting requirements, incur additional costs to reduce methane emissions associated with our operations or be required to aggregate the emissions from separate facilities for permitting purposes or to relocate one or more of our facilities due to more stringent emissions standards." (MPLX LP, 2018, p. 44)
- "If we are unable to recover or pass through a significant level of our costs related to complying with climate change regulatory requirements imposed on us, it could have a material adverse effect on our results of operations and financial condition." (The Williams Companies Inc., 2018, p. 35)

9.4 Coding guide

Guidance to measure specificity in GHG emissions risk disclosure
based on Ingram and Frazier (1980)

Please code each sentence following the definition below:

- General disclosure: “a statement not referencing a firm’s own activities or situation”.
- Specific disclosure: “a statement referencing a firm’s own activities or situation” (Ingram and Frazier, 1980, p. 621).

Sentence is understood here as a unit of text delimited by graphological features, such as upper-case letters or bulletin points, and markers, such as periods, question marks and exclamation marks. Sentences in the risk title and in the discussion should be coded.

The sentences indicating specific sections in the report, such as the examples below, should be classified as specific disclosure:

- “Both the EPA and California have implemented laws that seek to reduce GHG emissions as discussed in Item 1 – Business – Regulation of the Oil and Natural Gas Industry.”
- “For more information regarding greenhouse gas and methane emission and regulation, please read Item 1. Business - Environmental Regulation - Climate Change”.

Sentences mentioning company’s customers should be considered specific, for example:

- “Increased concern over the effects of climate change may also affect our customers’ energy strategies, consumer consumption patterns, and government and private sector alternative energy initiatives.”
- “Recent rules imposing more stringent requirements on the oil and gas industry could cause our customers to incur increased capital expenditures and operating costs.”

Sentences expressing company’s views about an issue should be considered specific, such as:

- “We recognise that climate change is a global environmental concern.”
- “There are a number of regulatory and legislative initiatives that have been proposed which could introduce carbon pricing or cap-and-trade mechanisms related to greenhouse gas emissions, and we cannot predict whether any such proposals will be enacted.”

- "We expect that the EPA will not be issuing a New Source Performance Standard (NSPS) to regulate GHG from petroleum refineries at this time but that it may do so in the future."

In case of lists with bullet points, even if they are not presented in separate lines, the header and each bullet point should be analysed individually.

- When the header clearly states that all items in the list apply to the company, as in the example below (references to the company are underlined), the header and all items should be considered specific disclosure, including those items not explicitly referring to the company (which is the case of item 3 in the example below):

  > "Requiring reductions in greenhouse gas emissions could cause us to incur substantial costs to (1) operate and maintain our facilities, (2) install new emission controls at our facilities and (3) administer and manage any greenhouse gas emissions programs, including the acquisition or maintenance of emission credits or allowances."

- When the header does not clearly state that all items in the list apply to the company, if there is an item not referencing company's activities or situation it should be considered general disclosure. However, if at least one item explicitly refers to the company, the header should also be considered specific even when it does not have a clear reference to the company, as in the example below (specific disclosure in italic, references to the company underlined):

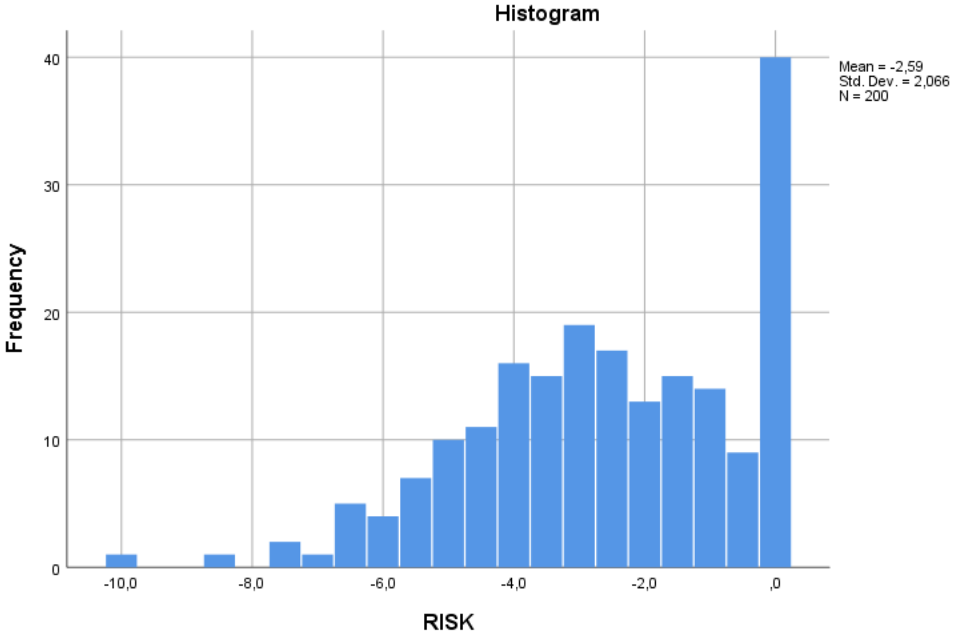
  > *Requiring reductions in these emissions could result in increased costs to (i) operate and maintain our facilities, (ii) install new emission controls at our facilities and* (iii) administer and manage any emissions programs, including acquiring emission credits or allotments.

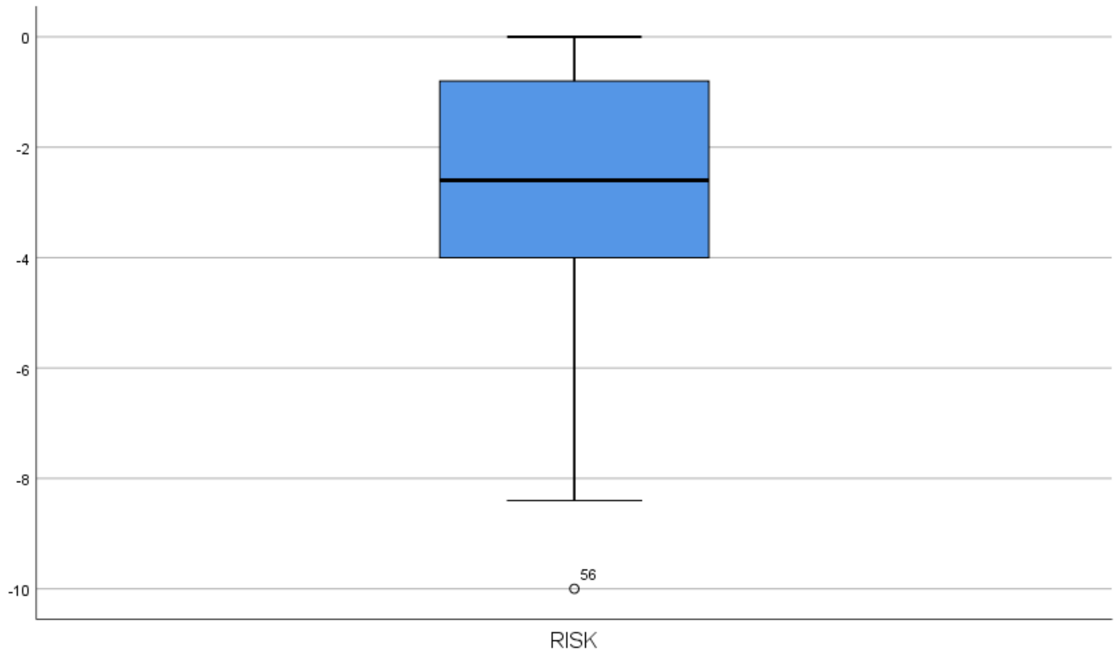
Reference

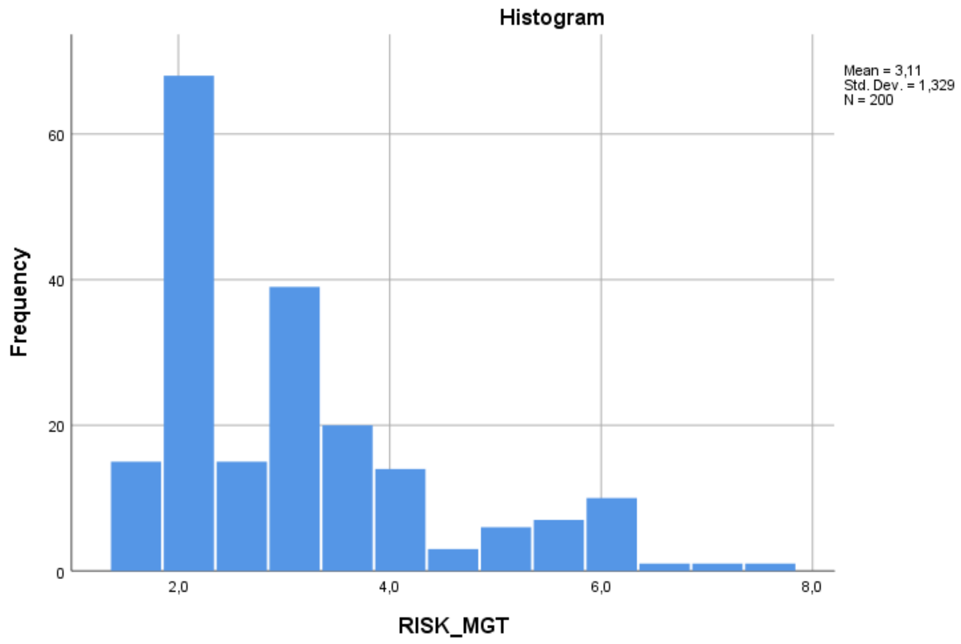
Ingram, R.W. and Frazier, K.B. (1980) 'Environmental performance and corporate disclosure', *Journal of Accounting Research*, 18(2), pp.614-622.

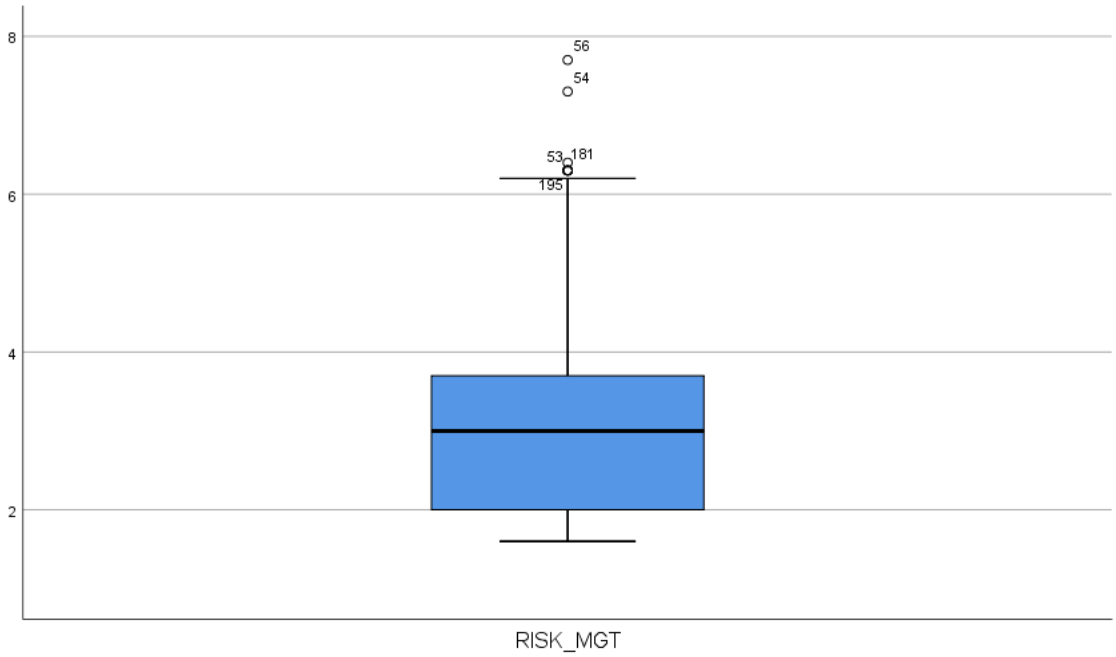
9.5 Histogram and scatter plots for the full sample (200 companies)

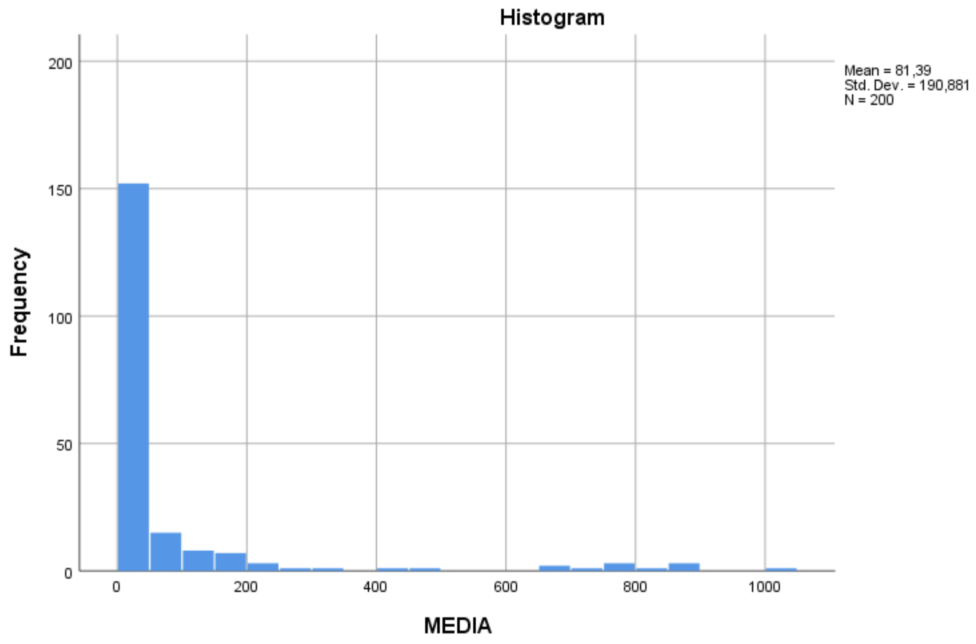
To complement the descriptive statistics presented in section 6.1.1, histograms and scatter plots for all the independent variables are presented below for the full sample, composed of 200 companies.

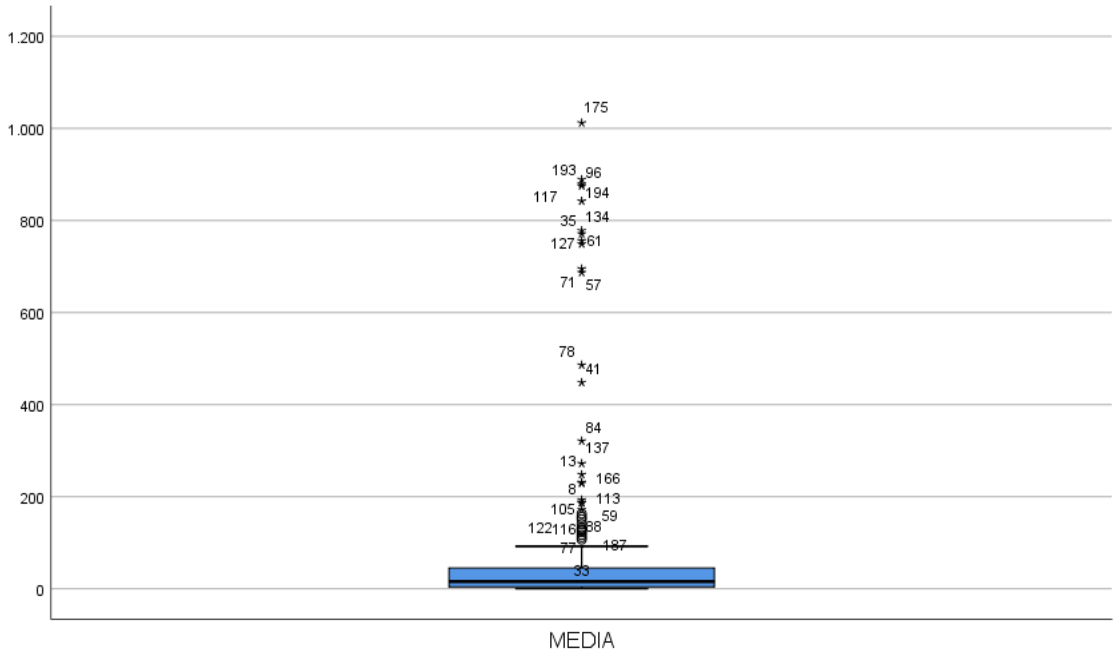


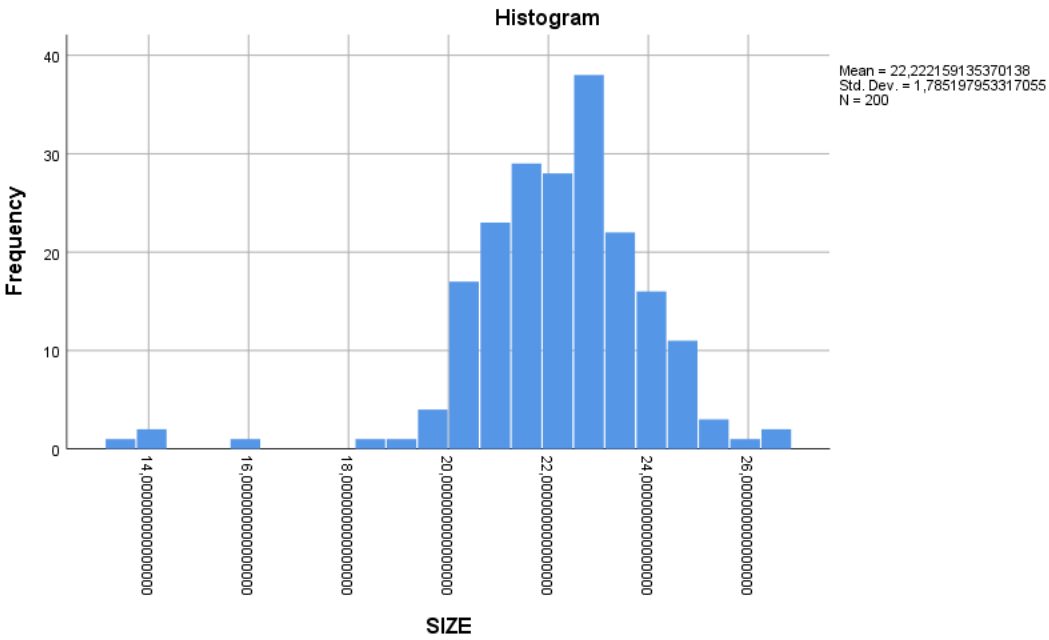


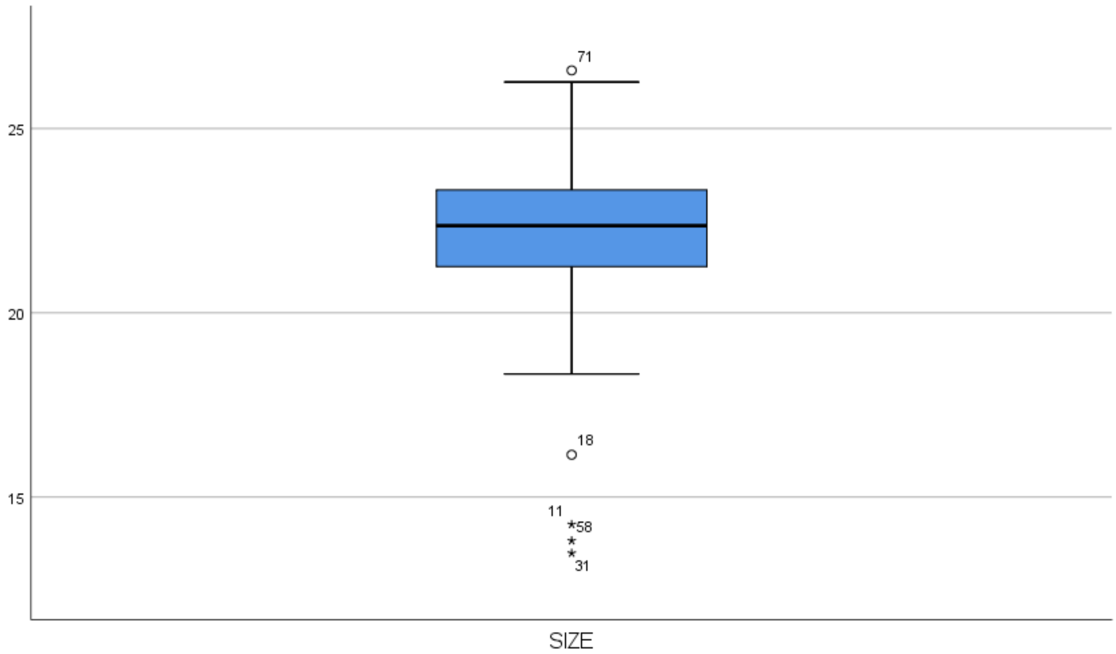

Histogram
Mean = 3,11
Std. Dev. = 1,329
N = 200
Frequency
0
20
40
60
2,0
4,0
6,0
8,0
RISK_MGT

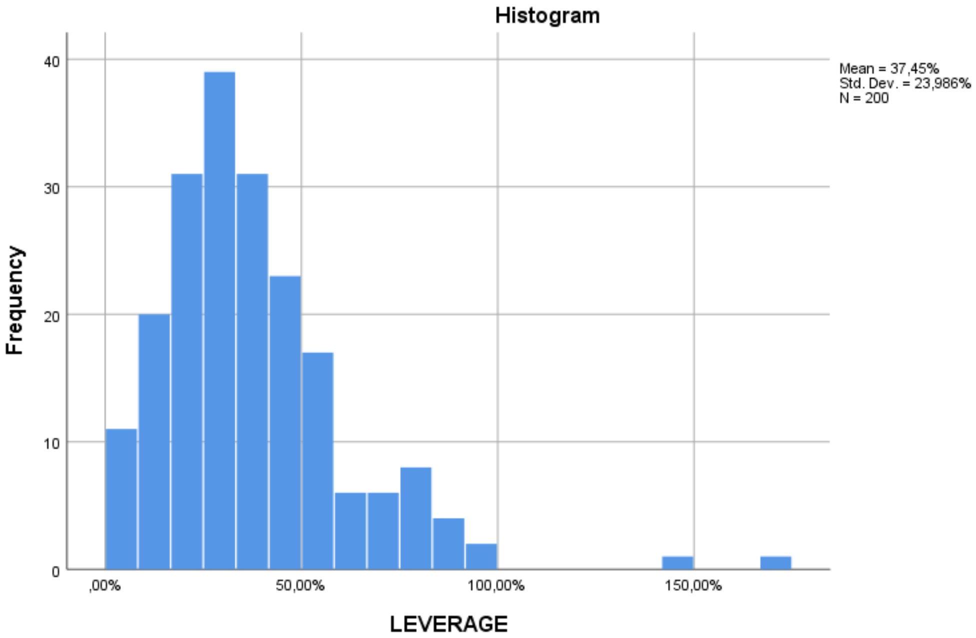

8
6
4
2
56
54
53
181
195
RISK_MGT


Histogram
Mean = 81,39
Std. Dev. = 190,881
N = 200
Frequency
MEDIA

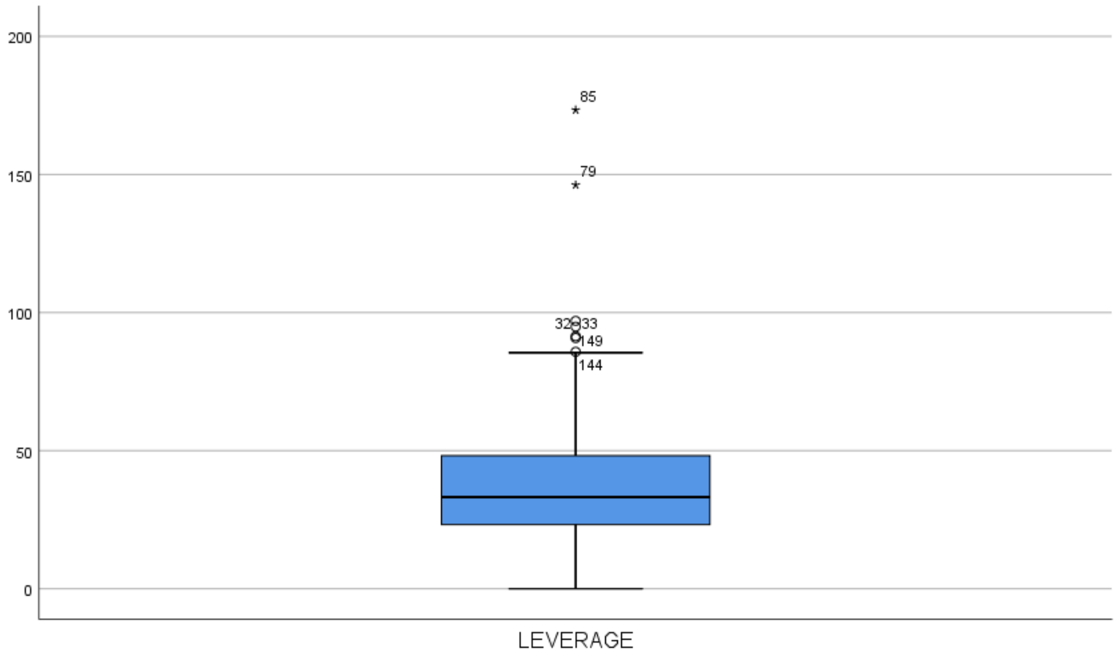

MEDIA


Histogram
Mean = 22,222159135370138
Std. Dev. = 1,785197953317055
N = 200
Frequency
40
30
20
10
0
14,0000000000000
16,0000000000000
18,0000000000000
20,0000000000000
22,0000000000000
24,0000000000000
26,0000000000000
SIZE


71
25
20
18
15
11
58
31
SIZE



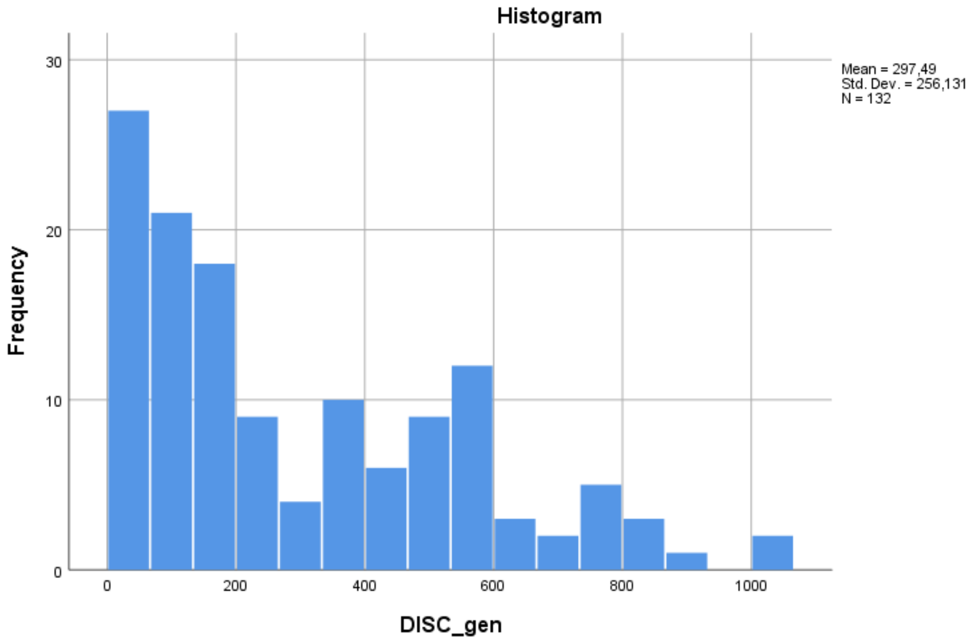
Histogram
Mean = 37,45%
Std. Dev. = 23,986%
N = 200
Frequency
40
30
20
10
0
,00%
50,00%
100,00%
150,00%
LEVERAGE

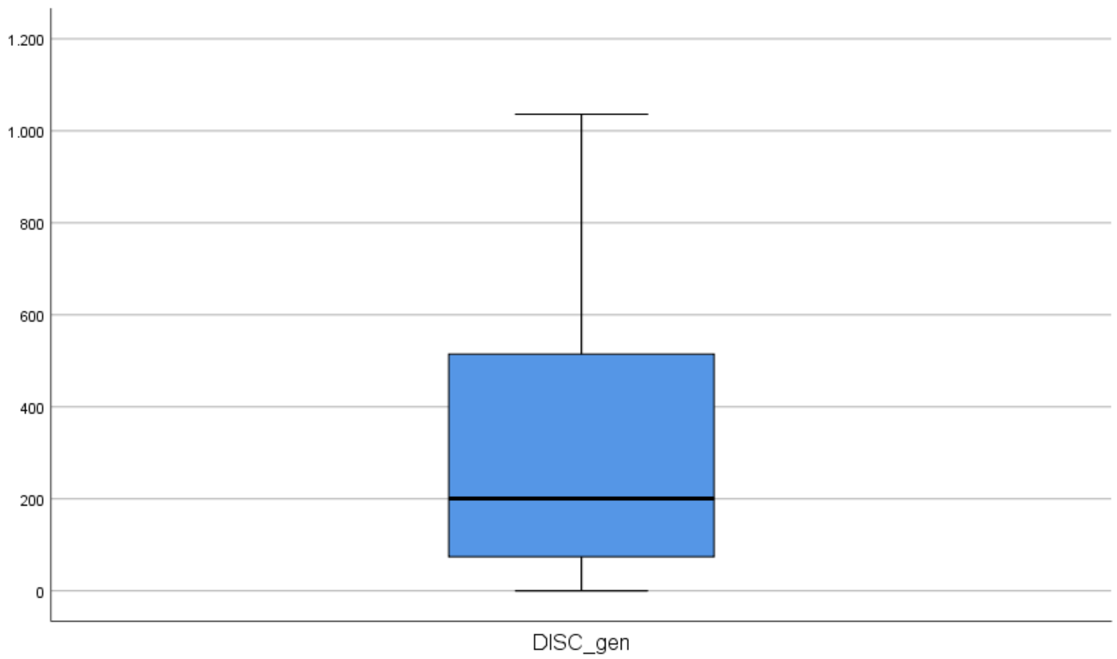


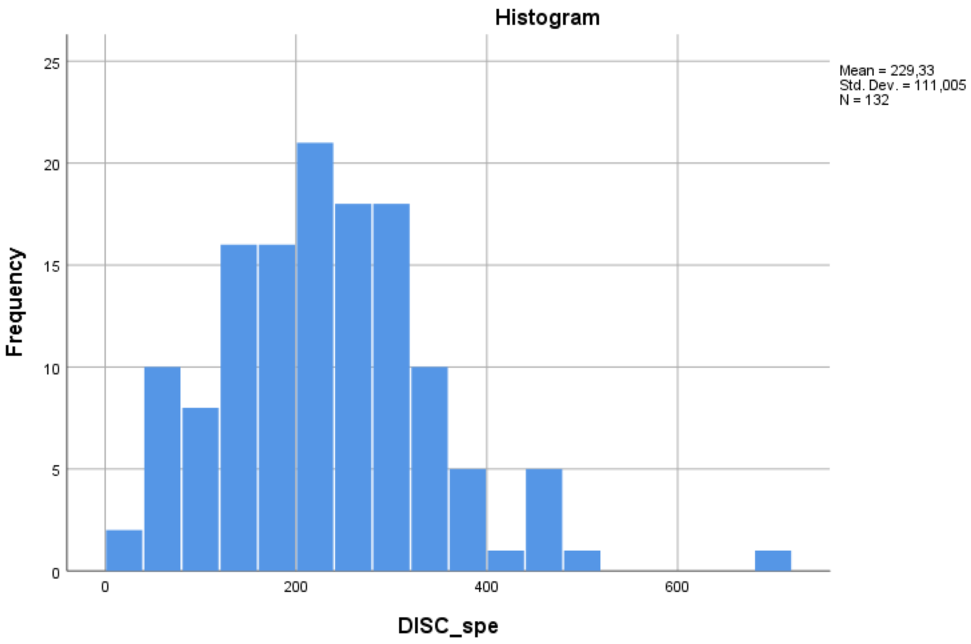
200
150
100
50
0
85
79
32
33
149
144
LEVERAGE

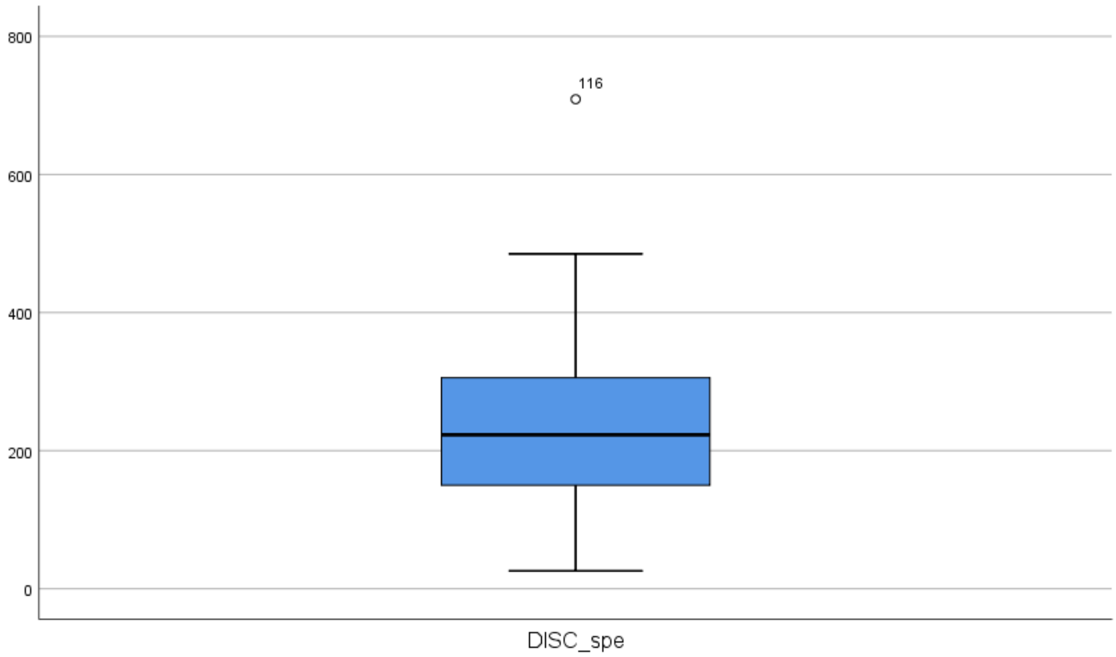
9.6 Histogram and scatter plots for the sub-sample (132 companies)

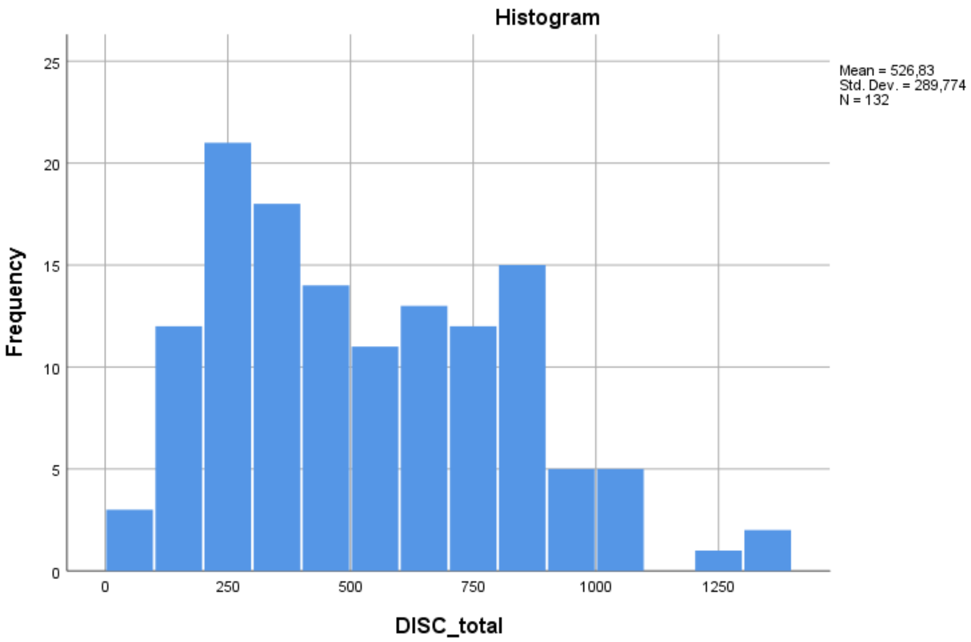
To complement the descriptive statistics presented in section 6.1.2, histograms and scatter plots for all variables are presented below for the sub-sample, composed of 132 companies.

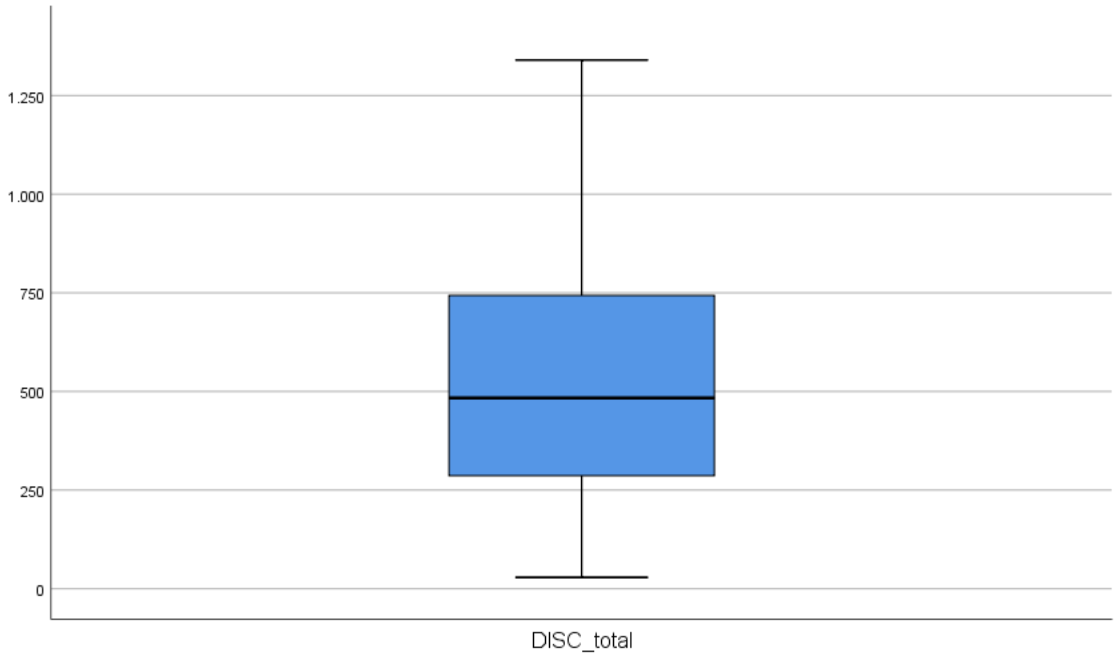


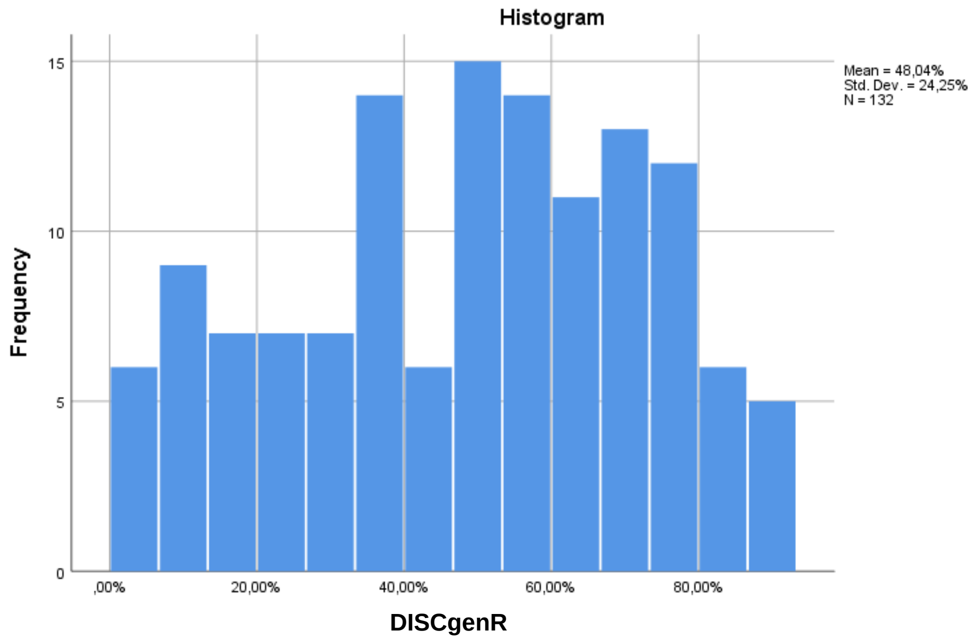


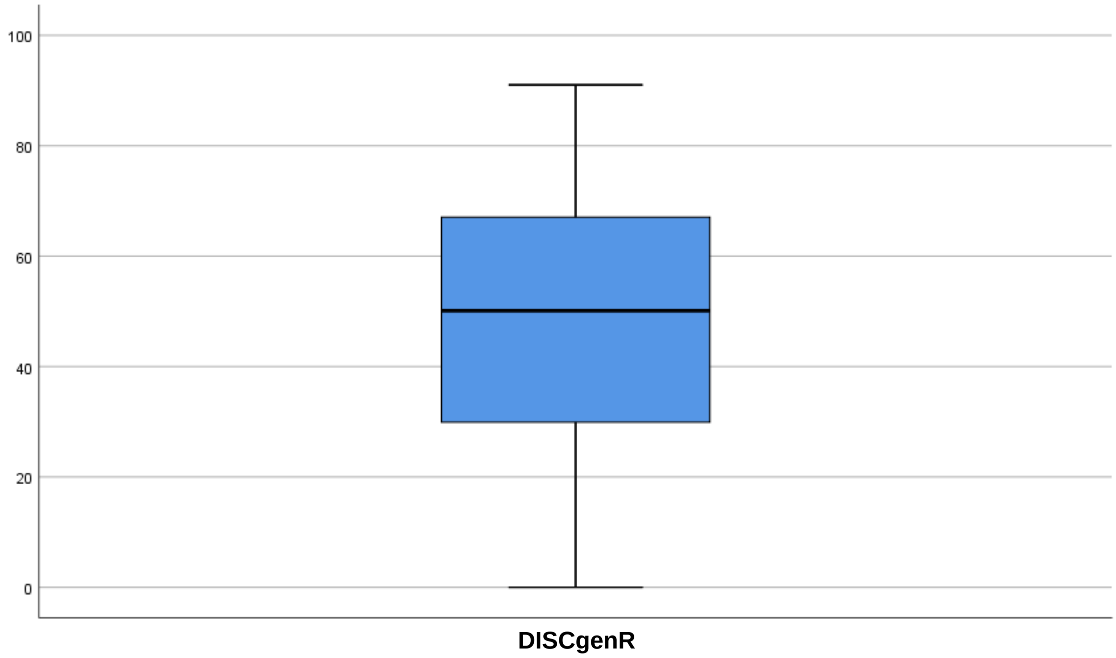

Histogram
Mean = 229,33
Std. Dev. = 111,005
N = 132
Frequency
0
5
10
15
20
25
0
200
400
600
DISC_spe

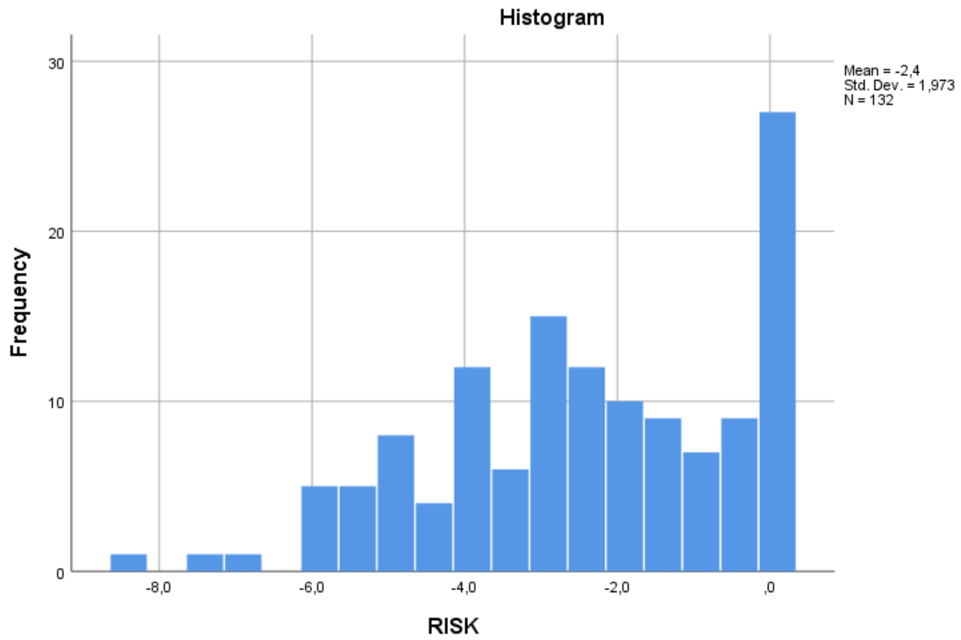

800
600
400
200
0
116
DISC_spe


Histogram
Mean = 526,83
Std. Dev. = 289,774
N = 132
Frequency
0
5
10
15
20
25
0
250
500
750
1000
1250
DISC_total

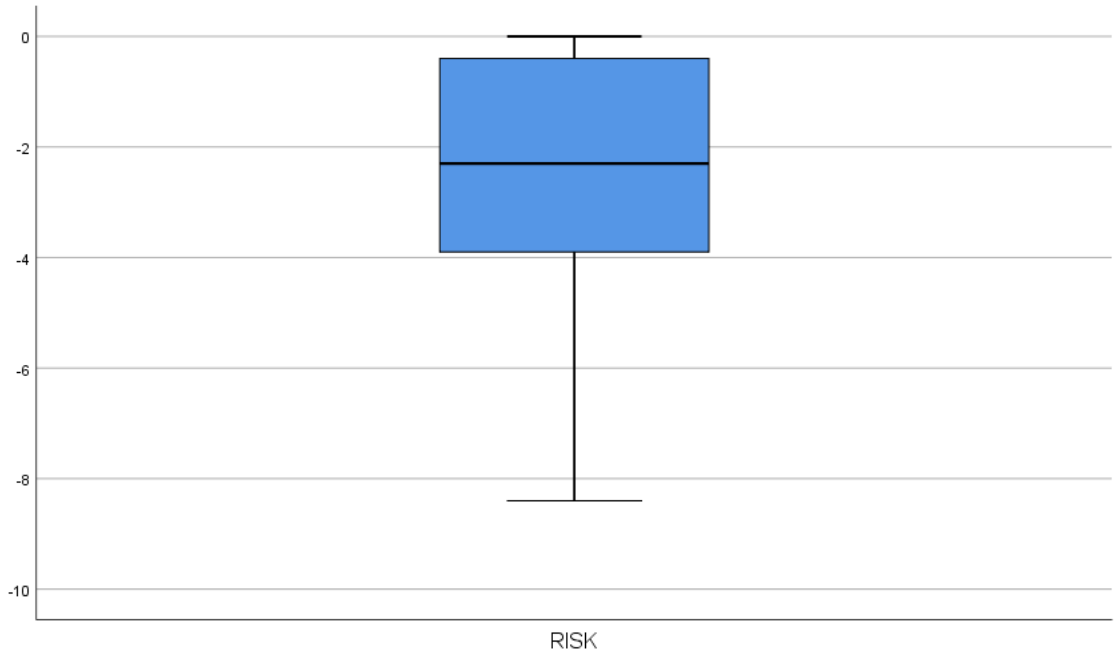

1.250
1.000
750
500
250
0
DISC_total


Histogram
Mean = 48,04%
Std. Dev. = 24,25%
N = 132
Frequency
15
10
5
0
,00%
20,00%
40,00%
60,00%
80,00%
DISCgenR

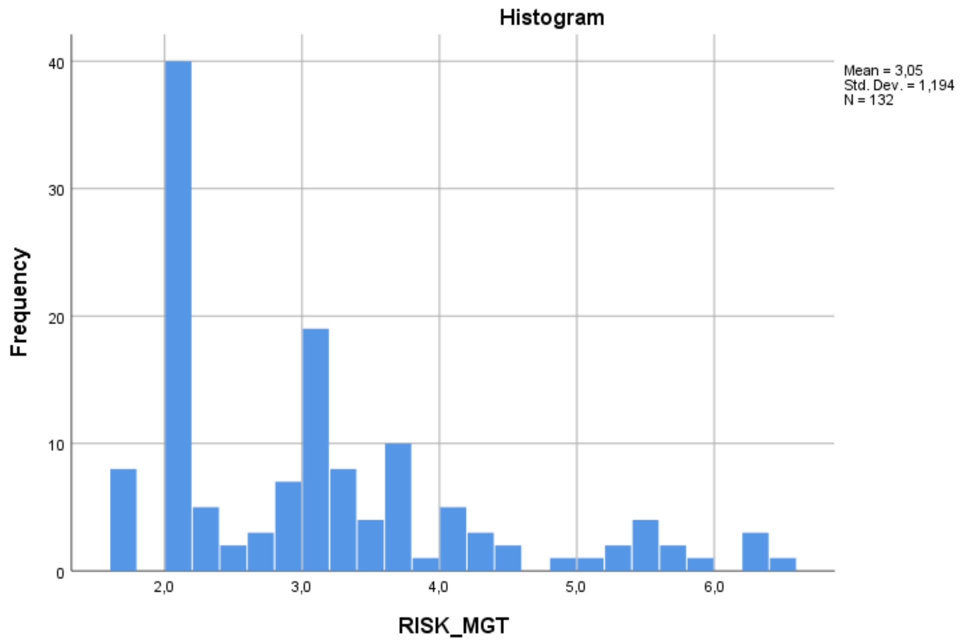

100
80
60
40
20
0
DISCgenR

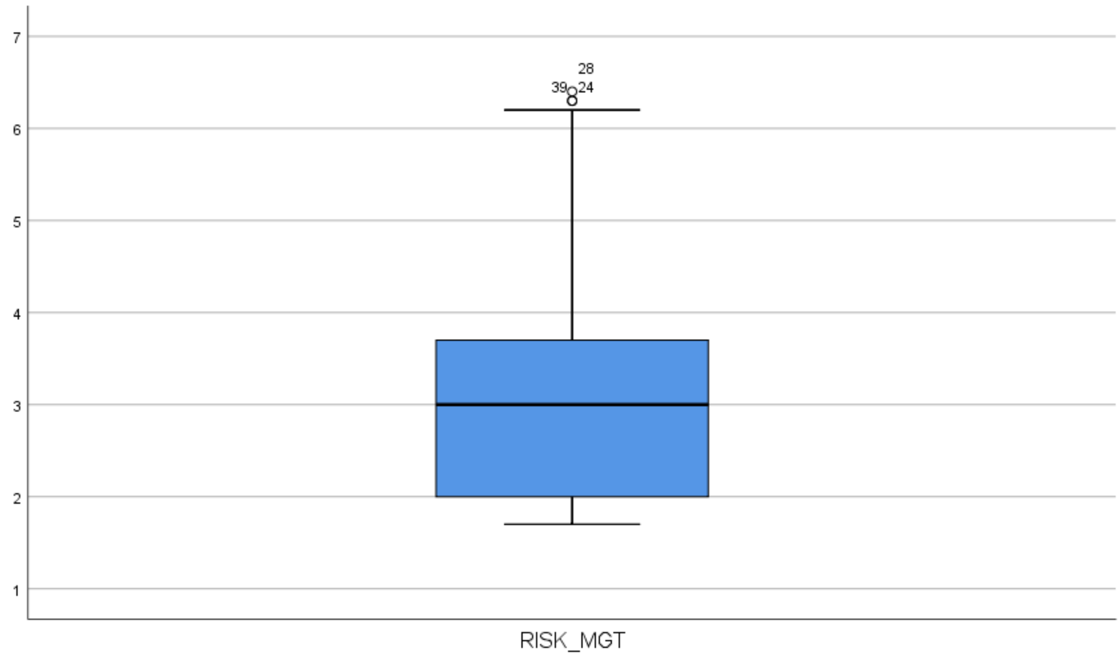


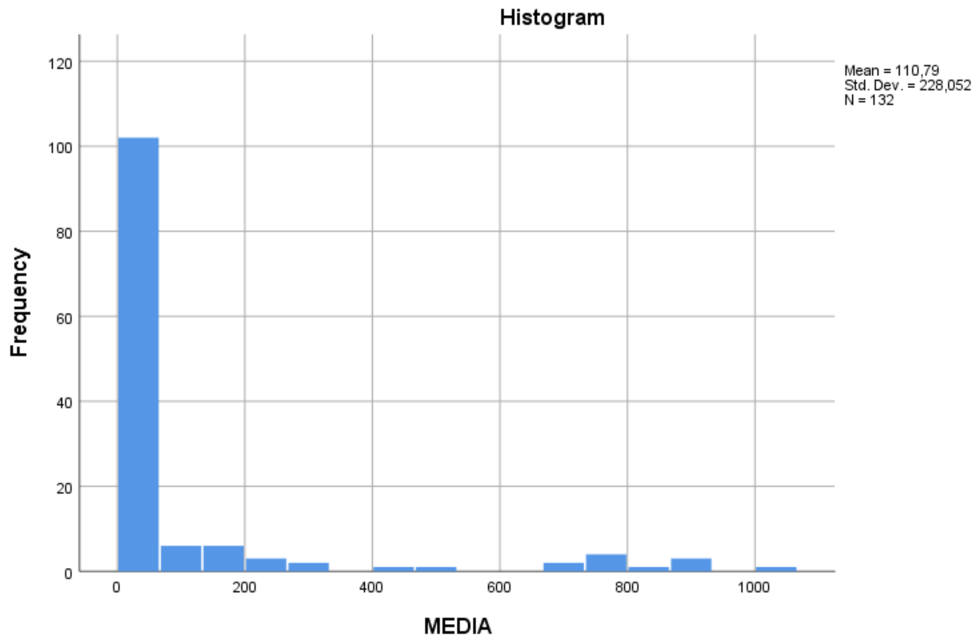
Histogram
Mean = -2,4
Std. Dev. = 1,973
N = 132
Frequency
30
20
10
0
-8,0
-6,0
-4,0
-2,0
,0
RISK

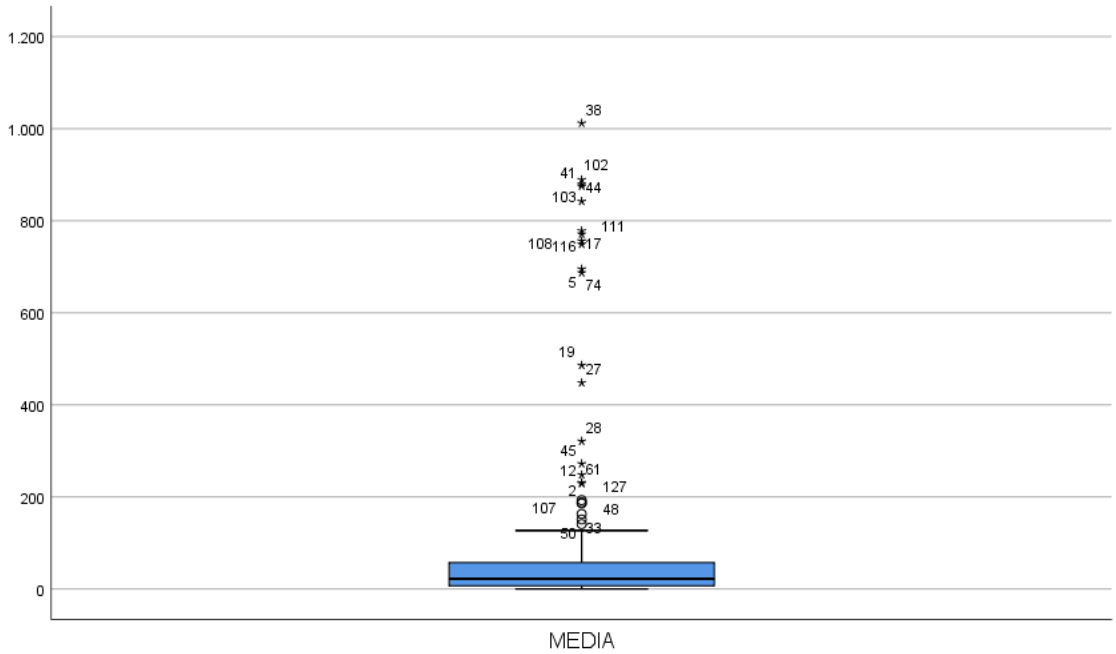


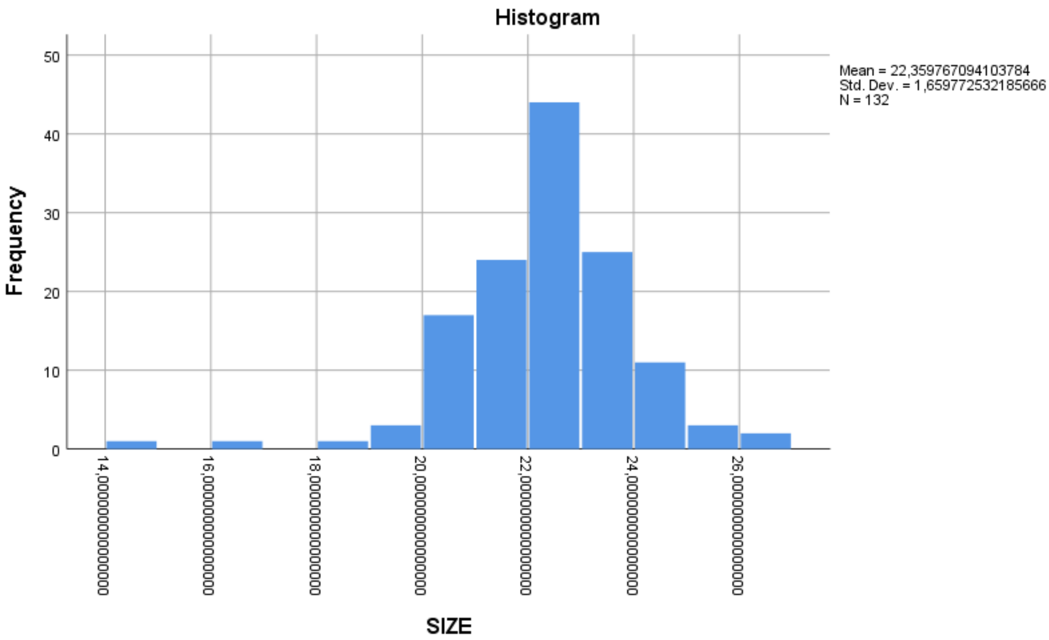
0
-2
-4
-6
-8
-10
RISK

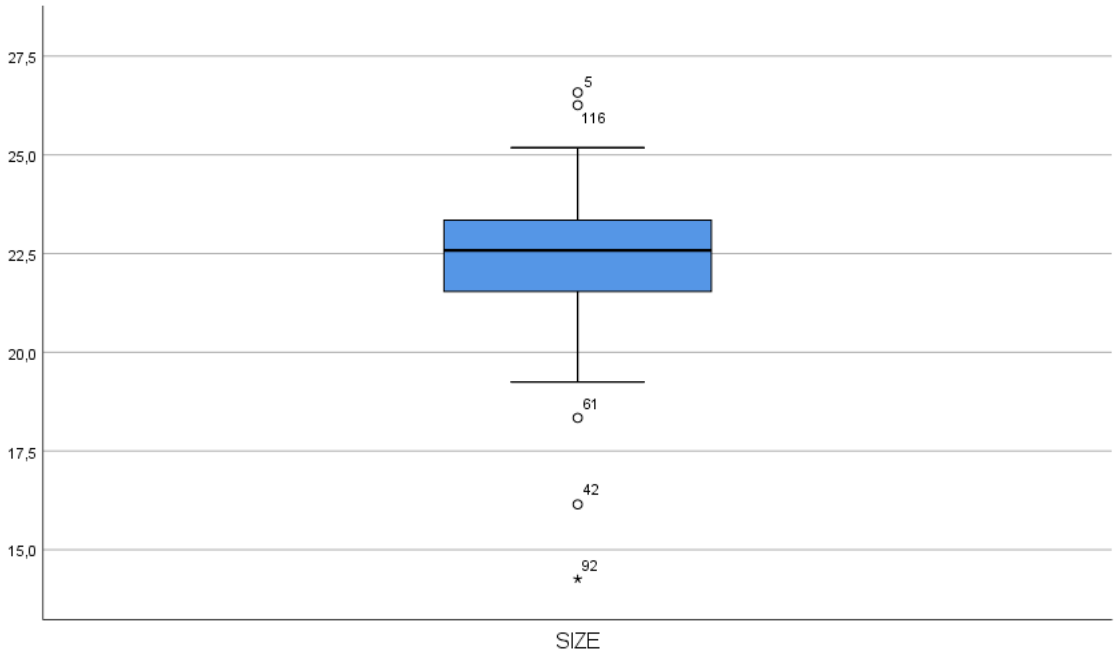

Histogram
Mean = 3,05
Std. Dev. = 1,194
N = 132
Frequency
40
30
20
10
0
2,0
3,0
4,0
5,0
6,0
RISK_MGT

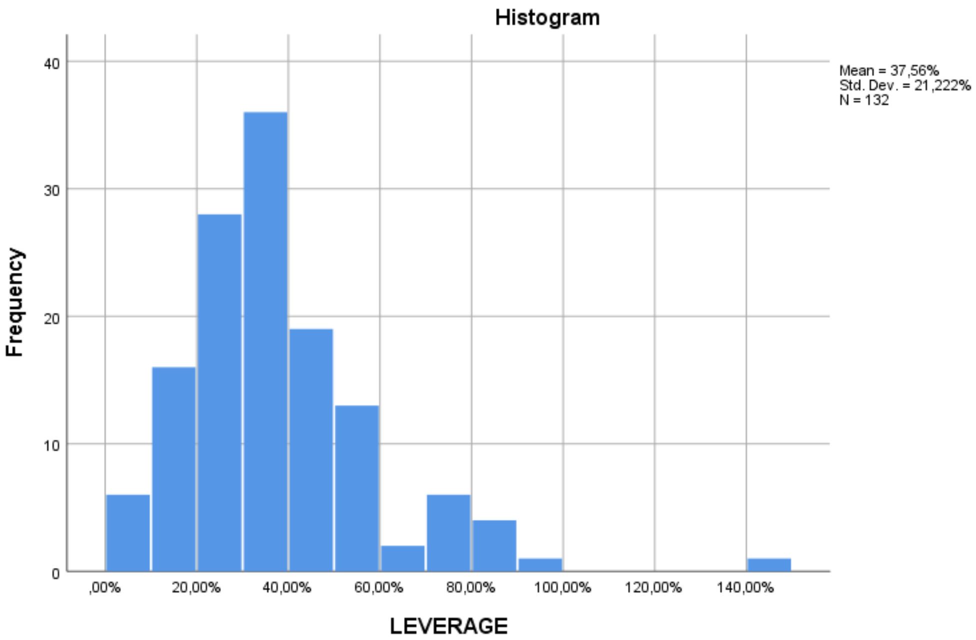

7
6
5
4
3
2
1
28
39
24
RISK_MGT

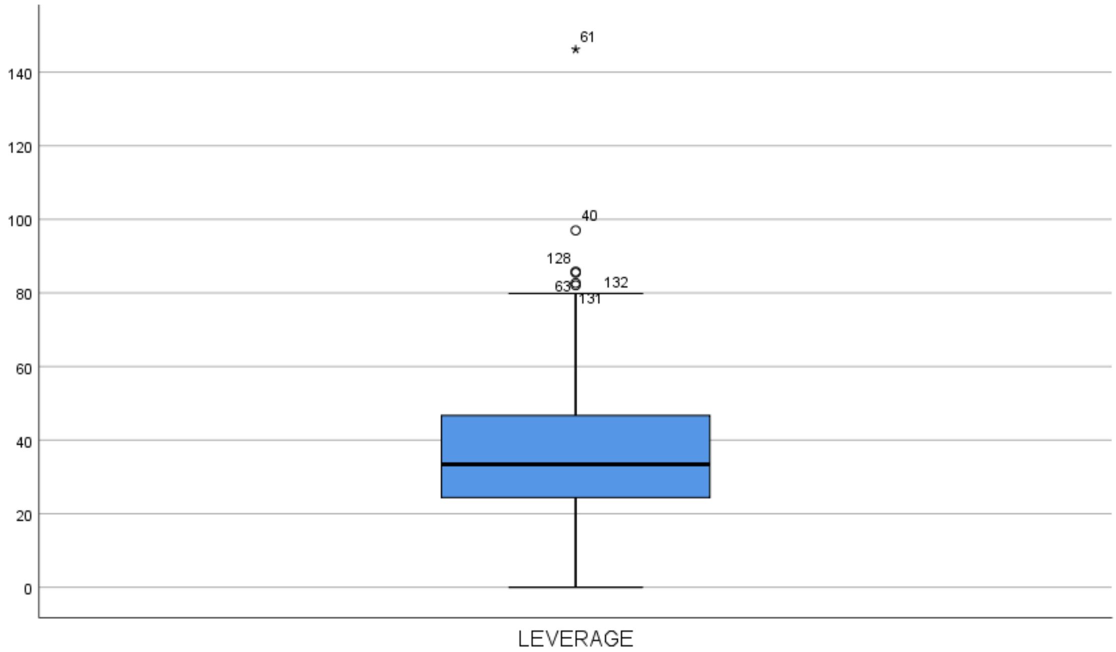

Histogram
Mean = 110,79
Std. Dev. = 228,052
N = 132
Frequency
MEDIA


MEDIA


Histogram
Mean = 22,359767094103784
Std. Dev. = 1,659772532185666
N = 132
Frequency
50
40
30
20
10
0
14,000000000000000
16,000000000000000
18,000000000000000
20,000000000000000
22,000000000000000
24,000000000000000
26,000000000000000
SIZE


27,5
25,0
22,5
20,0
17,5
15,0
5
116
61
42
92
SIZE


Histogram
Mean = 37,56%
Std. Dev. = 21,222%
N = 132
Frequency
40
30
20
10
0
,00%
20,00%
40,00%
60,00%
80,00%
100,00%
120,00%
140,00%
LEVERAGE


140
120
100
80
60
40
20
0
61
40
128
63
132
131
LEVERAGE

9.7 SPSS reports: Logistic regressions

9.7.1 DISC_GHG and RISK

Block 0: Beginning Block

Classification Table[a,b]

Observed			Predicted DISC_GHG N	Predicted DISC_GHG Y	Percentage Correct
Step 0	DISC_GHG	N	0	68	,0
		Y	0	132	100,0
	Overall Percentage				66,0

a. Constant is included in the model.

b. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	,663	,149	19,745	1	,000	1,941

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	RISK	3,343	1	,067
		MEDIA	9,255	1	,002
		SIZE	2,318	1	,128
		LEVERAGE	,008	1	,928
	Overall Statistics		17,454	4	,002

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	23,551	4	,000
	Block	23,551	4	,000
	Model	23,551	4	,000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	232,863[a]	,111	,154

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	6,385	8	,604

Classification Table[a]

Observed			Predicted DISC_GHG N	Predicted DISC_GHG Y	Percentage Correct
Step 1	DISC_GHG	N	19	49	27,9
		Y	10	122	92,4
	Overall Percentage				70,5

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	RISK	,225	,079	8,057	1	,005	1,252	1,072	1,463
	MEDIA	,008	,003	5,539	1	,019	1,008	1,001	1,014
	SIZE	,086	,094	,836	1	,360	1,089	,907	1,308
	LEVERAGE	,001	,006	,007	1	,934	1,001	,988	1,013
	Constant	-1,006	2,022	,248	1	,619	,366		

a. Variable(s) entered on step 1: RISK, MEDIA, SIZE, LEVERAGE.

9.7.2 DISC_GHG and RISK_Mgt

Block 0: Beginning Block

Classification Table[a,b]

Observed			Predicted DISC_GHG N	Predicted DISC_GHG Y	Percentage Correct
Step 0	DISC_GHG	N	0	68	,0
		Y	0	132	100,0
	Overall Percentage				66,0

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	,663	,149	19,745	1	,000	1,941

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	RISK_MGT	,985	1	,321
		MEDIA	9,255	1	,002
		SIZE	2,318	1	,128
		LEVERAGE	,008	1	,928
	Overall Statistics		12,519	4	,014

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	18,828	4	,001
	Block	18,828	4	,001
	Model	18,828	4	,001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	237,586[a]	,090	,124

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	10,003	8	,265

Classification Table[a]

Observed			Predicted DISC_GHG N	Predicted DISC_GHG Y	Percentage Correct
Step 1	DISC_GHG	N	10	58	14,7
		Y	5	127	96,2
	Overall Percentage				68,5

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	RISK_MGT	-,245	,127	3,697	1	,055	,783	,610	1,005
	MEDIA	,007	,003	4,995	1	,025	1,007	1,001	1,014
	SIZE	,100	,099	1,028	1	,311	1,105	,911	1,342
	LEVERAGE	-,001	,006	,023	1	,881	,999	,987	1,012
	Constant	-1,077	2,053	,275	1	,600	,341		

a. Variable(s) entered on step 1: RISK_MGT, MEDIA, SIZE, LEVERAGE.

9.8 SPSS reports: OLS multiple regressions

9.8.1 DISC_Gen and RISK: full sub-sample (132 companies)

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	LEVERAGE, MEDIA, SIZE, RISK[b]	.	Enter

a. Dependent Variable: DISC_gen

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,380[a]	,144	,117	240,613	2,286

a. Predictors: (Constant), LEVERAGE, MEDIA, SIZE, RISK

b. Dependent Variable: DISC_gen

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1241367,232	4	310341,808	5,360	,001[b]
	Residual	7352643,761	127	57894,833		
	Total	8594010,992	131			

a. Dependent Variable: DISC_gen

b. Predictors: (Constant), LEVERAGE, MEDIA, SIZE, RISK

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	92,164	311,377		,296	,768		
	RISK	49,161	11,812	,379	4,162	,000	,813	1,229
	MEDIA	-,031	,102	-,028	-,307	,760	,823	1,215
	SIZE	11,244	13,968	,073	,805	,422	,822	1,216
	LEVERAGE	2,007	1,013	,166	1,982	,050	,957	1,045

a. Dependent Variable: DISC_gen

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIA	SIZE	LEVERAGE
1	1	3,807	1,000	,00	,02	,02	,00	,01
	2	,744	2,262	,00	,00	,75	,00	,02
	3	,276	3,711	,00	,92	,17	,00	,06
	4	,170	4,727	,00	,01	,01	,00	,87
	5	,002	41,043	,99	,05	,07	,99	,04

a. Dependent Variable: DISC_gen

Casewise Diagnostics[a]

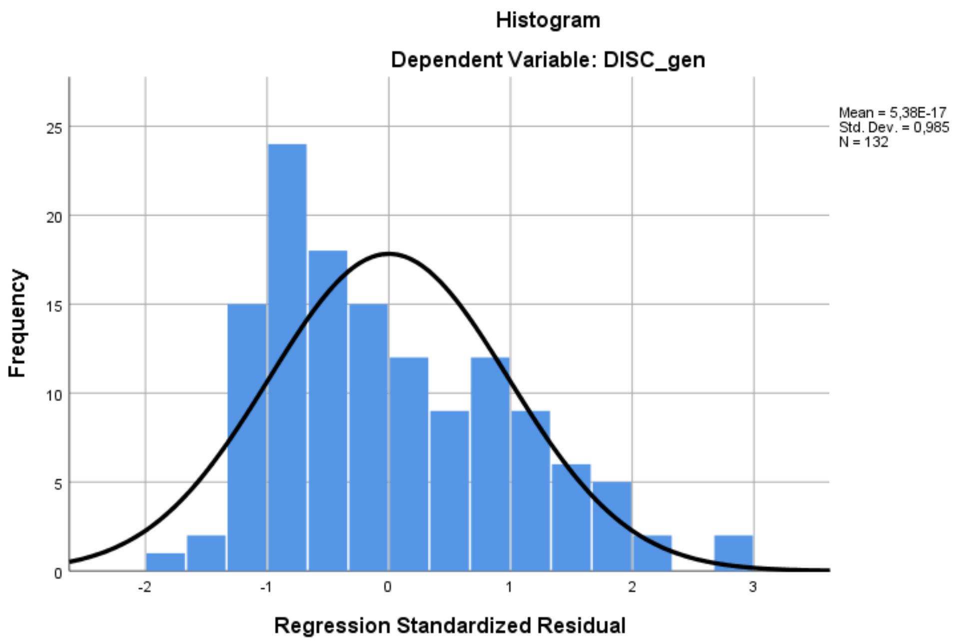
Case Number	Std. Residual	DISC_gen	Predicted Value	Residual
44	2,193	1036	508,32	527,679
46	2,198	1036	507,18	528,823
68	2,790	810	138,72	671,281
70	2,745	810	149,60	660,399

a. Dependent Variable: DISC_gen

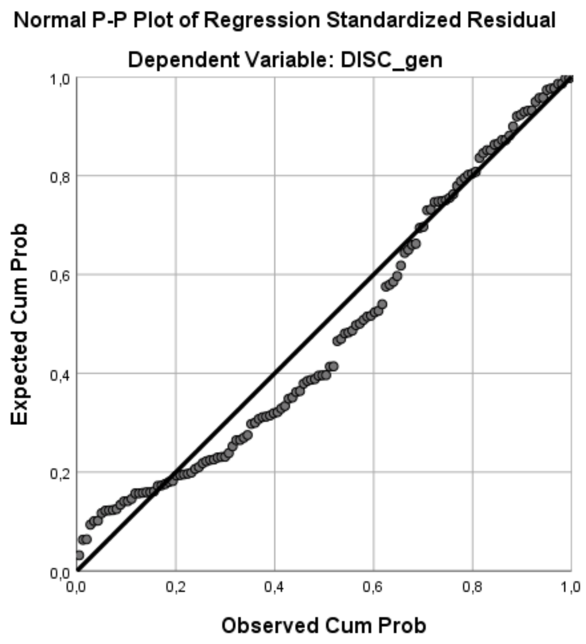
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4,49	531,12	297,49	97,345	132
Std. Predicted Value	-3,010	2,400	,000	1,000	132
Standard Error of Predicted Value	23,501	123,552	43,247	18,031	132
Adjusted Predicted Value	4,66	575,95	297,37	98,430	132
Residual	-447,116	671,281	,000	236,911	132
Std. Residual	-1,858	2,790	,000	,985	132
Stud. Residual	-1,949	2,846	,000	1,005	132
Deleted Residual	-491,952	698,566	,124	246,994	132
Stud. Deleted Residual	-1,971	2,930	,003	1,012	132
Mahal. Distance	,257	33,548	3,970	4,905	132
Cook's Distance	,000	,109	,009	,018	132
Centered Leverage Value	,002	,256	,030	,037	132

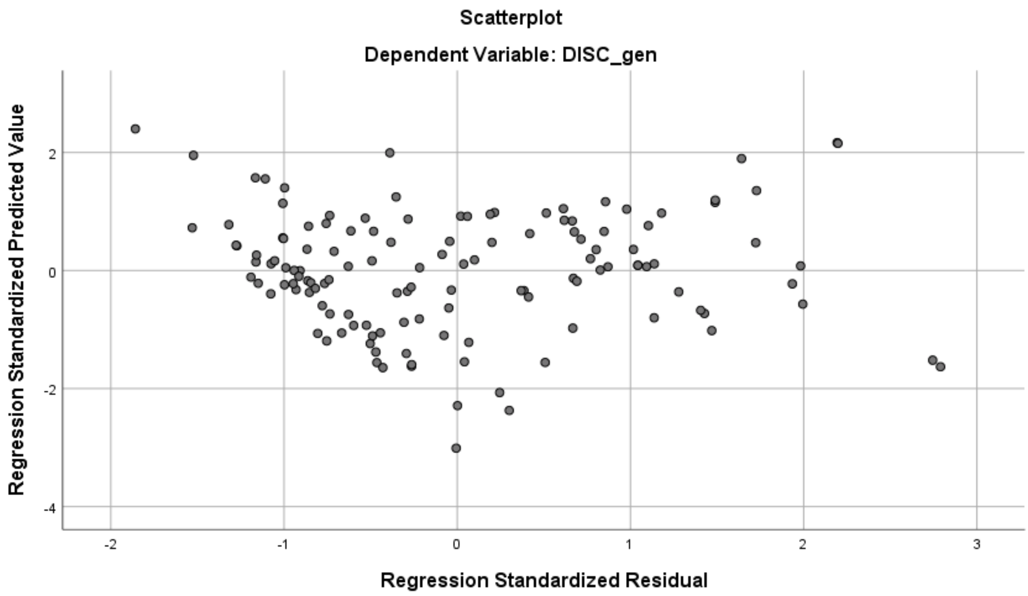
a. Dependent Variable: DISC_gen



Histogram
Dependent Variable: DISC_gen
Mean = 5,38E-17
Std. Dev. = 0,985
N = 132
Frequency
Regression Standardized Residual
0
5
10
15
20
25
-2
-1
0
1
2
3



Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DISC_gen
Expected Cum Prob
Observed Cum Prob
0,0
0,2
0,4
0,6
0,8
1,0



9.8.2 DISC_Gen and RISK: outliers removed (129 companies)

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	LEVERAGE, MEDIA, RISK, SIZE[b]	.	Enter

a. Dependent Variable: DISC_gen

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,384[a]	,148	,120	240,822	2,123

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK, SIZE

b. Dependent Variable: DISC_gen

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1247101,304	4	311775,326	5,376	,001[b]
	Residual	7191397,735	124	57995,143		
	Total	8438499,039	128			

a. Dependent Variable: DISC_gen

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK, SIZE

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	20,023	395,956		,051	,960		
	RISK	48,495	12,123	,373	4,000	,000	,792	1,263
	MEDIA	-,033	,103	-,029	-,317	,752	,798	1,253
	SIZE	13,818	18,024	,073	,767	,445	,750	1,333
	LEVERAGE	2,364	1,117	,176	2,117	,036	,989	1,011

a. Dependent Variable: DISC_gen

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK	MEDIA	SIZE	LEVERAGE
1	1	3,815	1,000	,00	,02	,02	,00	,01
	2	,752	2,252	,00	,01	,72	,00	,02
	3	,286	3,651	,00	,87	,17	,00	,07
	4	,146	5,119	,00	,02	,00	,00	,90
	5	,001	52,167	1,00	,08	,10	1,00	,00

a. Dependent Variable: DISC_gen

Casewise Diagnostics[a]

Case Number	Std. Residual	DISC_gen	Predicted Value	Residual
27	2,130	1036	523,05	512,948
28	2,136	1036	521,71	514,295
64	2,778	810	141,06	668,942
66	2,725	810	153,87	656,129

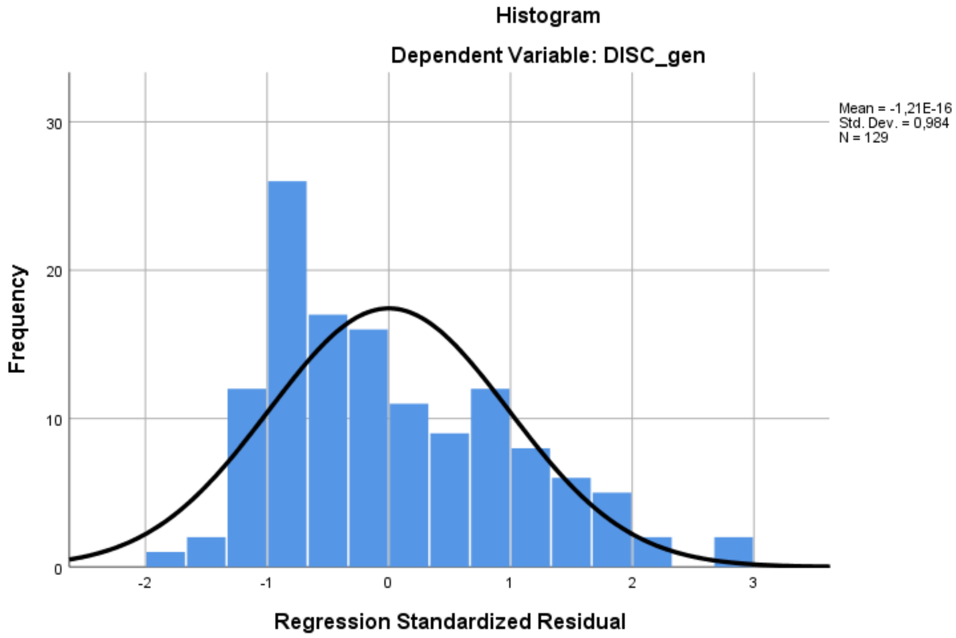
a. Dependent Variable: DISC_gen

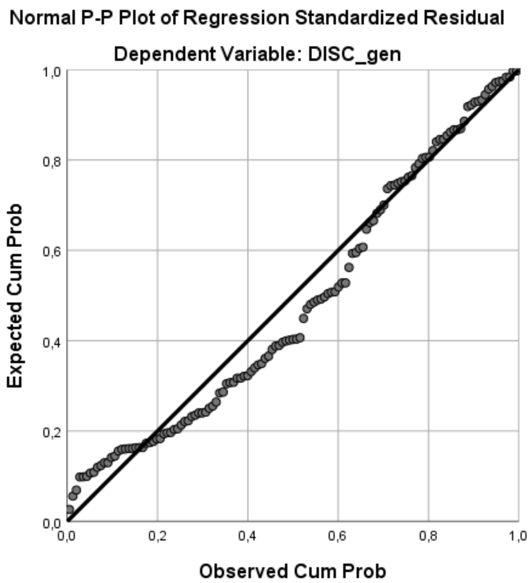
Residuals Statistics[a]

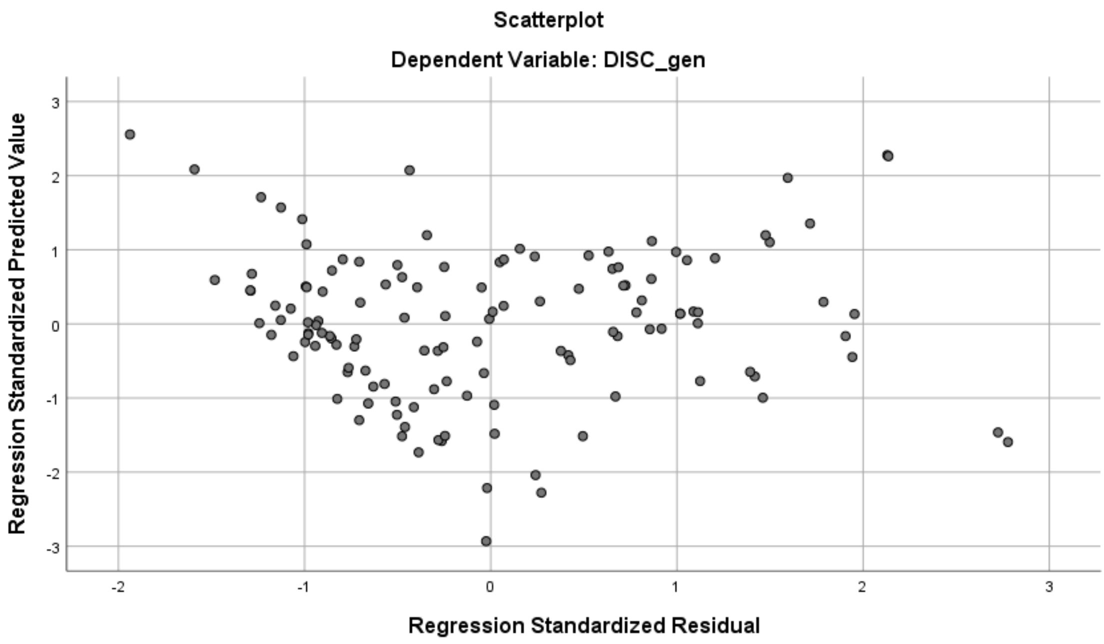
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	8,97	550,71	298,40	98,707	129
Std. Predicted Value	-2,932	2,556	,000	1,000	129
Standard Error of Predicted Value	23,819	88,982	44,572	16,226	129
Adjusted Predicted Value	9,67	604,09	298,44	99,453	129
Residual	-466,712	668,942	,000	237,029	129
Std. Residual	-1,938	2,778	,000	,984	129
Stud. Residual	-2,046	2,834	,000	1,005	129
Deleted Residual	-520,092	696,232	-,033	247,141	129
Stud. Deleted Residual	-2,073	2,918	,003	1,012	129

Mahal. Distance	,260	16,483	3,969	3,818	129
Cook's Distance	,000	,096	,009	,017	129
Centered Leverage Value	,002	,129	,031	,030	129

a. Dependent Variable: DISC_gen







9.8.3 DISC_Gen and RISK_Mgt: full sub-sample (132 companies)

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	LEVERAGE, MEDIA, RISK_MGT, SIZE[b]	.	Enter

a. Dependent Variable: DISC_gen

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,316[a]	,100	,071	246,839	1,575

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

b. Dependent Variable: DISC_gen

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	855942,429	4	213985,607	3,512	,009[b]
	Residual	7738068,563	127	60929,674		
	Total	8594010,992	131			

a. Dependent Variable: DISC_gen

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	140,012	319,632		,438	,662		
	RISK_MGT	-62,249	19,554	-,290	-3,183	,002	,853	1,172
	MEDIA	-,132	,101	-,117	-1,307	,194	,880	1,136
	SIZE	13,277	14,796	,086	,897	,371	,771	1,297
	LEVERAGE	1,729	1,033	,143	1,673	,097	,968	1,033

a. Dependent Variable: DISC_gen

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIA	SIZE	LEVERAGE
1	1	3,976	1,000	,00	,01	,01	,00	,01
	2	,747	2,307	,00	,00	,87	,00	,01
	3	,191	4,564	,00	,08	,01	,00	,91
	4	,084	6,894	,01	,83	,00	,01	,03
	5	,002	42,557	,99	,08	,10	,99	,04

a. Dependent Variable: DISC_gen

Casewise Diagnostics[a]

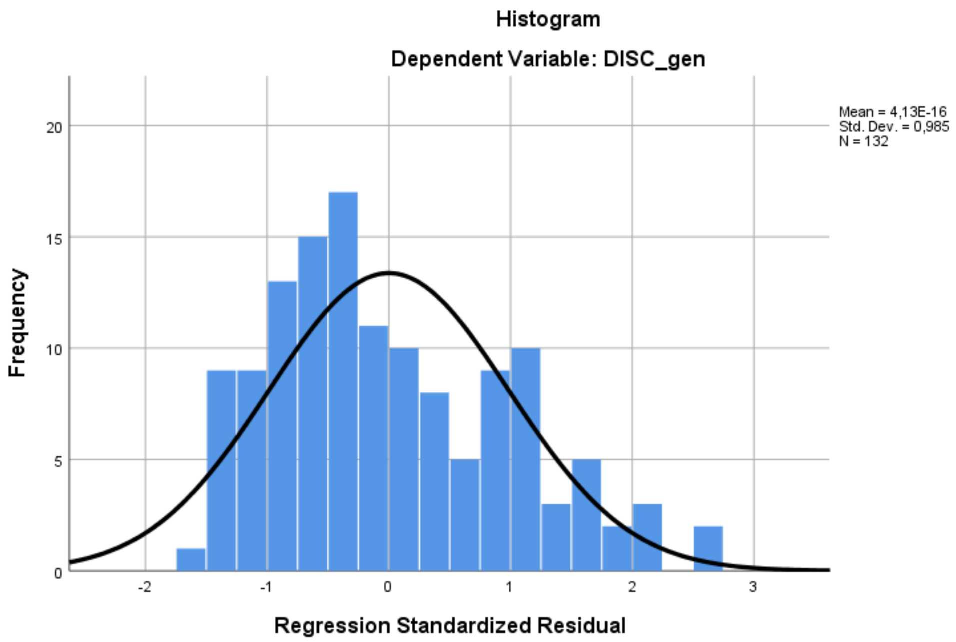
Case Number	Std. Residual	DISC_gen	Predicted Value	Residual
65	2,622	1036	388,76	647,236
66	2,618	1036	389,74	646,257
156	2,013	845	348,18	496,817
171	2,106	810	290,23	519,770
172	2,144	810	280,74	529,255

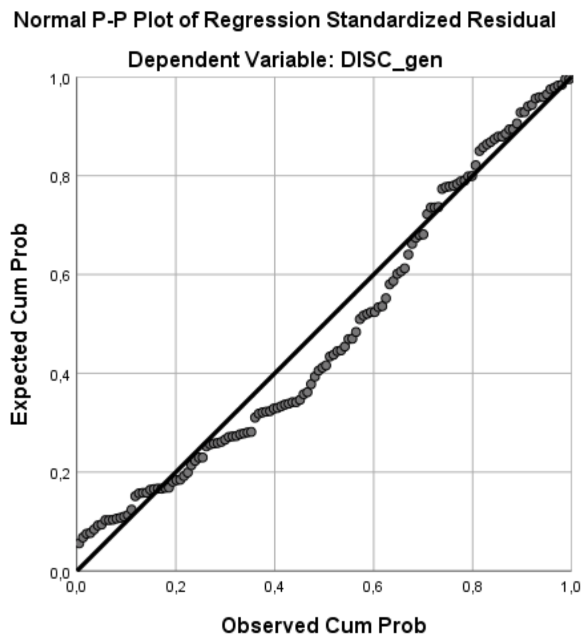
a. Dependent Variable: DISC_gen

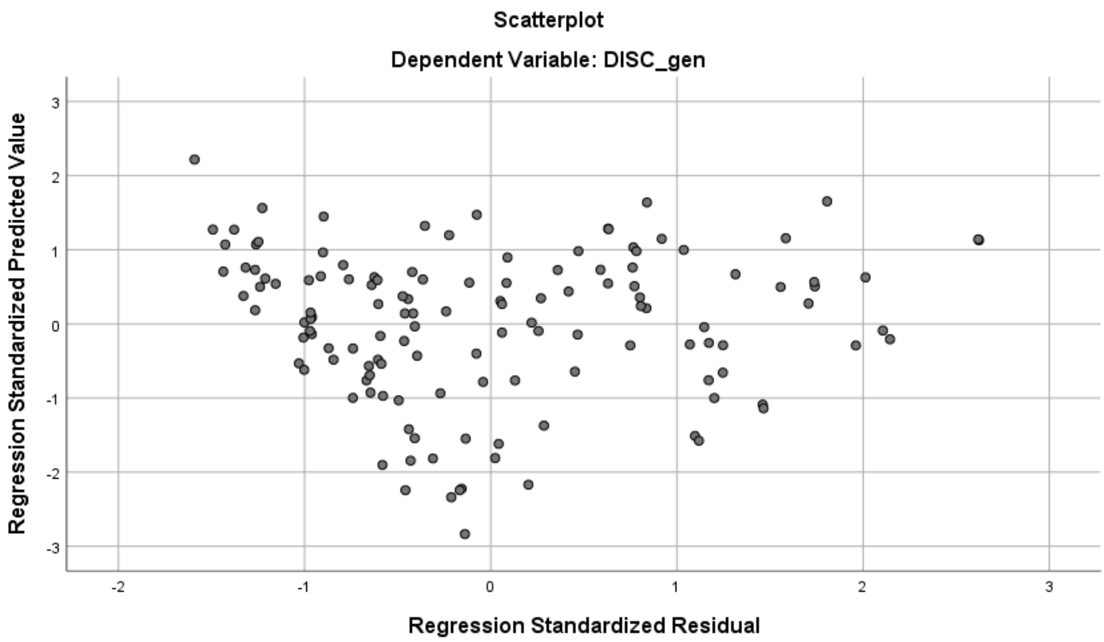
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	68,34	476,76	297,49	80,833	132
Std. Predicted Value	-2,835	2,218	,000	1,000	132
Standard Error of Predicted Value	24,790	124,166	44,265	18,741	132
Adjusted Predicted Value	71,09	512,53	297,90	83,704	132
Residual	-392,756	647,236	,000	243,042	132
Std. Residual	-1,591	2,622	,000	,985	132
Stud. Residual	-1,662	2,682	-,001	1,005	132
Deleted Residual	-428,531	677,189	-,405	253,520	132
Stud. Deleted Residual	-1,674	2,751	,002	1,012	132
Mahal. Distance	,329	32,155	3,970	4,982	132
Cook's Distance	,000	,166	,009	,019	132
Centered Leverage Value	,003	,245	,030	,038	132

a. Dependent Variable: DISC_gen







9.8.4 DISC_Gen and RISK_Mgt: outliers removed (129 companies)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,337[a]	,113	,085	245,633	1,671

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

b. Dependent Variable: DISC_gen

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	956876,698	4	239219,174	3,965	,005[b]
	Residual	7481622,341	124	60335,664		
	Total	8438499,039	128			

a. Dependent Variable: DISC_gen

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	73,035	405,410		,180	,857		
	RISK_MGT	-64,960	19,979	-,304	-3,251	,001	,816	1,225
	MEDIA	-,127	,103	-,114	-1,232	,220	,832	1,202
	SIZE	15,733	19,016	,084	,827	,410	,701	1,426
	LEVERAGE	2,284	1,139	,170	2,005	,047	,989	1,011

a. Dependent Variable: DISC_gen

Coefficient Correlations[a]

Model			LEVERAGE	MEDIA	RISK_MGT	SIZE
1	Correlations	LEVERAGE	1,000	,022	-,097	,003
		MEDIA	,022	1,000	,029	-,387
		RISK_MGT	-,097	,029	1,000	-,396
		SIZE	,003	-,387	-,396	1,000
	Covariances	LEVERAGE	1,297	,003	-2,208	,067
		MEDIA	,003	,011	,061	-,760
		RISK_MGT	-2,208	,061	399,148	-150,622
		SIZE	,067	-,760	-150,622	361,619

a. Dependent Variable: DISC_gen

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIA	SIZE	LEVERAGE
1	1	3,993	1,000	,00	,01	,01	,00	,01
	2	,753	2,302	,00	,00	,82	,00	,01
	3	,169	4,860	,00	,12	,02	,00	,90
	4	,083	6,941	,01	,75	,00	,01	,08
	5	,001	54,365	,99	,12	,15	,99	,00

a. Dependent Variable: DISC_gen

Casewise Diagnostics[a]

Case Number	Std. Residual	DISC_gen	Predicted Value	Residual

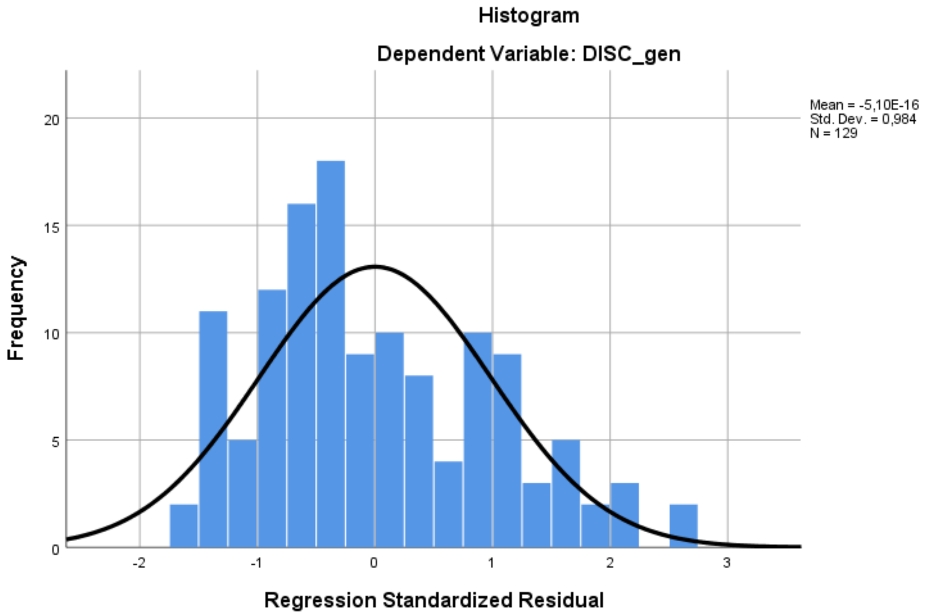
44	2,527	1036	415,40	620,605
45	2,532	1036	414,10	621,901
70	2,042	758	256,38	501,623
166	2,164	810	278,33	531,671
170	2,114	810	290,81	519,192

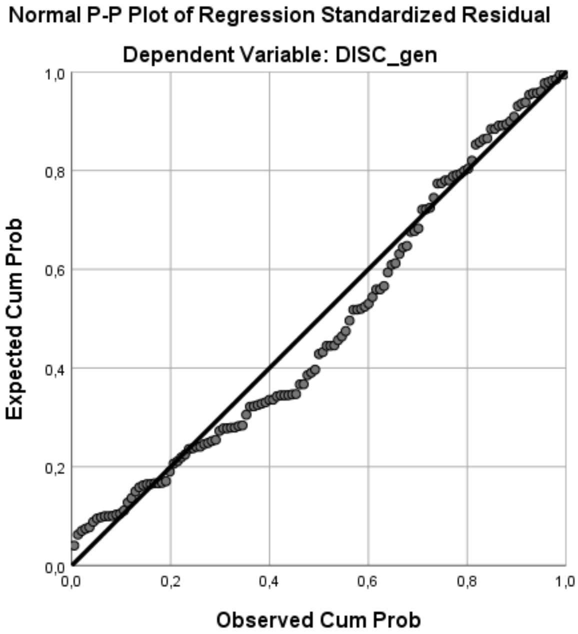
a. Dependent Variable: DISC_gen

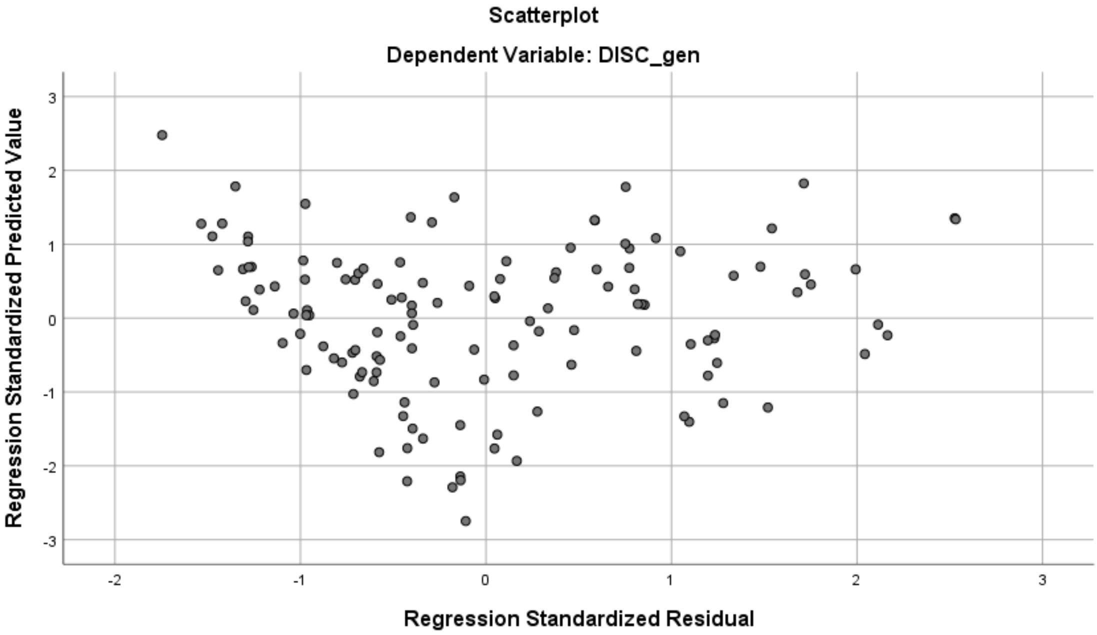
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	60,80	512,70	298,40	86,462	129
Std. Predicted Value	-2,748	2,478	,000	1,000	129
Standard Error of Predicted Value	24,979	94,909	45,403	16,712	129
Adjusted Predicted Value	62,96	559,09	298,97	87,565	129
Residual	-428,697	621,901	,000	241,765	129
Std. Residual	-1,745	2,532	,000	,984	129
Stud. Residual	-1,837	2,602	-,001	1,004	129
Deleted Residual	-475,093	656,821	-,569	251,740	129
Stud. Deleted Residual	-1,855	2,665	,001	1,011	129
Mahal. Distance	,331	18,117	3,969	3,863	129
Cook's Distance	,000	,078	,008	,015	129
Centered Leverage Value	,003	,142	,031	,030	129

a. Dependent Variable: DISC_gen




Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DISC_gen
Expected Cum Prob
Observed Cum Prob
0,0
0,2
0,4
0,6
0,8
1,0


Scatterplot
Dependent Variable: DISC_gen
Regression Standardized Predicted Value
Regression Standardized Residual
-3
-2
-1
0
1
2
3

9.8.5 DISC_Spe and RISK: full sub-sample (132 companies)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,305[a]	,093	,065	107,357	1,744

a. Predictors: (Constant), LEVERAGE, MEDIA, SIZE, RISK

b. Dependent Variable: DISC_spe

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	150458,026	4	37614,506	3,264	,014[b]
	Residual	1463743,307	127	11525,538		
	Total	1614201,333	131			

a. Dependent Variable: DISC_spe

b. Predictors: (Constant), LEVERAGE, MEDIA, SIZE, RISK

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	-9,677	138,930		-,070	,945		
	RISK	13,234	5,270	,235	2,511	,013	,813	1,229
	MEDIA	,103	,045	,212	2,274	,025	,823	1,215
	SIZE	10,631	6,232	,159	1,706	,090	,822	1,216
	LEVERAGE	,577	,452	,110	1,276	,204	,957	1,045

a. Dependent Variable: DISC_spe

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK	MEDIA	SIZE	LEVERAGE
1	1	3,807	1,000	,00	,02	,02	,00	,01
	2	,744	2,262	,00	,00	,75	,00	,02
	3	,276	3,711	,00	,92	,17	,00	,06
	4	,170	4,727	,00	,01	,01	,00	,87
	5	,002	41,043	,99	,05	,07	,99	,04

a. Dependent Variable: DISC_spe

Casewise Diagnostics[a]

Case Number	Std. Residual	DISC_spe	Predicted Value	Residual
8	2,125	485	256,85	228,148
35	3,774	709	303,88	405,121
71	-2,235	53	292,95	-239,952

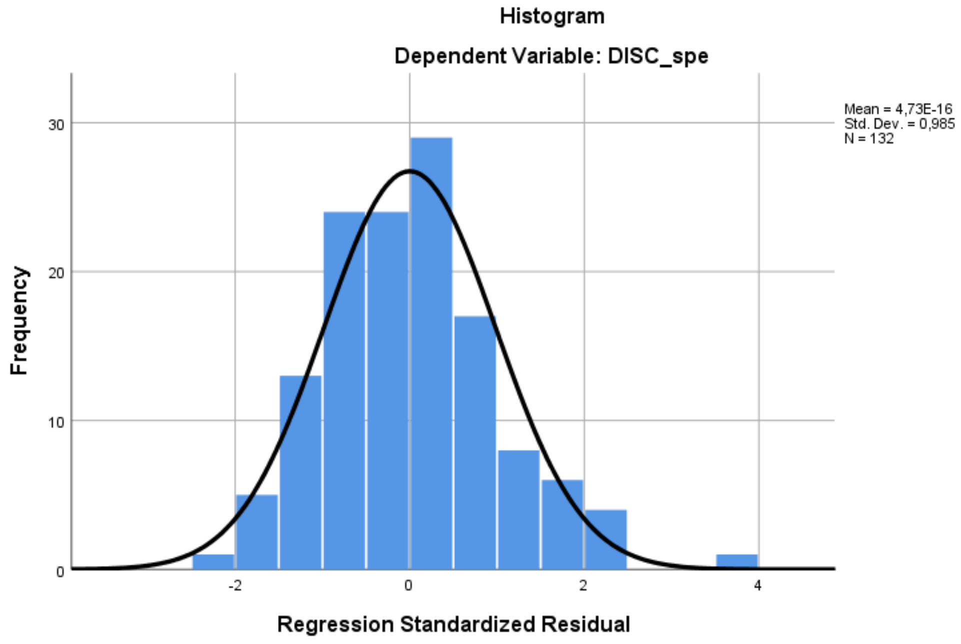
169	2,112	446	219,27	226,732
170	2,113	446	219,19	226,809
184	2,339	446	194,93	251,066

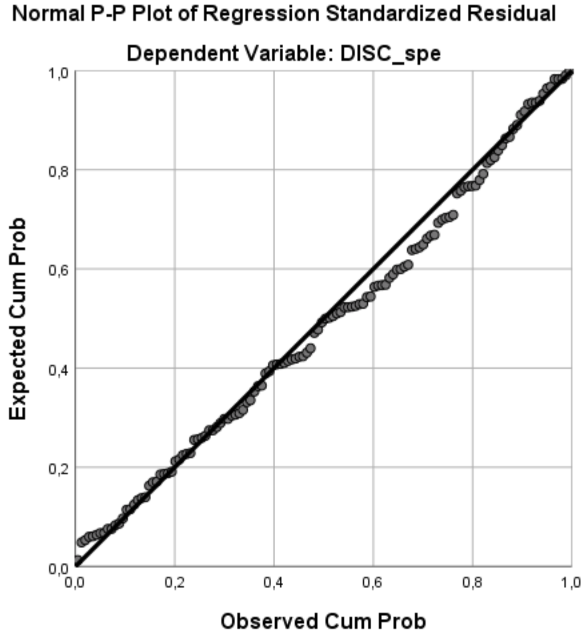
a. Dependent Variable: DISC_spe

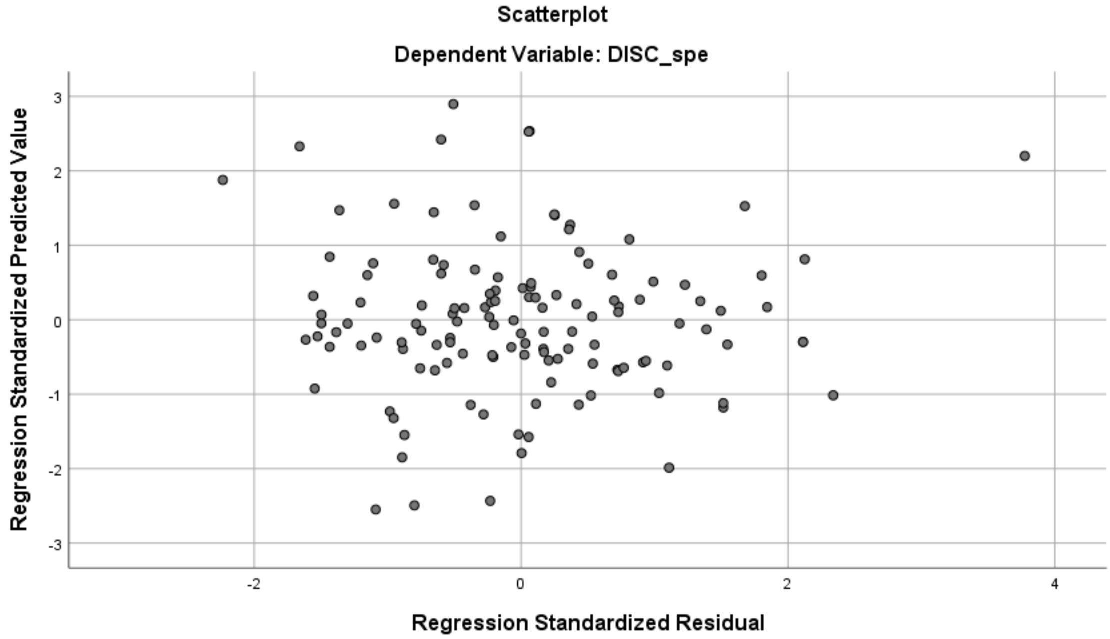
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	142,96	327,51	229,33	33,890	132
Std. Predicted Value	-2,549	2,897	,000	1,000	132
Standard Error of Predicted Value	10,486	55,126	19,296	8,045	132
Adjusted Predicted Value	143,70	335,66	229,14	34,506	132
Residual	-239,952	405,121	,000	105,705	132
Std. Residual	-2,235	3,774	,000	,985	132
Stud. Residual	-2,349	3,952	,001	1,007	132
Deleted Residual	-265,017	444,285	,196	110,574	132
Stud. Deleted Residual	-2,392	4,203	,004	1,020	132
Mahal. Distance	,257	33,548	3,970	4,905	132
Cook's Distance	,000	,302	,009	,030	132
Centered Leverage Value	,002	,256	,030	,037	132

a. Dependent Variable: DISC_spe







9.8.6 DISC_Spe and RISK: outliers removed (129 companies)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,314[a]	,099	,070	107,762	1,955

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK, SIZE

b. Dependent Variable: DISC_spe

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	157783,664	4	39445,916	3,397	,011[b]
	Residual	1439955,174	124	11612,542		
	Total	1597738,837	128			

a. Dependent Variable: DISC_spe

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK, SIZE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-109,034	177,180		-,615	,539		
	RISK	14,578	5,425	,257	2,687	,008	,792	1,263
	MEDIA	,095	,046	,195	2,041	,043	,798	1,253
	SIZE	15,432	8,065	,188	1,913	,058	,750	1,333
	LEVERAGE	,421	,500	,072	,841	,402	,989	1,011

a. Dependent Variable: DISC_spe

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIA	SIZE	LEVERAGE
1	1	3,815	1,000	,00	,02	,02	,00	,01
	2	,752	2,252	,00	,01	,72	,00	,02
	3	,286	3,651	,00	,87	,17	,00	,07
	4	,146	5,119	,00	,02	,00	,00	,90
	5	,001	52,167	1,00	,08	,10	1,00	,00

a. Dependent Variable: DISC_spe

Casewise Diagnostics[a]

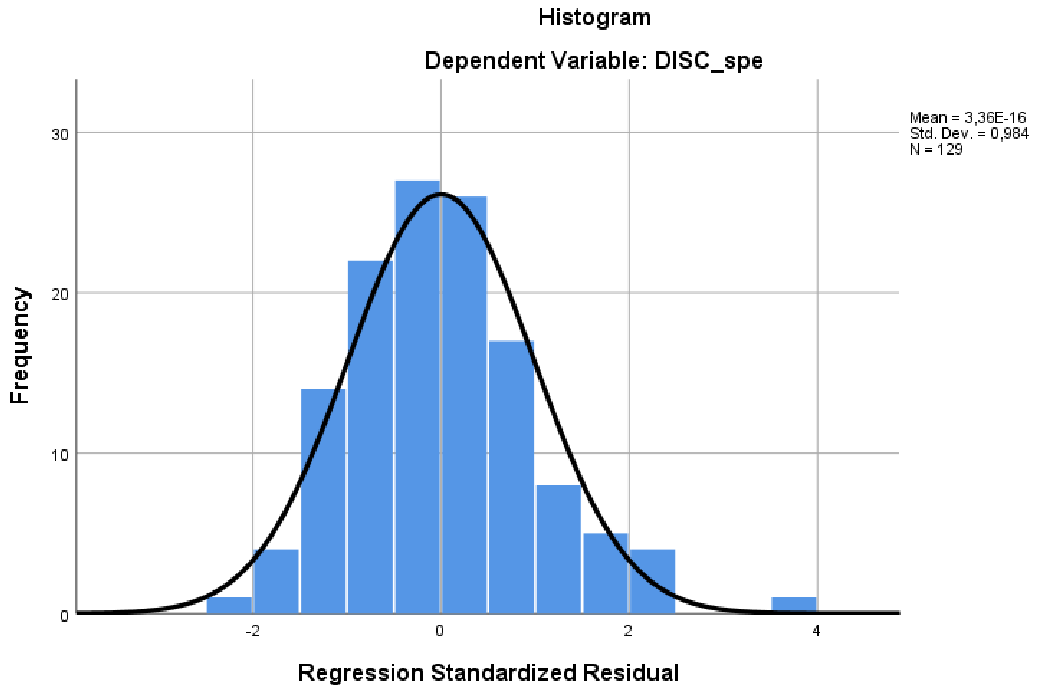
Case Number	Std. Residual	DISC_spe	Predicted Value	Residual
9	-2,371	53	308,53	-255,527
15	3,697	709	310,60	398,400
31	2,394	446	187,99	258,010
122	2,051	485	264,03	220,969
123	2,157	446	213,54	232,456
124	2,152	446	214,11	231,893

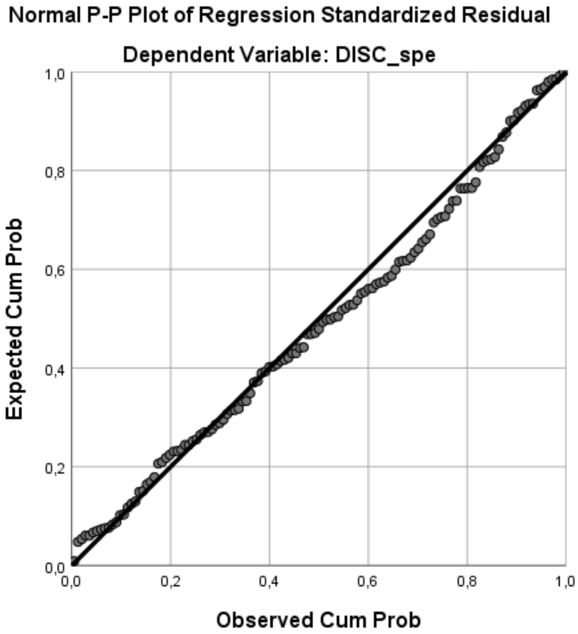
a. Dependent Variable: DISC_spe

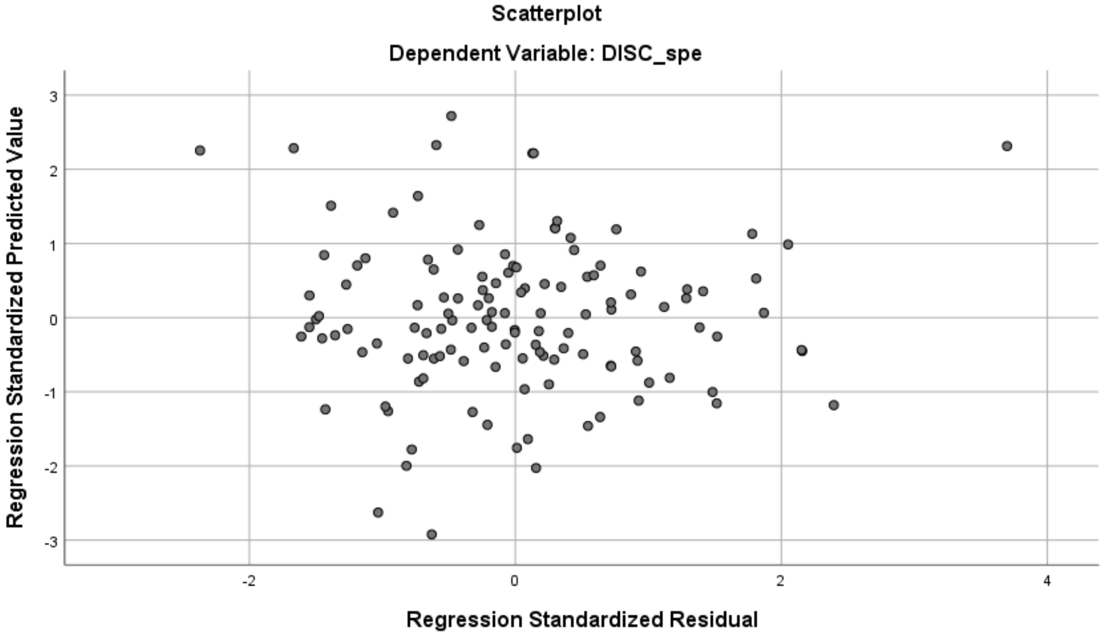
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	126,80	324,86	229,40	35,110	129
Std. Predicted Value	-2,922	2,719	,000	1,000	129
Standard Error of Predicted Value	10,658	39,817	19,945	7,261	129
Adjusted Predicted Value	135,85	341,97	229,33	35,707	129
Residual	-255,527	398,400	,000	106,064	129
Std. Residual	-2,371	3,697	,000	,984	129
Stud. Residual	-2,522	3,888	,000	1,009	129
Deleted Residual	-288,966	440,652	,067	111,467	129
Stud. Deleted Residual	-2,578	4,133	,003	1,022	129
Mahal. Distance	,260	16,483	3,969	3,818	129
Cook's Distance	,000	,321	,010	,034	129
Centered Leverage Value	,002	,129	,031	,030	129

a. Dependent Variable: DISC_spe







9.8.7 DISC_Spe and RISK_Mgt: full sub-sample (132 companies)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,266[a]	,071	,042	108,667	1,776

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

b. Dependent Variable: DISC_spe

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	114515,779	4	28628,945	2,424	,051[b]
	Residual	1499685,554	127	11808,548		
	Total	1614201,333	131			

a. Dependent Variable: DISC_spe

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	8,011	140,713		,057	,955		
	RISK_MGT	-15,183	8,608	-,163	-1,764	,080	,853	1,172
	MEDIA	,076	,044	,156	1,708	,090	,880	1,136
	SIZE	10,770	6,514	,161	1,654	,101	,771	1,297
	LEVERAGE	,489	,455	,094	1,076	,284	,968	1,033

a. Dependent Variable: DISC_spe

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK_MGT	MEDIA	SIZE	LEVERAGE
1	1	3,976	1,000	,00	,01	,01	,00	,01
	2	,747	2,307	,00	,00	,87	,00	,01
	3	,191	4,564	,00	,08	,01	,00	,91
	4	,084	6,894	,01	,83	,00	,01	,03
	5	,002	42,557	,99	,08	,10	,99	,04

a. Dependent Variable: DISC_spe

Casewise Diagnostics[a]

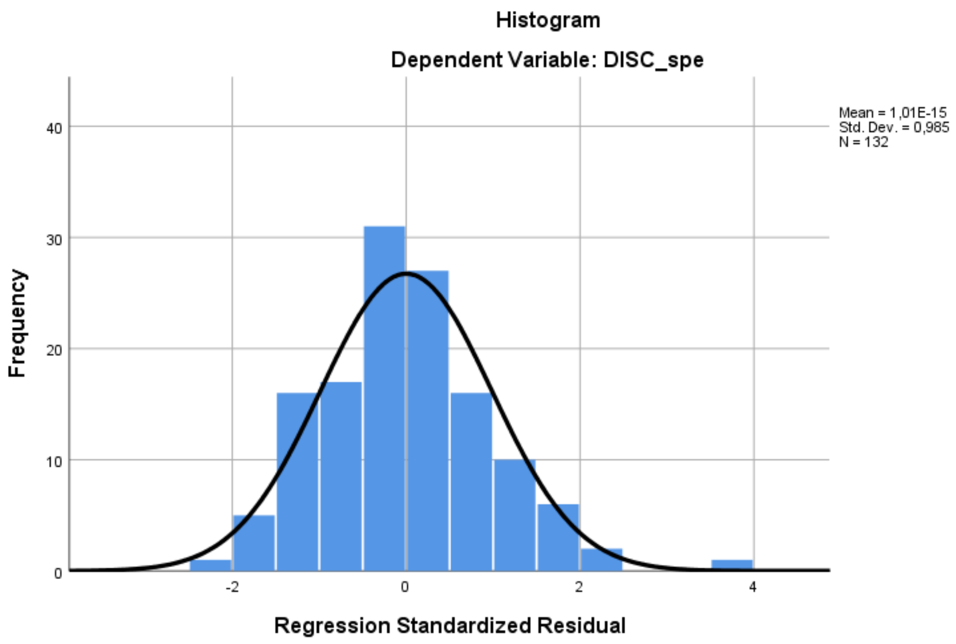
Case Number	Std. Residual	DISC_spe	Predicted Value	Residual
8	2,183	485	247,80	237,202
35	3,879	709	287,43	421,565
71	-2,052	53	275,97	-222,970
184	2,360	446	189,50	256,504

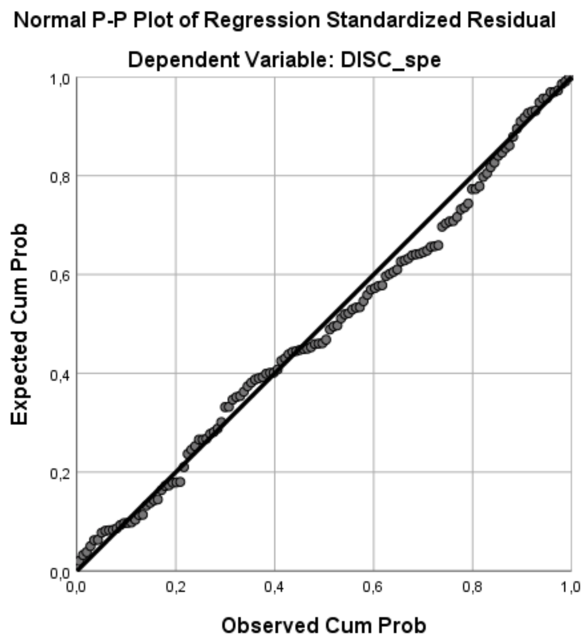
a. Dependent Variable: DISC_spe

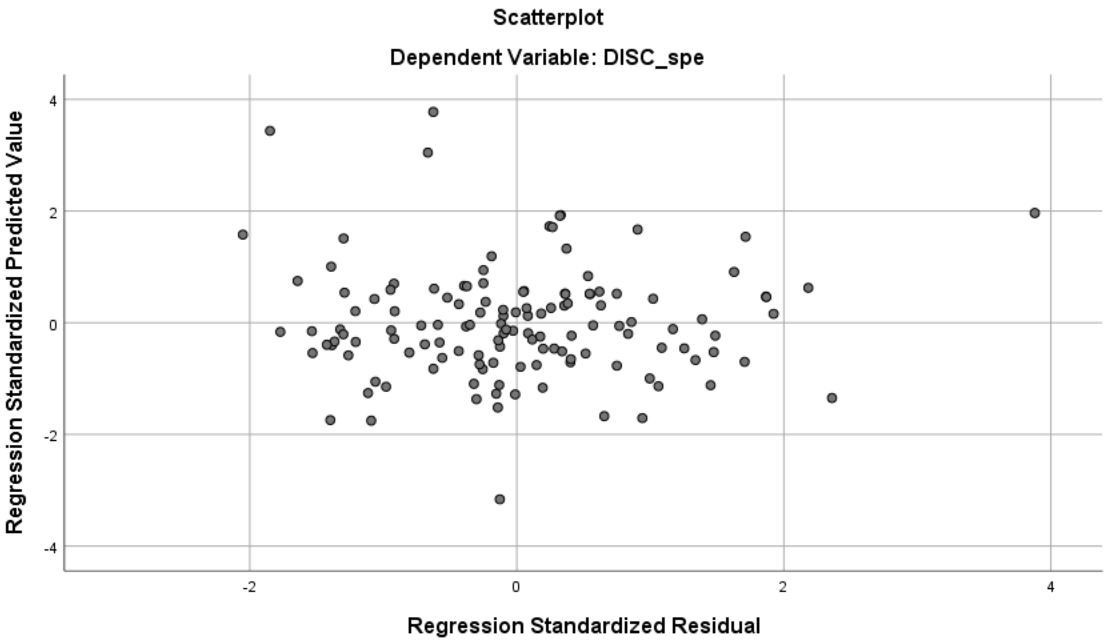
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	135,86	340,97	229,33	29,566	132
Std. Predicted Value	-3,161	3,776	,000	1,000	132
Standard Error of Predicted Value	10,913	54,662	19,487	8,250	132
Adjusted Predicted Value	140,00	353,42	229,07	30,760	132
Residual	-222,970	421,565	,000	106,995	132
Std. Residual	-2,052	3,879	,000	,985	132
Stud. Residual	-2,163	4,084	,001	1,008	132
Deleted Residual	-247,732	467,196	,264	112,203	132
Stud. Deleted Residual	-2,195	4,365	,004	1,022	132
Mahal. Distance	,329	32,155	3,970	4,982	132
Cook's Distance	,000	,361	,010	,035	132
Centered Leverage Value	,003	,245	,030	,038	132

a. Dependent Variable: DISC_spe







9.8.8 DISC_Spe and RISK_Mgt: outliers removed (129 companies)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,267[a]	,071	,041	109,404	2,025

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

b. Dependent Variable: DISC_spe

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	113563,397	4	28390,849	2,372	,056[b]
	Residual	1484175,441	124	11969,157		
	Total	1597738,837	128			

a. Dependent Variable: DISC_spe

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	-74,352	180,567		-,412	,681		
	RISK_MGT	-16,196	8,898	-,174	-1,820	,071	,816	1,225
	MEDIA	,067	,046	,137	1,447	,150	,832	1,202
	SIZE	14,751	8,470	,180	1,742	,084	,701	1,426
	LEVERAGE	,378	,507	,065	,745	,458	,989	1,011

a. Dependent Variable: DISC_spe

Collinearity Diagnostics[a]

				Variance Proportions				
Model	Dimension	Eigenvalue	Condition Index	(Constant)	RISK_MGT	MEDIA	SIZE	LEVERAGE
1	1	3,993	1,000	,00	,01	,01	,00	,01
	2	,753	2,302	,00	,00	,82	,00	,01
	3	,169	4,860	,00	,12	,02	,00	,90
	4	,083	6,941	,01	,75	,00	,01	,08
	5	,001	54,365	,99	,12	,15	,99	,00

a. Dependent Variable: DISC_spe

Casewise Diagnostics[a]

Case Number	Std. Residual	DISC_spe	Predicted Value	Residual
9	-2,141	53	287,27	-234,267
15	3,807	709	292,46	416,539
31	2,413	446	182,02	263,980
122	2,119	485	253,18	231,815

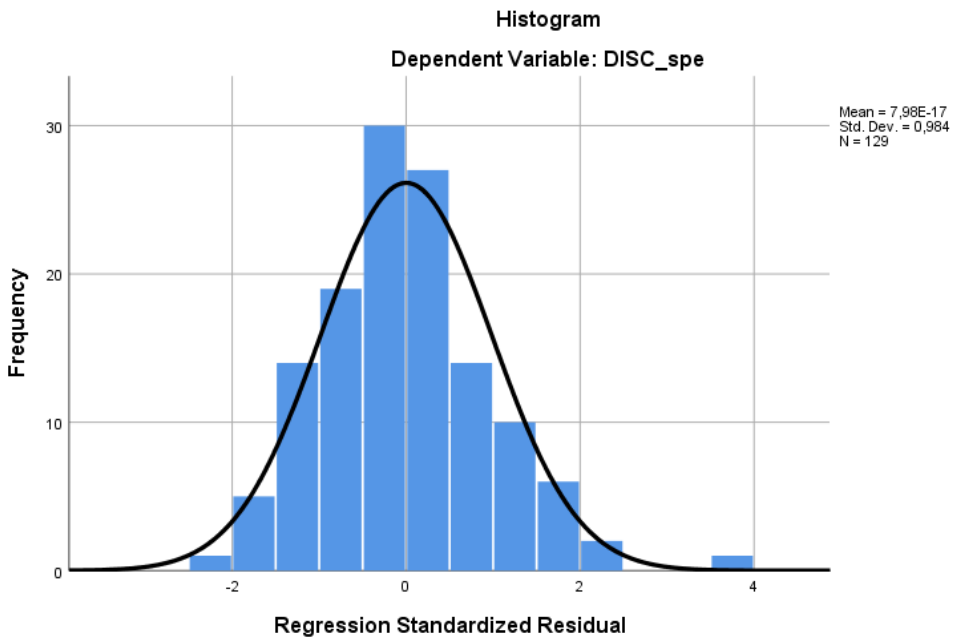
a. Dependent Variable: DISC_spe

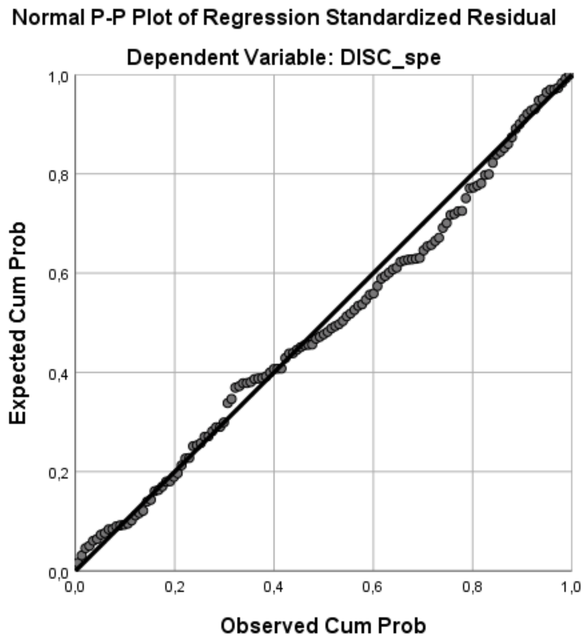
Residuals Statistics[a]

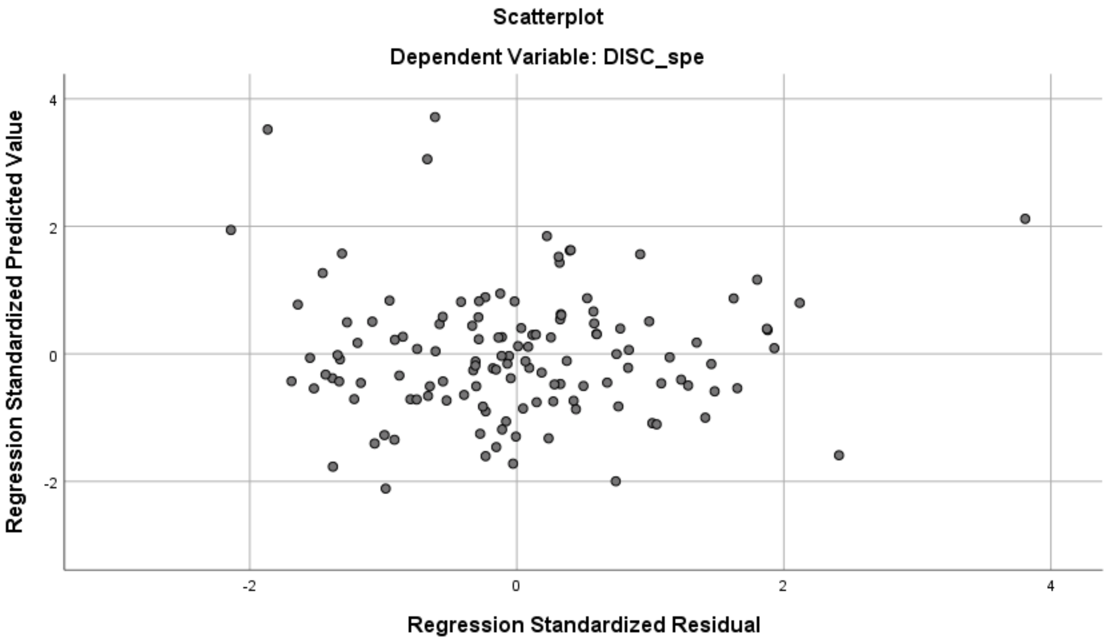
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	166,47	340,01	229,40	29,786	129
Std. Predicted Value	-2,113	3,714	,000	1,000	129

Standard Error of Predicted Value	11,126	42,272	20,222	7,443	129
Adjusted Predicted Value	158,88	358,66	229,24	31,242	129
Residual	-234,267	416,539	,000	107,681	129
Std. Residual	-2,141	3,807	,000	,984	129
Stud. Residual	-2,278	4,019	,001	1,010	129
Deleted Residual	-265,026	464,129	,152	113,495	129
Stud. Deleted Residual	-2,317	4,292	,003	1,024	129
Mahal. Distance	,331	18,117	3,969	3,863	129
Cook's Distance	,000	,369	,011	,037	129
Centered Leverage Value	,003	,142	,031	,030	129

a. Dependent Variable: DISC_spe







9.8.9 DISC_Tot and RISK: full sub-sample (132 companies)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,403[a]	,162	,136	269,349	1,472

a. Predictors: (Constant), LEVERAGE, MEDIA, SIZE, RISK

b. Dependent Variable: DISC_total

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1786189,418	4	446547,355	6,155	,000[b]
	Residual	9213713,574	127	72548,926		
	Total	10999902,992	131			

a. Dependent Variable: DISC_total

b. Predictors: (Constant), LEVERAGE, MEDIA, SIZE, RISK

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	82,487	348,563		,237	,813		
	RISK	62,395	13,222	,425	4,719	,000	,813	1,229
	MEDIA	,072	,114	,057	,632	,528	,823	1,215
	SIZE	21,875	15,636	,125	1,399	,164	,822	1,216
	LEVERAGE	2,584	1,134	,189	2,279	,024	,957	1,045

a. Dependent Variable: DISC_total

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK	MEDIA	SIZE	LEVERAGE
1	1	3,807	1,000	,00	,02	,02	,00	,01
	2	,744	2,262	,00	,00	,75	,00	,02
	3	,276	3,711	,00	,92	,17	,00	,06
	4	,170	4,727	,00	,01	,01	,00	,87
	5	,002	41,043	,99	,05	,07	,99	,04

a. Dependent Variable: DISC_total

Casewise Diagnostics[a]

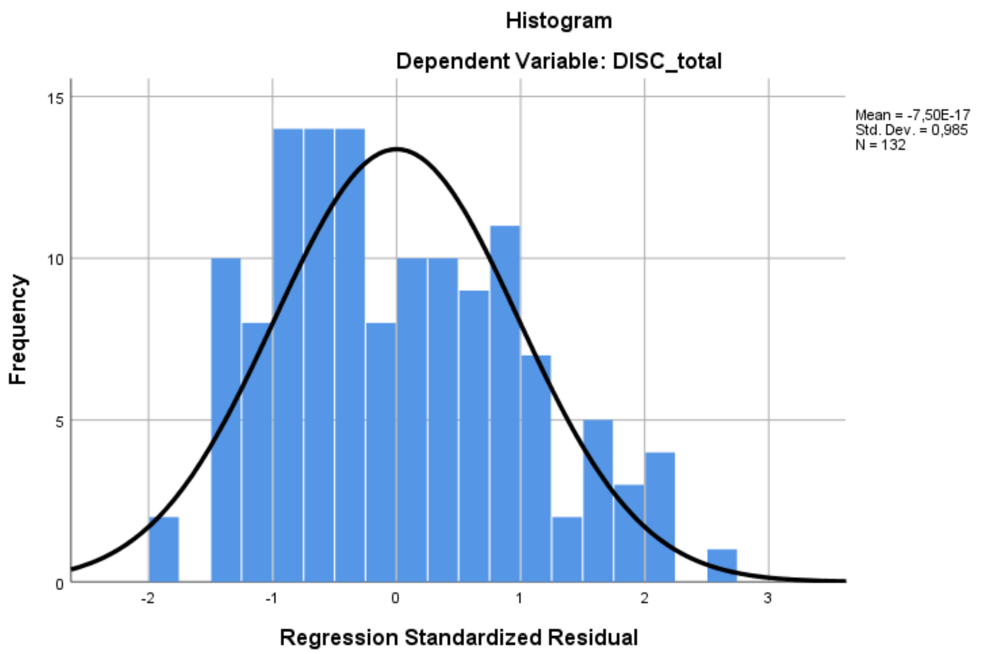
Case Number	Std. Residual	DISC_total	Predicted Value	Residual
65	2,064	1340	784,10	555,903
66	2,058	1340	785,56	554,443
77	2,505	1215	540,15	674,854
171	2,060	892	337,19	554,808
172	2,111	892	323,28	568,720

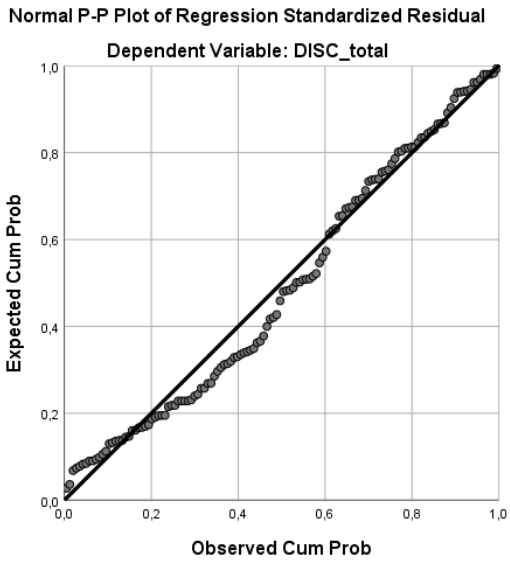
a. Dependent Variable: DISC_total

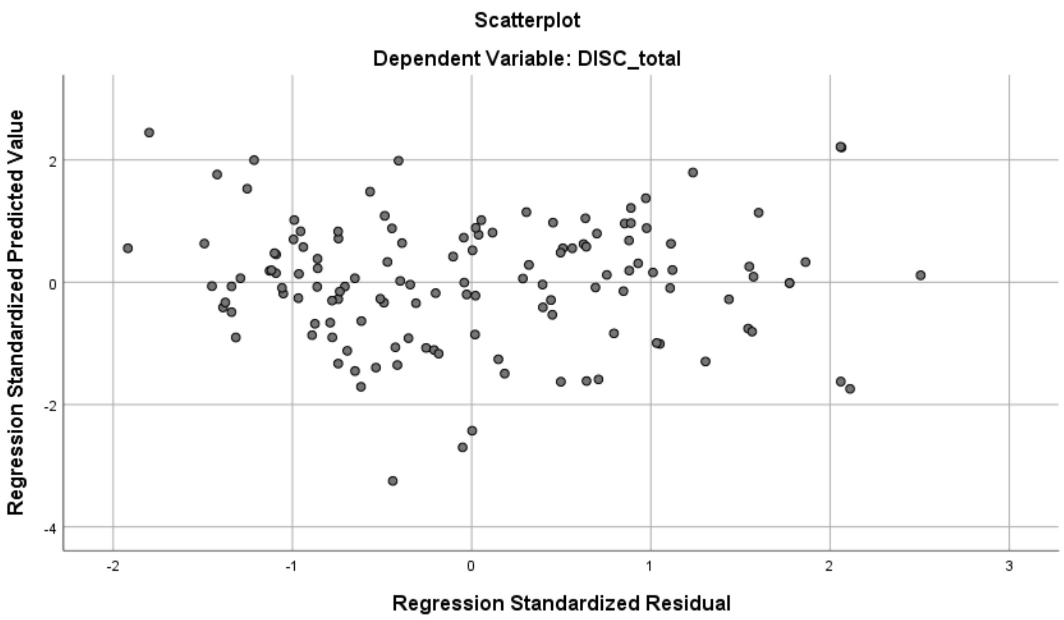
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	147,45	812,57	526,83	116,769	132
Std. Predicted Value	-3,249	2,447	,000	1,000	132
Standard Error of Predicted Value	26,308	138,307	48,412	20,184	132
Adjusted Predicted Value	160,91	861,17	526,51	117,802	132
Residual	-516,728	674,854	,000	265,205	132
Std. Residual	-1,918	2,505	,000	,985	132
Stud. Residual	-1,943	2,520	,001	1,003	132
Deleted Residual	-533,166	682,802	,321	275,524	132
Stud. Deleted Residual	-1,965	2,575	,002	1,009	132
Mahal. Distance	,257	33,548	3,970	4,905	132
Cook's Distance	,000	,074	,008	,013	132
Centered Leverage Value	,002	,256	,030	,037	132

a. Dependent Variable: DISC_total







9.8.10 DISC_Tot and RISK: outliers removed (129 companies)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,408[a]	,166	,139	271,020	1,916

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK, SIZE

b. Dependent Variable: DISC_total

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1817523,506	4	454380,877	6,186	,000[b]
	Residual	9108031,254	124	73451,865		
	Total	10925554,760	128			

a. Dependent Variable: DISC_total

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK, SIZE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-89,011	445,607		-,200	,842		
	RISK	63,073	13,643	,426	4,623	,000	,792	1,263
	MEDIA	,062	,116	,049	,530	,597	,798	1,253
	SIZE	29,250	20,284	,136	1,442	,152	,750	1,333
	LEVERAGE	2,784	1,257	,183	2,215	,029	,989	1,011

a. Dependent Variable: DISC_total

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIA	SIZE	LEVERAGE
1	1	3,815	1,000	,00	,02	,02	,00	,01
	2	,752	2,252	,00	,01	,72	,00	,02
	3	,286	3,651	,00	,87	,17	,00	,07
	4	,146	5,119	,00	,02	,00	,00	,90
	5	,001	52,167	1,00	,08	,10	1,00	,00

a. Dependent Variable: DISC_total

Casewise Diagnostics[a]

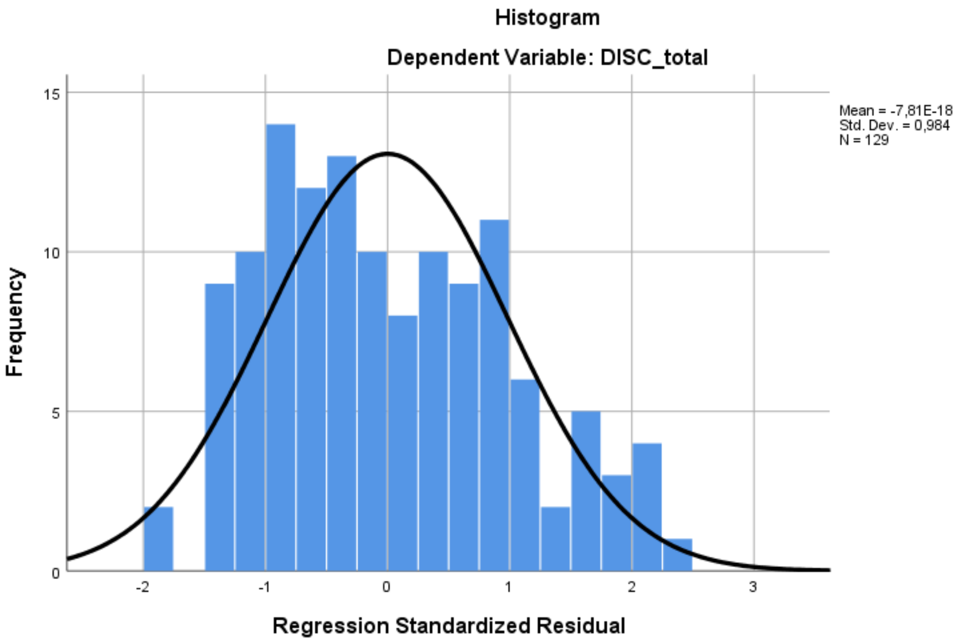
Case Number	Std. Residual	DISC_total	Predicted Value	Residual
29	2,011	1340	794,98	545,025
31	2,017	1340	793,41	546,587
66	2,088	892	326,17	565,826
69	2,032	892	341,19	550,807
185	2,479	1215	543,21	671,794

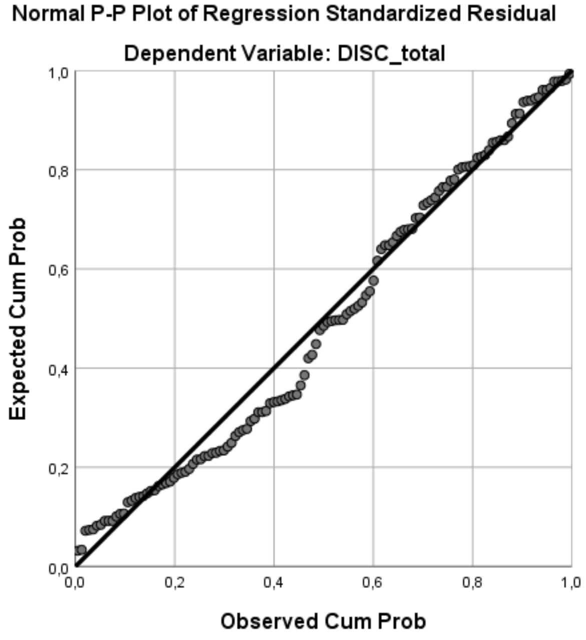
a. Dependent Variable: DISC_total

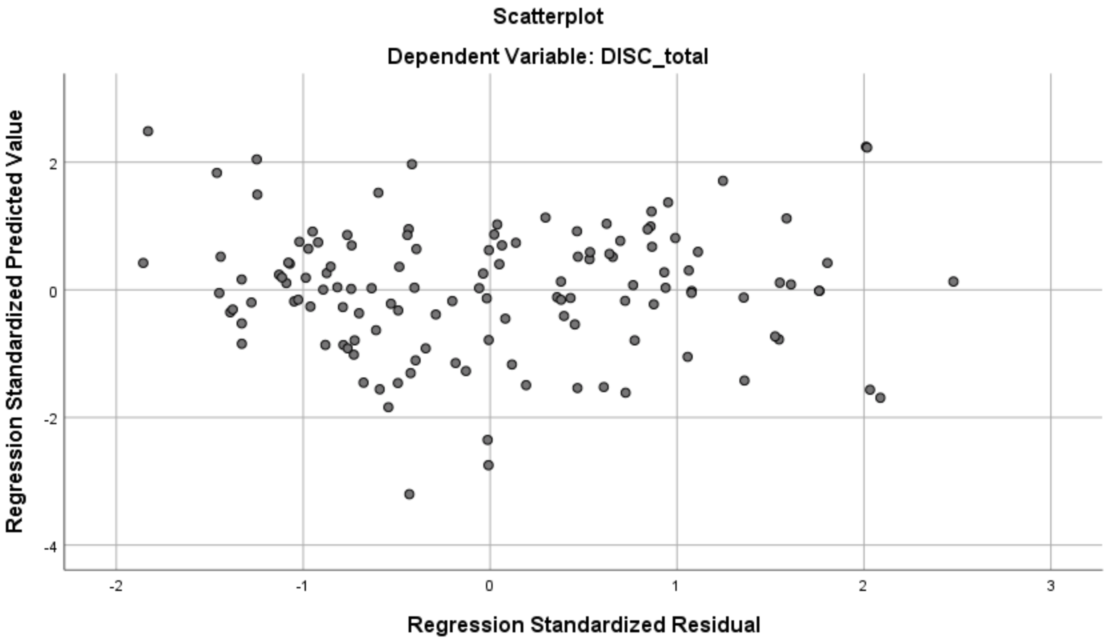
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	146,15	823,97	527,80	119,161	129
Std. Predicted Value	-3,203	2,486	,000	1,000	129
Standard Error of Predicted Value	26,806	100,140	50,161	18,261	129
Adjusted Predicted Value	159,77	880,70	527,76	119,864	129
Residual	-502,966	671,794	,000	266,752	129
Std. Residual	-1,856	2,479	,000	,984	129
Stud. Residual	-1,932	2,495	,000	1,004	129
Deleted Residual	-552,700	680,606	,034	277,948	129
Stud. Deleted Residual	-1,954	2,550	,002	1,010	129
Mahal. Distance	,260	16,483	3,969	3,818	129
Cook's Distance	,000	,085	,009	,014	129
Centered Leverage Value	,002	,129	,031	,030	129

a. Dependent Variable: DISC_total







9.8.11 DISC_Tot and RISK_Mgt: full sub-sample (132 companies)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,320[a]	,102	,074	278,831	1,811

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

b. Dependent Variable: DISC_total

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1126084,452	4	281521,113	3,621	,008[b]
	Residual	9873818,540	127	77746,603		
	Total	10999902,992	131			

a. Dependent Variable: DISC_total

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	148,023	361,057		,410	,683		
	RISK_MGT	-77,433	22,088	-,319	-3,506	,001	,853	1,172
	MEDIA	-,056	,114	-,044	-,491	,624	,880	1,136
	SIZE	24,047	16,713	,138	1,439	,153	,771	1,297
	LEVERAGE	2,218	1,167	,162	1,901	,060	,968	1,033

a. Dependent Variable: DISC_total

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIA	SIZE	LEVERAGE
1	1	3,976	1,000	,00	,01	,01	,00	,01
	2	,747	2,307	,00	,00	,87	,00	,01
	3	,191	4,564	,00	,08	,01	,00	,91
	4	,084	6,894	,01	,83	,00	,01	,03
	5	,002	42,557	,99	,08	,10	,99	,04

a. Dependent Variable: DISC_total

Casewise Diagnostics[a]

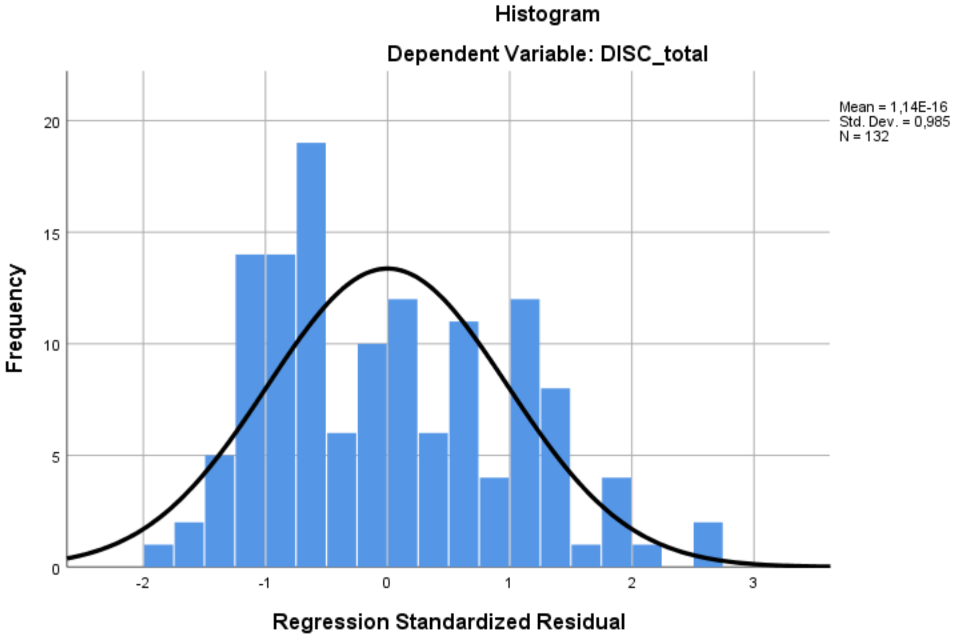
Case Number	Std. Residual	DISC_total	Predicted Value	Residual
112	2,037	1215	647,13	567,872
127	2,535	1340	633,21	706,788
128	2,530	1340	634,46	705,545

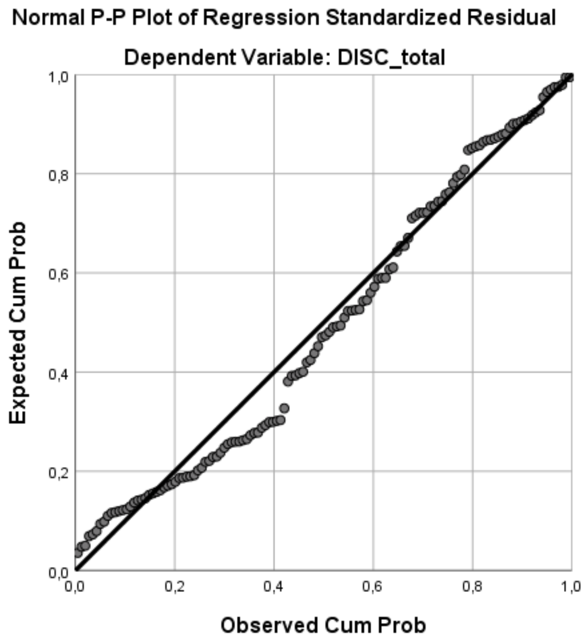
a. Dependent Variable: DISC_total

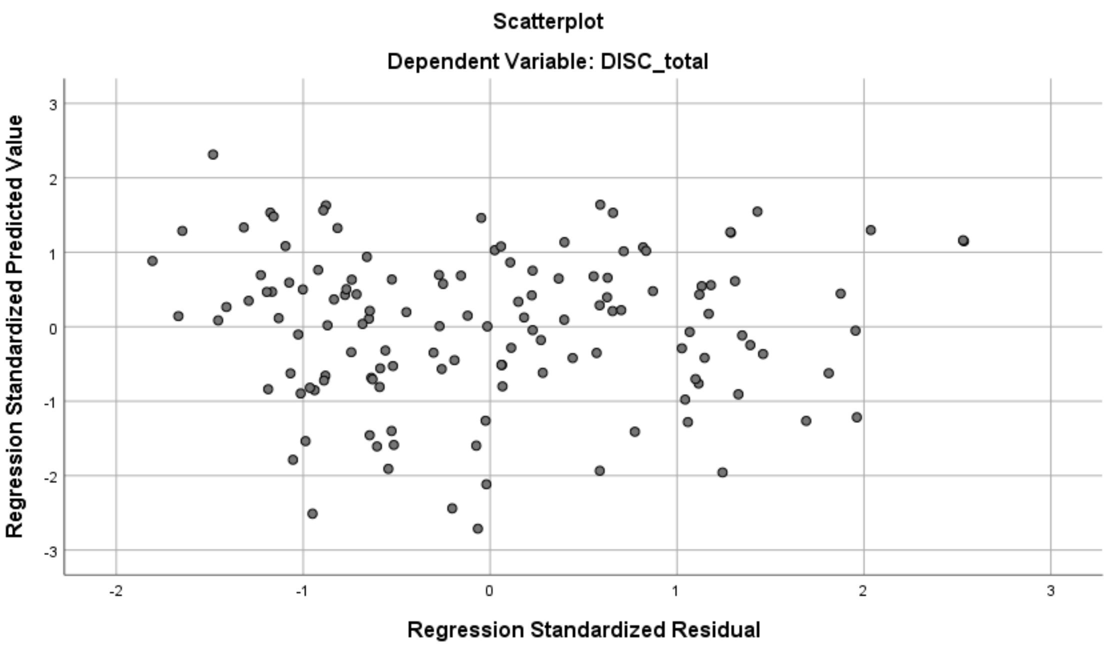
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	275,30	741,28	526,83	92,715	132
Std. Predicted Value	-2,713	2,313	,000	1,000	132
Standard Error of Predicted Value	28,003	140,258	50,002	21,170	132
Adjusted Predicted Value	241,73	778,92	526,97	96,314	132
Residual	-503,708	706,788	,000	274,541	132
Std. Residual	-1,807	2,535	,000	,985	132
Stud. Residual	-1,828	2,593	,000	1,005	132
Deleted Residual	-515,935	739,497	-,141	286,022	132
Stud. Deleted Residual	-1,846	2,654	,001	1,010	132
Mahal. Distance	,329	32,155	3,970	4,982	132
Cook's Distance	,000	,120	,009	,016	132
Centered Leverage Value	,003	,245	,030	,038	132

a. Dependent Variable: DISC_total







9.8.12 DISC_Tot and RISK_Mgt: outliers removed (129 companies)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,337[a]	,114	,085	279,435	1,724

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

b. Dependent Variable: DISC_total

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1243150,786	4	310787,697	3,980	,005[b]
	Residual	9682403,974	124	78083,903		
	Total	10925554,760	128			

a. Dependent Variable: DISC_total

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-1,318	461,198		-,003	,998		
	RISK_MGT	-81,157	22,728	-,334	-3,571	,001	,816	1,225
	MEDIA	-,061	,118	-,048	-,517	,606	,832	1,202
	SIZE	30,484	21,633	,142	1,409	,161	,701	1,426
	LEVERAGE	2,662	1,296	,175	2,054	,042	,989	1,011

a. Dependent Variable: DISC_total

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIA	SIZE	LEVERAGE
1	1	3,993	1,000	,00	,01	,01	,00	,01
	2	,753	2,302	,00	,00	,82	,00	,01
	3	,169	4,860	,00	,12	,02	,00	,90
	4	,083	6,941	,01	,75	,00	,01	,08
	5	,001	54,365	,99	,12	,15	,99	,00

a. Dependent Variable: DISC_total

Casewise Diagnostics[a]

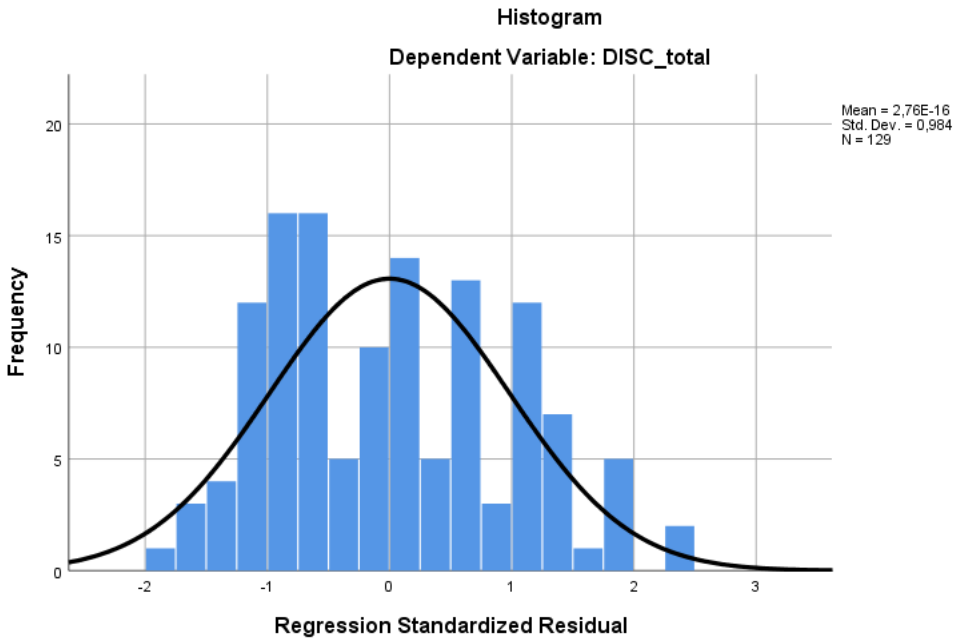
Case Number	Std. Residual	DISC_total	Predicted Value	Residual
44	2,454	1340	654,13	685,868
45	2,460	1340	652,64	687,357

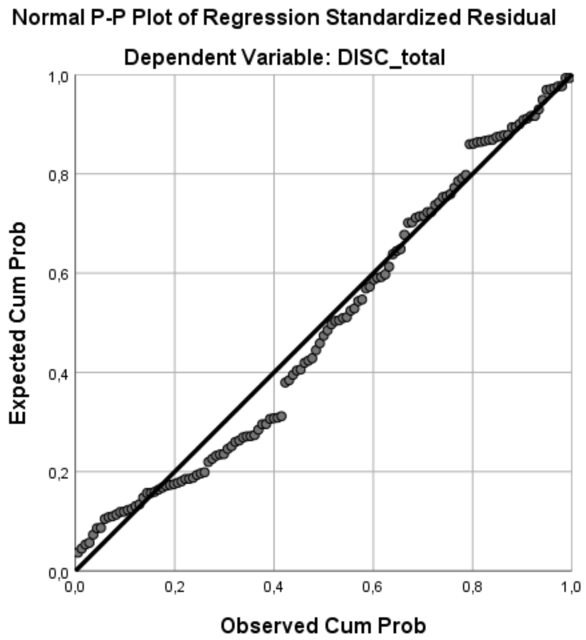
a. Dependent Variable: DISC_total

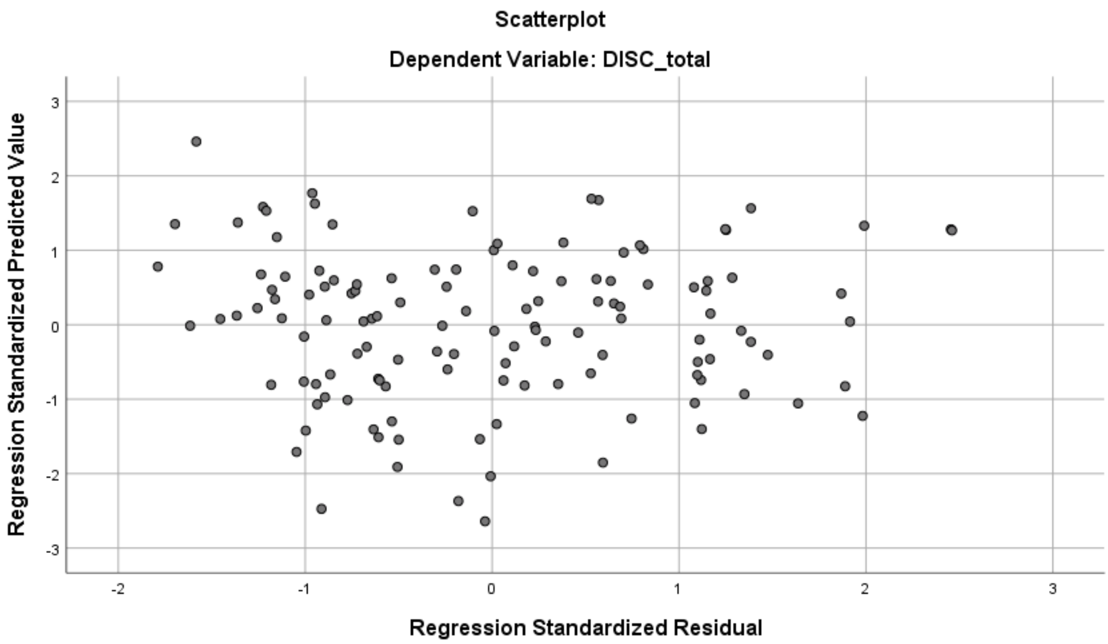
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	267,59	770,27	527,80	98,550	129
Std. Predicted Value	-2,640	2,460	,000	1,000	129
Standard Error of Predicted Value	28,417	107,969	51,651	19,011	129
Adjusted Predicted Value	268,44	818,13	528,21	100,404	129
Residual	-499,738	687,357	,000	275,034	129
Std. Residual	-1,788	2,460	,000	,984	129
Stud. Residual	-1,817	2,528	-,001	1,005	129
Deleted Residual	-515,666	725,952	-,416	286,896	129
Stud. Deleted Residual	-1,834	2,585	,001	1,011	129
Mahal. Distance	,331	18,117	3,969	3,863	129
Cook's Distance	,000	,073	,009	,014	129
Centered Leverage Value	,003	,142	,031	,030	129

a. Dependent Variable: DISC_total







9.8.13 DISCgenR and RISK: full sub-sample (132 companies)

In the following tables and charts, extracted from SPSS, the dependent variable DISCgenR was named DIS_gen%.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,313[a]	,098	,070	23,39177%	1,519

a. Predictors: (Constant), LEVERAGE, MEDIA, SIZE, RISK

b. Dependent Variable: DIS_gen%

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7545,912	4	1886,478	3,448	,010[b]
	Residual	69491,228	127	547,175		
	Total	77037,141	131			

a. Dependent Variable: DIS_gen%

b. Predictors: (Constant), LEVERAGE, MEDIA, SIZE, RISK

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	55,505	30,271		1,834	,069		
	RISK	3,267	1,148	,266	2,845	,005	,813	1,229
	MEDIA	-,010	,010	-,095	-1,026	,307	,823	1,215
	SIZE	-,082	1,358	-,006	-,060	,952	,822	1,216
	LEVERAGE	,089	,098	,078	,900	,370	,957	1,045

a. Dependent Variable: DIS_gen%

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIA	SIZE	LEVERAGE
1	1	3,807	1,000	,00	,02	,02	,00	,01
	2	,744	2,262	,00	,00	,75	,00	,02
	3	,276	3,711	,00	,92	,17	,00	,06
	4	,170	4,727	,00	,01	,01	,00	,87
	5	,002	41,043	,99	,05	,07	,99	,04

a. Dependent Variable: DIS_gen%

Casewise Diagnostics[a]

Case Number	Std. Residual	DIS_gen%	Predicted Value	Residual
61	2,074	84,74%	36,2245%	48,51724%
92	-2,379	0,00%	55,6492%	-55,64921%
94	-2,063	0,00%	48,2591%	-48,25914%
171	2,250	90,81%	38,1709%	52,63629%
172	2,271	90,81%	37,6831%	53,12411%
186	-2,051	0,00%	47,9867%	-47,98671%

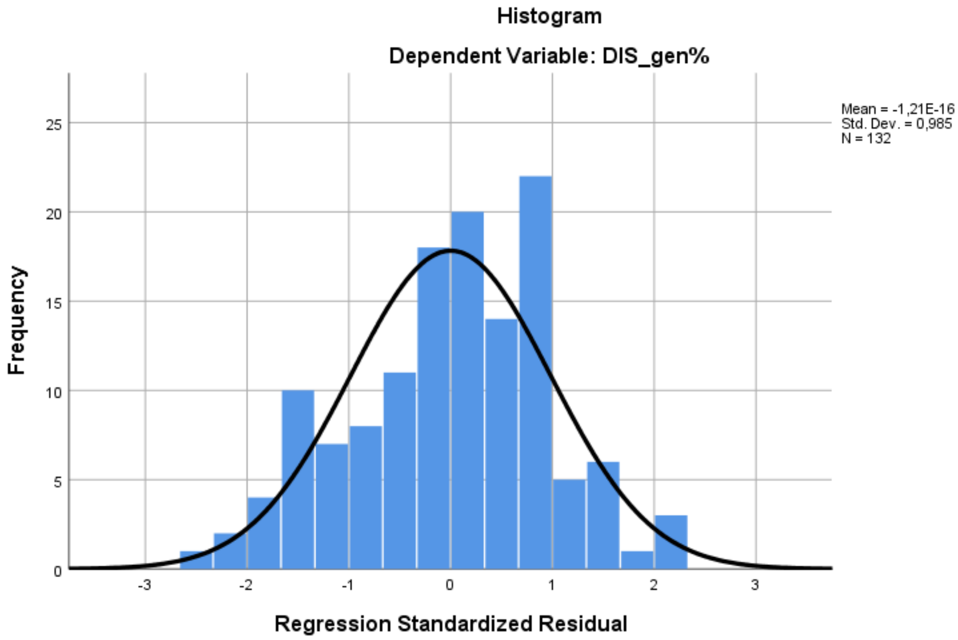
a. Dependent Variable: DIS_gen%

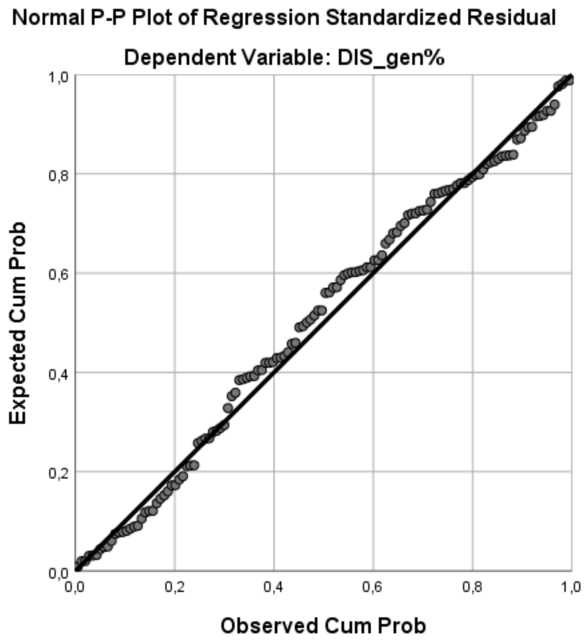
Residuals Statistics[a]

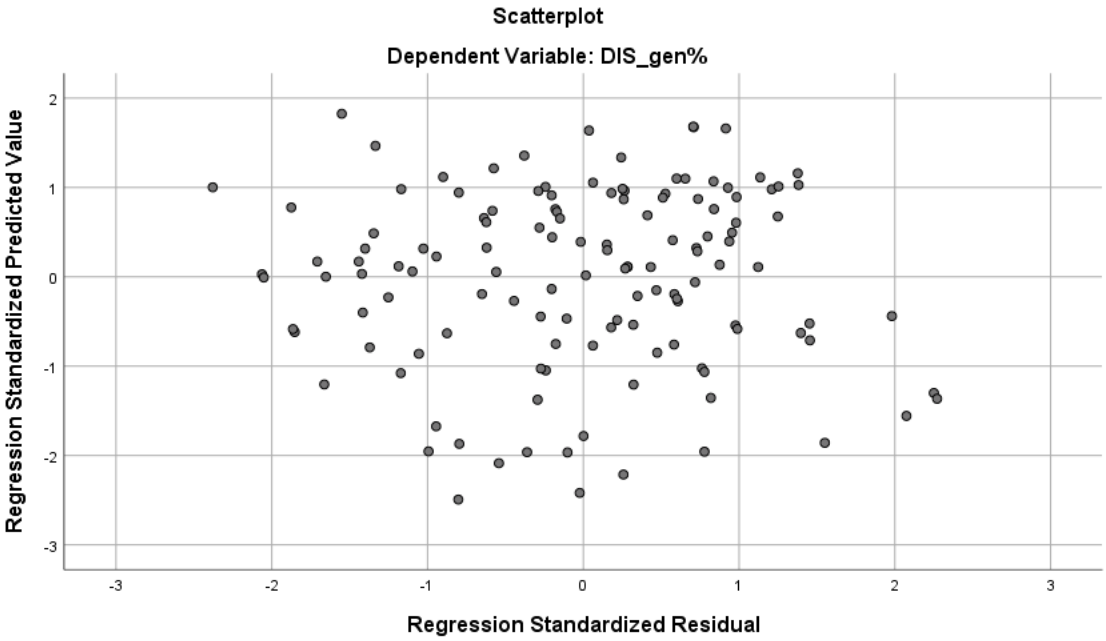
	Minimum	Maximum	Mean	Std. Deviation	N

Predicted Value	29,1198%	61,8890%	48,0419%	7,58962%	132
Std. Predicted Value	-2,493	1,824	,000	1,000	132
Standard Error of Predicted Value	2,285	12,011	4,204	1,753	132
Adjusted Predicted Value	29,7274%	65,5271%	48,0650%	7,71077%	132
Residual	-55,64921%	53,12411%	0,00000%	23,03188%	132
Std. Residual	-2,379	2,271	,000	,985	132
Stud. Residual	-2,410	2,317	,000	1,005	132
Deleted Residual	-57,08889%	55,28337%	-0,02314%	24,03073%	132
Stud. Deleted Residual	-2,457	2,358	-,001	1,012	132
Mahal. Distance	,257	33,548	3,970	4,905	132
Cook's Distance	,000	,104	,009	,017	132
Centered Leverage Value	,002	,256	,030	,037	132

a. Dependent Variable: DIS_gen%







9.8.14 DISCgenR and RISK: outliers removed (129 companies)

In the following tables and charts, extracted from SPSS, the dependent variable DISCgenR was named DIS_gen%.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,313[a]	,098	,069	23,30358%	2,203

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK, SIZE

b. Dependent Variable: DIS_gen%

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7312,107	4	1828,027	3,366	,012[b]
	Residual	67339,027	124	543,057		
	Total	74651,134	128			

a. Dependent Variable: DIS_gen%

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK, SIZE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	58,808	38,315		1,535	,127		
	RISK	3,120	1,173	,255	2,660	,009	,792	1,263
	MEDIA	-,010	,010	-,092	-,961	,338	,798	1,253
	SIZE	-,287	1,744	-,016	-,164	,870	,750	1,333
	LEVERAGE	,116	,108	,092	1,077	,284	,989	1,011

a. Dependent Variable: DIS_gen%

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIA	SIZE	LEVERAGE
1	1	3,815	1,000	,00	,02	,02	,00	,01
	2	,752	2,252	,00	,01	,72	,00	,02
	3	,286	3,651	,00	,87	,17	,00	,07
	4	,146	5,119	,00	,02	,00	,00	,90
	5	,001	52,167	1,00	,08	,10	1,00	,00

a. Dependent Variable: DIS_gen%

Casewise Diagnostics[a]

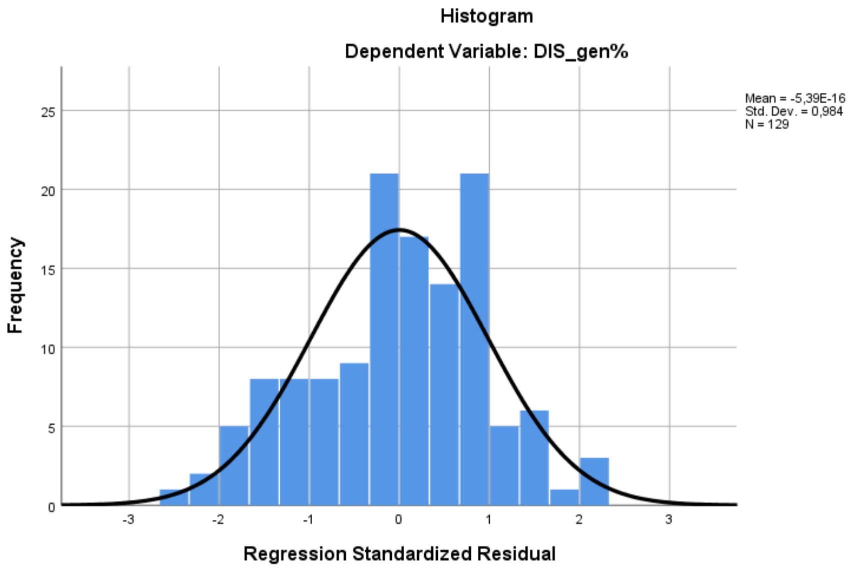
Case Number	Std. Residual	DIS_gen%	Predicted Value	Residual
19	2,058	84,74%	36,7914%	47,95034%
66	2,272	90,81%	37,8531%	52,95409%
69	2,245	90,81%	38,4899%	52,31723%
83	-2,090	0,00%	48,7040%	-48,70399%
105	-2,371	0,00%	55,2628%	-55,26284%
176	-2,055	0,00%	47,8870%	-47,88700%

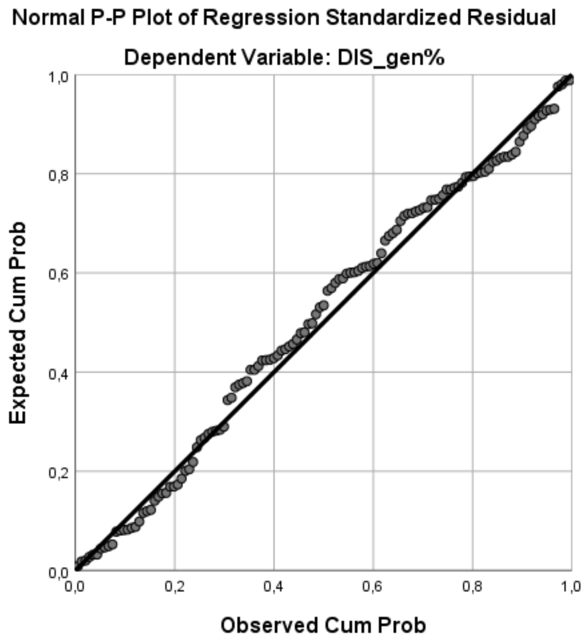
a. Dependent Variable: DIS_gen%

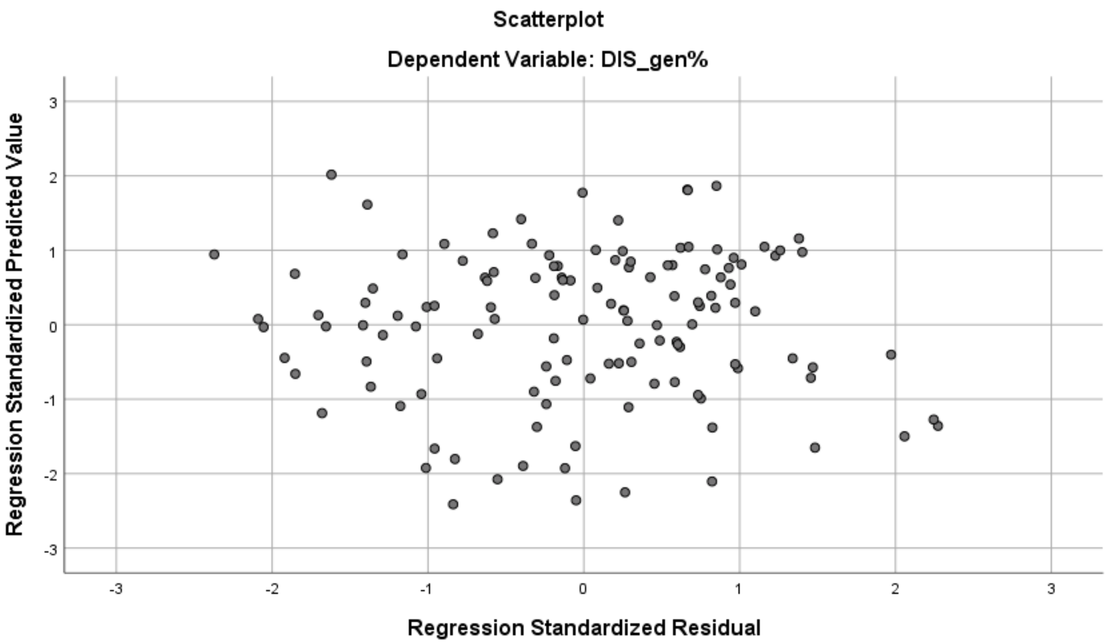
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	29,8896%	63,3603%	48,1237%	7,55816%	129
Std. Predicted Value	-2,413	2,016	,000	1,000	129
Standard Error of Predicted Value	2,305	8,610	4,313	1,570	129
Adjusted Predicted Value	29,7041%	67,6779%	48,1540%	7,70787%	129
Residual	-55,26284%	52,95409%	0,00000%	22,93657%	129
Std. Residual	-2,371	2,272	,000	,984	129
Stud. Residual	-2,406	2,318	-,001	1,005	129
Deleted Residual	-56,88424%	55,11435%	-0,03024%	23,93150%	129
Stud. Deleted Residual	-2,454	2,361	-,001	1,012	129
Mahal. Distance	,260	16,483	3,969	3,818	129
Cook's Distance	,000	,080	,009	,015	129
Centered Leverage Value	,002	,129	,031	,030	129

a. Dependent Variable: DIS_gen%







9.8.15 DISCgenR and RISK_Mgt: full sub-sample (132 companies)

In the following tables and charts, extracted from SPSS, the dependent variable DISCgenR was named DIS_gen%.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,276[a]	,076	,047	23,67562%	1,589

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

b. Dependent Variable: DIS_gen%

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5849,177	4	1462,294	2,609	,039[b]
	Residual	71187,964	127	560,535		
	Total	77037,141	131			

a. Dependent Variable: DIS_gen%

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	58,672	30,658		1,914	,058		
	RISK_MGT	-4,140	1,876	-,204	-2,207	,029	,853	1,172
	MEDIA	-,017	,010	-,158	-1,740	,084	,880	1,136
	SIZE	,054	1,419	,004	,038	,969	,771	1,297
	LEVERAGE	,070	,099	,061	,708	,481	,968	1,033

a. Dependent Variable: DIS_gen%

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIA	SIZE	LEVERAGE
1	1	3,976	1,000	,00	,01	,01	,00	,01
	2	,747	2,307	,00	,00	,87	,00	,01
	3	,191	4,564	,00	,08	,01	,00	,91
	4	,084	6,894	,01	,83	,00	,01	,03
	5	,002	42,557	,99	,08	,10	,99	,04

a. Dependent Variable: DIS_gen%

Casewise Diagnostics[a]

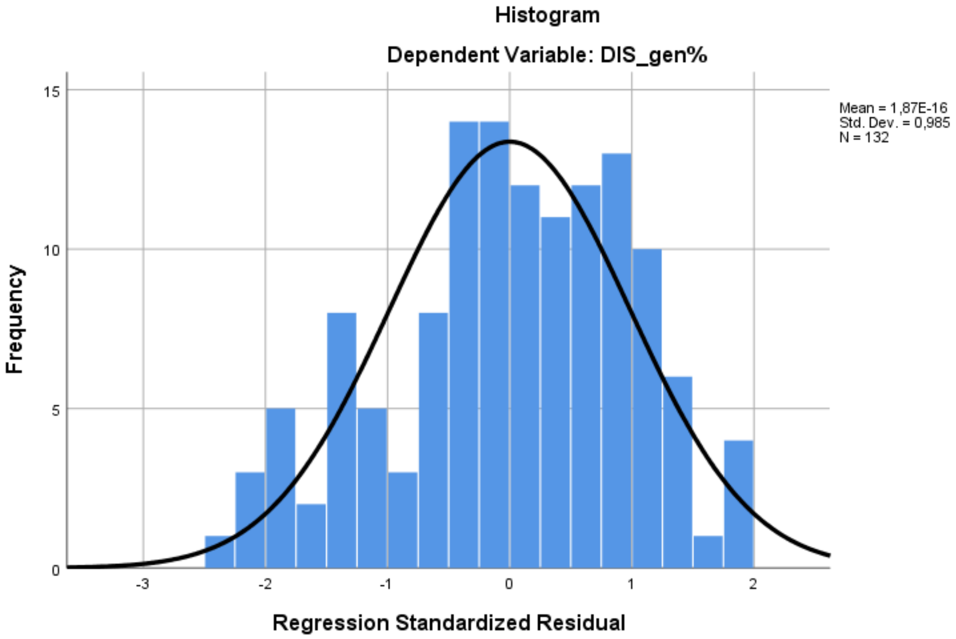
Case Number	Std. Residual	DIS_gen%	Predicted Value	Residual
92	-2,238	0,00%	52,9853%	-52,98533%
94	-2,111	0,00%	49,9792%	-49,97917%
99	-2,036	0,00%	48,2060%	-48,20605%
186	-2,295	0,00%	54,3391%	-54,33913%

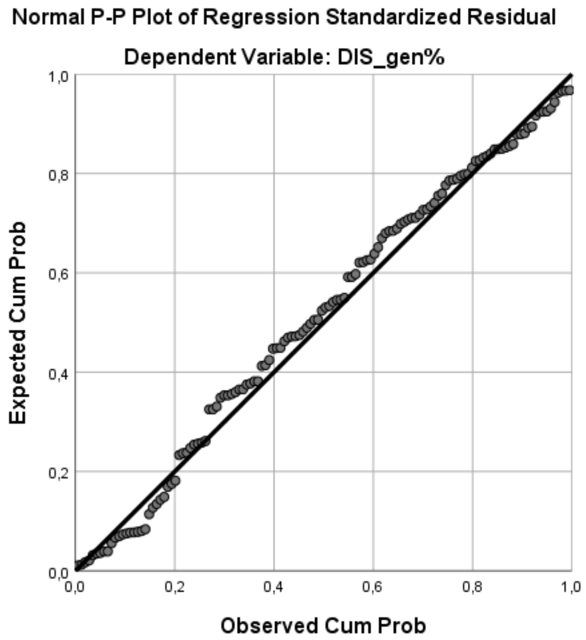
a. Dependent Variable: DIS_gen%

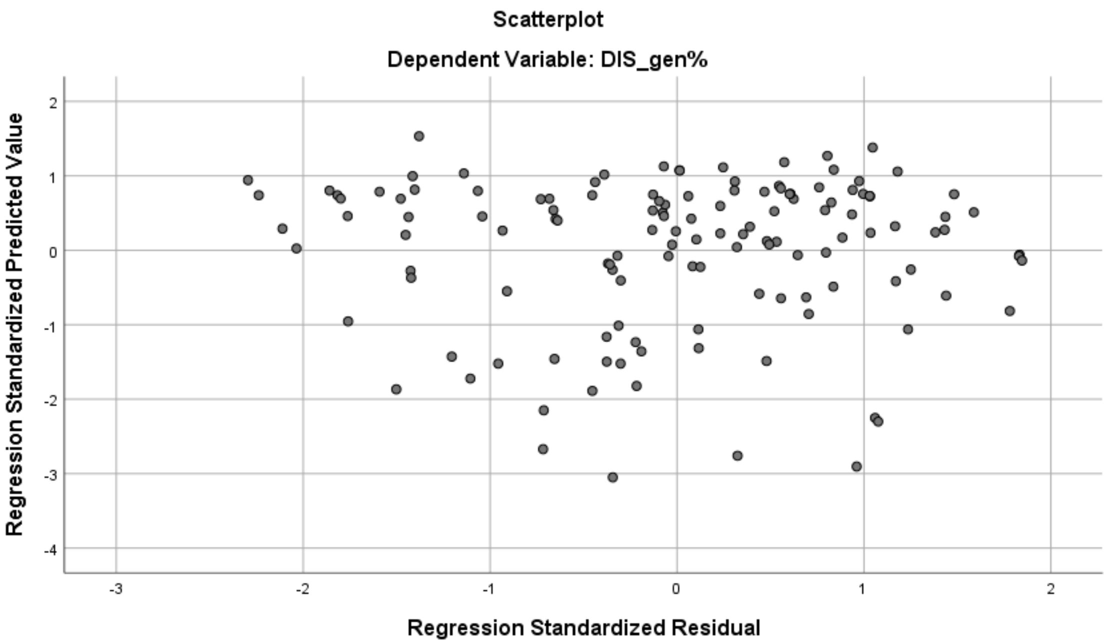
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	27,6618%	58,2825%	48,0419%	6,68208%	132
Std. Predicted Value	-3,050	1,533	,000	1,000	132
Standard Error of Predicted Value	2,378	11,909	4,246	1,798	132
Adjusted Predicted Value	26,1066%	61,2586%	48,1183%	6,88402%	132
Residual	-54,33913%	43,68781%	0,00000%	23,31136%	132
Std. Residual	-2,295	1,845	,000	,985	132
Stud. Residual	-2,321	1,877	-,002	1,006	132
Deleted Residual	-55,55012%	46,86496%	-0,07640%	24,36543%	132
Stud. Deleted Residual	-2,362	1,896	-,003	1,012	132
Mahal. Distance	,329	32,155	3,970	4,982	132
Cook's Distance	,000	,148	,009	,019	132
Centered Leverage Value	,003	,245	,030	,038	132

a. Dependent Variable: DIS_gen%







9.8.16 DISCgenR and RISK_Mgt: outliers removed (129 companies)

In the following tables and charts, extracted from SPSS, the dependent variable DISCgenR was named DIS_gen%.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,290[a]	,084	,055	23,48163%	1,609

a. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

b. Dependent Variable: DIS_gen%

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6279,177	4	1569,794	2,847	,027[b]
	Residual	68371,958	124	551,387		
	Total	74651,134	128			

a. Dependent Variable: DIS_gen%

b. Predictors: (Constant), LEVERAGE, MEDIA, RISK_MGT, SIZE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	61,480	38,756		1,586	,115		
	RISK_MGT	-4,310	1,910	-,215	-2,257	,026	,816	1,225
	MEDIA	-,016	,010	-,150	-1,592	,114	,832	1,202
	SIZE	-,114	1,818	-,006	-,063	,950	,701	1,426
	LEVERAGE	,112	,109	,089	1,028	,306	,989	1,011

a. Dependent Variable: DIS_gen%

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIA	SIZE	LEVERAGE
1	1	3,993	1,000	,00	,01	,01	,00	,01
	2	,753	2,302	,00	,00	,82	,00	,01
	3	,169	4,860	,00	,12	,02	,00	,90
	4	,083	6,941	,01	,75	,00	,01	,08
	5	,001	54,365	,99	,12	,15	,99	,00

a. Dependent Variable: DIS_gen%

Casewise Diagnostics[a]

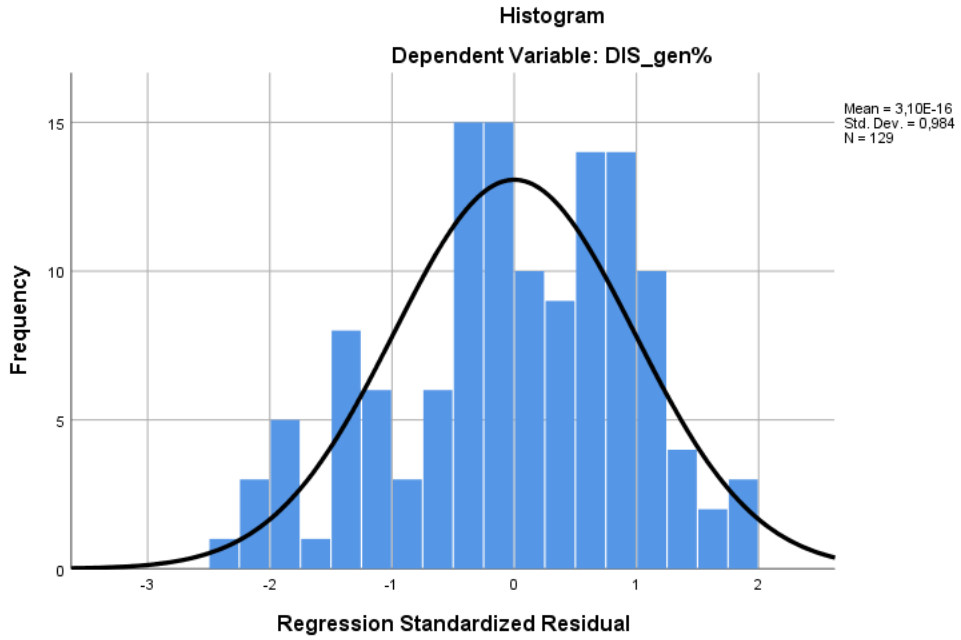
Case Number	Std. Residual	DIS_gen%	Predicted Value	Residual
92	-2,019	0,00%	47,4119%	-47,41191%
101	-2,347	0,00%	55,1105%	-55,11050%
117	-2,249	0,00%	52,8187%	-52,81874%
163	-2,108	0,00%	49,4888%	-49,48877%

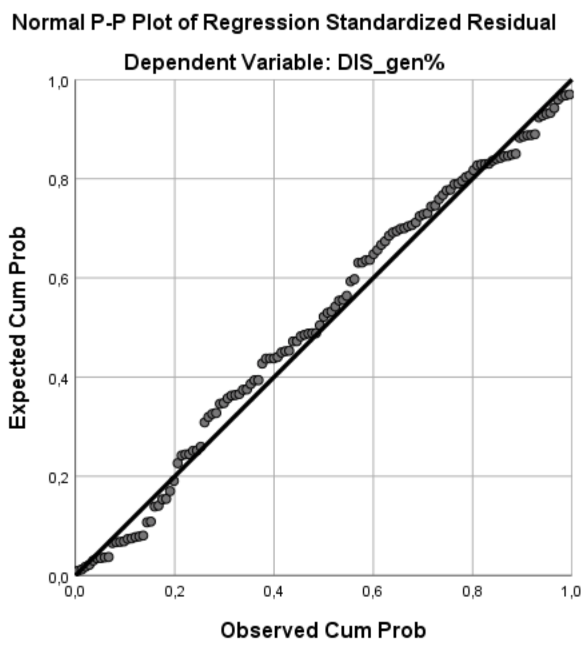
a. Dependent Variable: DIS_gen%

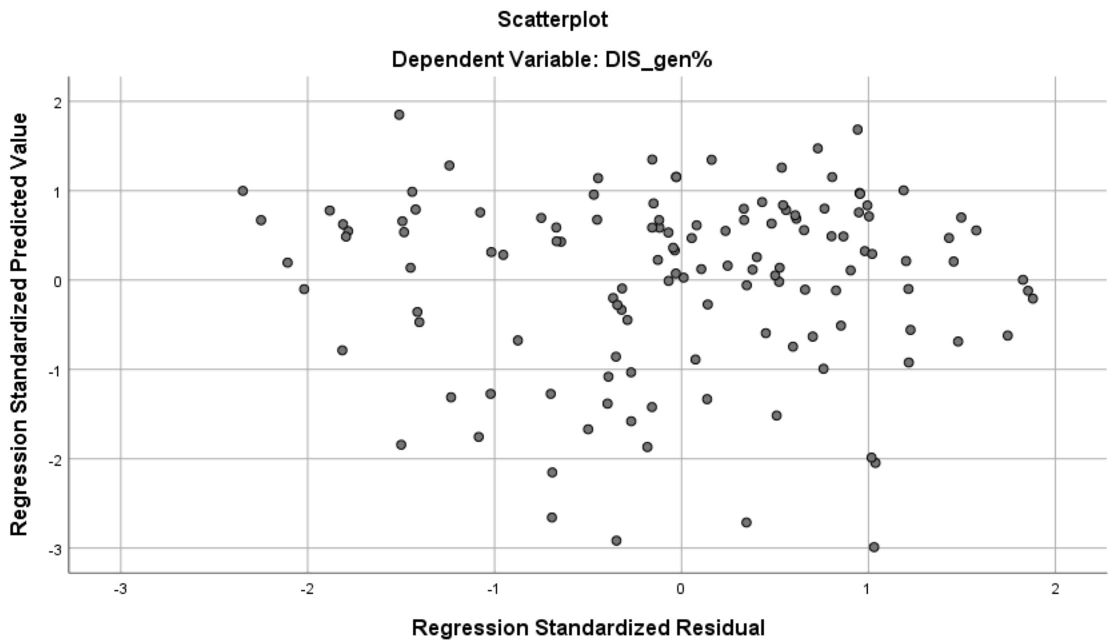
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	27,1865%	61,0824%	48,1237%	7,00400%	129
Std. Predicted Value	-2,989	1,850	,000	1,000	129
Standard Error of Predicted Value	2,388	9,073	4,340	1,598	129
Adjusted Predicted Value	24,0104%	64,9214%	48,2122%	7,14889%	129
Residual	-55,11050%	44,14121%	0,00000%	23,11181%	129
Std. Residual	-2,347	1,880	,000	,984	129
Stud. Residual	-2,384	1,895	-,002	1,005	129
Deleted Residual	-56,86123%	45,88227%	-0,08847%	24,11712%	129
Stud. Deleted Residual	-2,431	1,916	-,003	1,011	129
Mahal. Distance	,331	18,117	3,969	3,863	129
Cook's Distance	,000	,082	,009	,015	129
Centered Leverage Value	,003	,142	,031	,030	129

a. Dependent Variable: DIS_gen%




Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DIS_gen%
Expected Cum Prob
Observed Cum Prob
0,0
0,2
0,4
0,6
0,8
1,0


Scatterplot
Dependent Variable: DIS_gen%
Regression Standardized Predicted Value
Regression Standardized Residual
-3
-2
-1
0
1
2

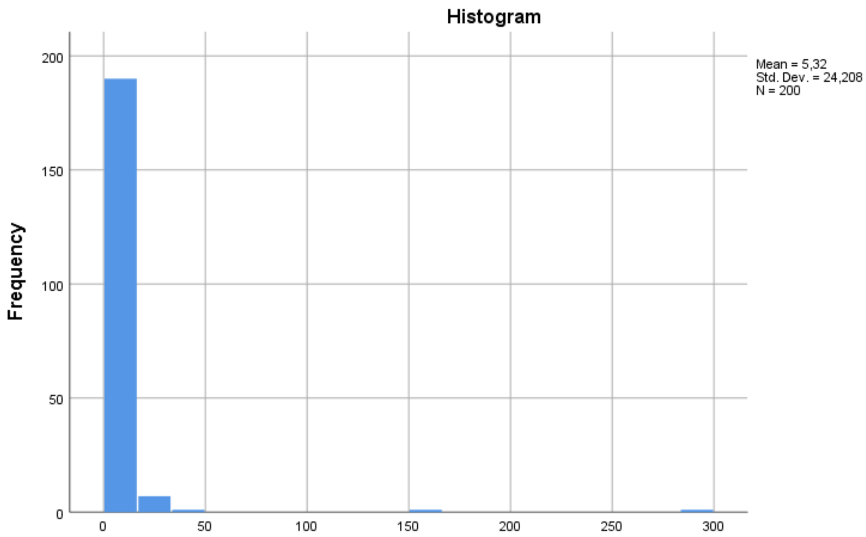
9.9 Sensitivity analysis: Alternative measure of GHG media visibility

9.9.1 Descriptive statistics for media visibility focused on printed sources

Descriptive statistics for the alternative measure of GHG emissions media visibility, collected from ABI/Inform Global based on newspapers, trade journals and magazines, are presented below. Firstly, the statistics for the full sample are presented, composed of 200 companies, employed in the logistic regressions. These are followed by the statistics for the sub-sample, composed of 132 companies, employed in the OLS multiple regressions. The mean for the sub-sample is slightly higher than for the full sample (6.77 vs 5.32), while skewness and kurtosis are reduced in the sub-sample, but remaining far away from normality in both samples.

Table 9.3: Descriptive statistics of the alternative measure of media for the full sample (200 companies)

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
MEDIAalt	200	0	291	5.32	24.20	9.85	107.27



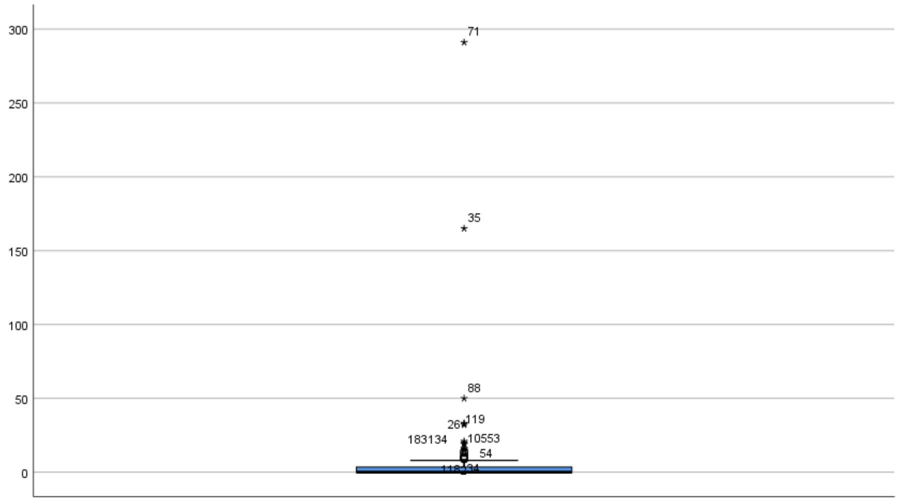
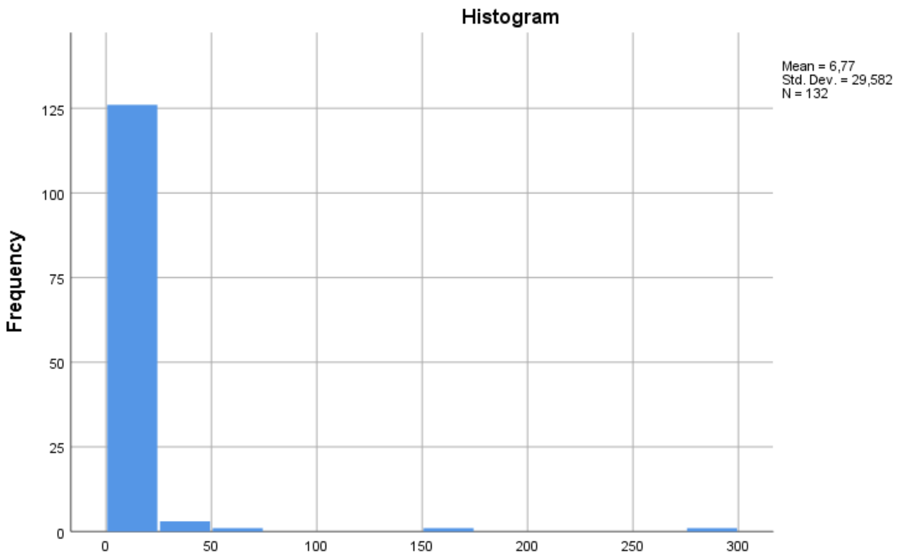
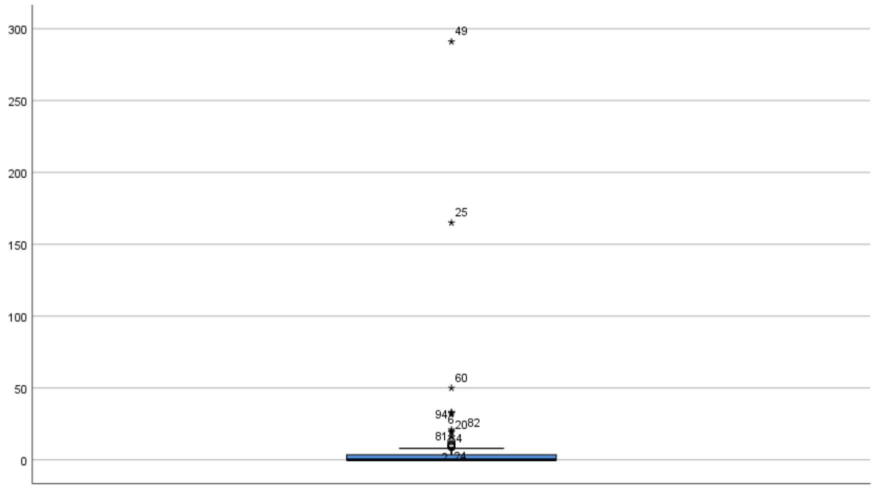


Table 9.4: Descriptive statistics of the alternative measure of media for the sub-sample (132 companies)

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
MEDIAalt	132	0	291	6.77	29.58	8.09	71.63





9.9.2 Logistic regressions: Diagnostics

9.9.2.1 Extent of media visibility

Two residuals were identified outside 1.96 standard deviations in the logistic regression model with the RISK variable, and only one in the model risk RISK_MGT, which is perfectly acceptable in a normal distribution composed of 200 cases (up to 5%, which means up to 10 cases). As presented in the next table, several observations presented leverage values above 0.075, calculated as 3 times (k+1)/N, where k is the number of predictors and N is the sample size (Field, 2013, p. 791), in this case, (4+1)/200=0.025.

Table 9.5: Leverage values above expectation (0.075) in the logistic regression models

Model	**RISK (1a)**	**RISK_Mgt (1b)**
Leverage	0.0759	0.0933
	0.0961	0.1324
	0.1226	0.1686
	0.1676	0.1729
	0.1808	0.1837
	0.1857	0.1990
	0.2002	

Nevertheless, the maximum value for Cook's distance in the regression employing the risk variable was 0.324, while in the equation employing risk management it was 0.263, both considerably lower than 1. Therefore, there was no reason for concern regarding influential cases based on this measure.

9.9.2.2 Media visibility considering printed sources only

No residual was identified outside 1.96 standard deviations in both logistic regression models using the alternative measure of media visibility. As presented in the next table, several observations presented leverage values above 0.075, calculated as 3 times (k+1)/N, where k is the number of predictors and N is the sample size (Field, 2013, p. 791), in this case, (4+1)/200=0.025.

Table 9.6: Leverage values above expectation (0.075) in the logistic regression models

Model	**RISK (1a)**	**RISK_Mgt (1b)**
Leverage	0.189	0.188
	0.179	0.172
	0.174	0.166
	0.164	0.160
	0.154	0.152
	0.146	0.147
	0.146	0.128
	0.078	0.091
	0.077	0.091
	0.077	0.084
	0.076	0.080
		0.078
		0.076

Nevertheless, the maximum value for Cook's distance in the regression employing the risk variable was 0.558, while in the equation employing risk management it was 0.484, both considerably lower than 1. Therefore, there was no reason for concern regarding influential cases based on this measure.

9.9.3 Logistic regression: SPSS report using RISK

9.9.3.1 Extent of media visibility

Dependent Variable Encoding

Original Value	Internal Value
0	0
1	1

Classification Table[a,b]

Observed			Predicted DISC_GHG 0	Predicted DISC_GHG 1	Percentage Correct
Step 0	DISC_GHG	0	0	68	,0
		1	0	132	100,0
	Overall Percentage				66,0

a. Constant is included in the model.

b. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	,663	,149	19,745	1	,000	1,941

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	RISK	3,343	1	,067
		MEDIA_ABI_categories_full_sample	8,514	1	,004
		SIZE	2,318	1	,128
		LEVERAGE	,008	1	,928
	Overall Statistics		16,416	4	,003

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	16,687	4	,002
	Block	16,687	4	,002
	Model	16,687	4	,002

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	239,727[a]	,080	,111

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	8,214	8	,413

Classification Table[a]

Observed			Predicted DISC_GHG 0	Predicted DISC_GHG 1	Percentage Correct
Step 1	DISC_GHG	0	19	49	27,9
		1	10	122	92,4
	Overall Percentage				70,5

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	RISK	,217	,079	7,478	1	,006	1,243	1,063	1,452
	MEDIA_ABI_categories_full_sample	,498	,168	8,756	1	,003	1,646	1,183	2,290
	SIZE	,095	,092	1,057	1	,304	1,099	,918	1,317
	LEVERAGE	-,001	,006	,010	1	,921	,999	,987	1,012
	Constant	-2,159	1,933	1,247	1	,264	,115		

a. Variable(s) entered on step 1: RISK, MEDIA_ABI_categories_full_sample, SIZE, LEVERAGE.

9.9.3.2 Media visibility considering printed sources only

Dependent Variable Encoding

Original Value	Internal Value
N	0
Y	1

Block 0: Beginning Block

Classification Table[a,b]

Observed			Predicted DISC_GHG N	Predicted DISC_GHG Y	Percentage Correct
Step 0	DISC_GHG	N	0	68	,0
		Y	0	132	100,0
	Overall Percentage				66,0

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	,663	,149	19,745	1	,000	1,941

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	RISK	3,343	1	,067
		MEDIAalt	1,395	1	,237
		SIZE	2,318	1	,128
		LEVERAGE	,008	1	,928
	Overall Statistics		8,544	4	,074

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	9,380	4	,052
	Block	9,380	4	,052
	Model	9,380	4	,052

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	247,034[a]	,046	,063

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	8,640	8	,374

Classification Table[a]

			Predicted		
			DISC_GHG		Percentage Correct
Observed			N	Y	
Step 1	DISC_GHG	N	10	58	14,7
		Y	8	124	93,9
	Overall Percentage				67,0

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	RISK	,183	,077	5,693	1	,017	1,201	1,033	1,396
	MEDIAalt	,023	,025	,799	1	,371	1,023	,974	1,075
	SIZE	,135	,093	2,108	1	,146	1,145	,954	1,375
	LEVERAGE	,002	,006	,125	1	,724	1,002	,990	1,015
	Constant	-2,017	2,017	1,000	1	,317	,133		

a. Variable(s) entered on step 1: RISK, MEDIAalt, SIZE, LEVERAGE.

9.9.4 Logistic regression: SPSS report using RISK_Mgt

9.9.4.1 Extent of media visibility

Dependent Variable Encoding

Original Value	Internal Value
0	0
1	1

Block 0: Beginning Block

Classification Table[a,b]

Observed			Predicted DISC_GHG 0	Predicted DISC_GHG 1	Percentage Correct
Step 0	DISC_GHG	0	0	68	,0
		1	0	132	100,0
	Overall Percentage				66,0

a. Constant is included in the model.

b. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	,663	,149	19,745	1	,000	1,941

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	RISK_MGT	,985	1	,321
		MEDIA_ABI_categories_full_sample	8,514	1	,004
		SIZE	2,318	1	,128
		LEVERAGE	,008	1	,928
	Overall Statistics		13,200	4	,010

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	13,540	4	,009
	Block	13,540	4	,009
	Model	13,540	4	,009

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	242,874[a]	,065	,091

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	6,785	8	,560

Classification Table[a]

	Observed		Predicted DISC_GHG 0	Predicted DISC_GHG 1	Percentage Correct
Step 1	DISC_GHG	0	12	56	17,6
		1	9	123	93,2
	Overall Percentage				67,5

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	RISK_MGT	-,273	,127	4,582	1	,032	,761	,593	,977
	MEDIA_ABI_categories_full_sample	,471	,167	7,969	1	,005	1,602	1,155	2,221
	SIZE	,118	,097	1,469	1	,226	1,125	,930	1,362
	LEVERAGE	-,002	,006	,104	1	,747	,998	,986	1,010
	Constant	-2,275	1,976	1,324	1	,250	,103		

a. Variable(s) entered on step 1: RISK_MGT, MEDIA_ABI_categories_full_sample, SIZE, LEVERAGE.

9.9.4.2 Media visibility considering printed sources only

Dependent Variable Encoding

Original Value	Internal Value
N	0
Y	1

Block 0: Beginning Block

Classification Table[a,b]

Observed			Predicted DISC_GHG N	Y	Percentage Correct
Step 0	DISC_GHG	N	0	68	,0
		Y	0	132	100,0
	Overall Percentage				66,0

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	,663	,149	19,745	1	,000	1,941

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	RISK_MGT	,985	1	,321
		MEDIAalt	1,395	1	,237
		SIZE	2,318	1	,128
		LEVERAGE	,008	1	,928
	Overall Statistics		6,236	4	,182

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	7,323	4	,120
	Block	7,323	4	,120
	Model	7,323	4	,120

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	249,091[a]	,036	,050

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than ,001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4,581	8	,801

Classification Table[a]

Observed			Predicted: DISC_GHG N	Predicted: DISC_GHG Y	Predicted: Percentage Correct
Step 1	DISC_GHG	N	5	63	7,4
		Y	6	126	95,5
	Overall Percentage				65,5

a. The cut value is ,500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	RISK_MGT	-,243	,126	3,750	1	,053	,784	,613	1,003
	MEDIAalt	,026	,027	,917	1	,338	1,026	,973	1,083
	SIZE	,149	,097	2,393	1	,122	1,161	,961	1,403
	LEVERAGE	,001	,006	,024	1	,878	1,001	,989	1,014
	Constant	-2,013	2,029	,984	1	,321	,134		

a. Variable(s) entered on step 1: RISK_MGT, MEDIAalt, SIZE, LEVERAGE.

9.9.5 OLS multiple regressions: Preliminary analysis and assumptions

9.9.5.1 Extent of media visibility

The following tables summarise the maximum values related to each parameter assessed, confirming that the regression models meet the assumptions, after the influential cases were removed. When Mahalanobis distance was higher than expected, but corresponding Cook's value and standardised DFBeta were within the thresholds, the cases were retained, as there was little reason to remove them. As a consequence, there was no need to remove cases in any regression.

Table 9.7: Residuals outside 2 standard deviations in the OLS regression models

Dependent variable	**DISC_Gen**		**DISC_Spe**		**DISC_Tot**		**DISCgenR**	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Residuals outside 2 standard deviations	4 residuals	5 residuals	5 residuals	4 residuals	5 residuals	2 residuals	3 residuals	2 residuals
	2.867	2.200	4.132	4.163	2.362	2.570	-2.310	-2,263
	2.826	2.165	2.078	2.075	2.078	2.566	2.380	-2,192
	2.191	2.044	2.134	2.009	2.123		2.362	
	2.187	2.667	2.128	2.460	2.050			
		2.663	2.478		2.045			

Table 9.8: Maximum values for Cook's distance in the OLS regression models

Dependent variable	**DISC_Gen**		**DISC_Spe**		**DISC_Tot**		**DISCgenR**	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Cook's distance	0.089	0.124	0.207	0.241	0.069	0.096	0.154	0.168

Table 9.9: Maximum Mahalanobis distance observed in the OLS regression models

Dependent variable	**DISC_Gen**		**DISC_Spe**		**DISC_Tot**		**DISCgenR**	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Mahalanobis	33.701	32.224	33.701	32.224	33.701	32.22	33.701	32.224

Table 9.10: Maximum absolute values for Standardised DfBeta in the OLS regression models

Dependent variable	**DISC_Gen**		**DISC_Spe**		**DISC_Tot**		**DISCgenR**	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Standardised DfBeta	0.658	0.770	-0.819	-0.807	0.553	0.675	0.836	0.845

Table 9.11: Maximum values for VIF in the OLS regression models

Dependent variable	**DISC_Gen**		**DISC_Spe**		**DISC_Tot**		**DISCgenR**	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*

VIF	1.327	1.343	1.327	1.343	1.327	1.343	1.327	1.343

Table 9.12: Durbin-Watson values in the OLS regression models

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Durbin-Watson	1.743	1.785	1.948	1.749	1.491	1.635	1.926	1.824

9.9.5.2 Media visibility considering printed sources only

In order to meet regression assumption, some influential cases were removed, based on Cook's distance and standardised DFBeta, as detailed in the table below.

Table 9.13: Outliers and influential cases removed to meet regression assumptions

Dependent variable	DISC_Gen	DISC_Spe	DISC_Tot	DISCgenR
Outliers and influential cases removed	No cases removed	71, Exxon Mobil 35, Chevron	35, Chevron 71, Exxon Mobil 11, Antero Midstream Partner:	71, Exxon Mobil

The following tables summarise the maximum values related to each parameter assessed, confirming that the regression models meet the assumptions, after the influential cases were removed. When Mahalanobis distance was higher than expected, but corresponding Cook's value and standardised DFBeta were within the thresholds, the cases were retained as there was little reason to remove them.

Table 9.14: Residuals outside 2 standard deviations in the OLS regression models

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Residuals outside 2 standard deviations	4 residuals 2.214 2.219 2.770 2.727	5 residuals 2.165 2.131 2.039 2.671 2.667	6 residuals 2.453 2.306 2.452 2.148 2.139 2.016	4 residuals 2.461 2.386 2.319 2.039	3 residuals 2.614 2.108 2.104	4 residuals 2.020 2.615 2.611 2.129	4 residuals -2.374 -2.028 2.298 2.319	2 residuals -2.190 -2.262

Table 9.15: Maximum values for Cook's distance in the OLS regression models

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Cook's distance	0.154	0.166	0.090	0.097	0.110	0.088	0.125	0,132

Table 9.16: Maximum Mahalanobis distance observed in the OLS regression models

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Mahalanobis	93.604	93.953	41.008	41.375	42.583	42.785	101.947	102.308

Table 9.17: Maximum absolute values for Standardised DfBeta in the OLS regression models

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Standardised DfBeta	0.865	0.902	0.618	0.680	0.725	0.636	0.780	0.792

Table 9.18: Maximum values for VIF in the OLS regression models

Dependent variable	DISC_Gen		DISC_Spe		DISC_Tot		DISCgenR	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
VIF	1.259	1.269	1.259	1.195	1.270	1.281	1.223	1.226

Table 9.19: Durbin-Watson values in the OLS regression models

Dependent variable	**DISC_Gen**		**DISC_Spe**		**DISC_Tot**		**DISCgenR**	
Model	*RISK (2a)*	*RISK_Mgt (2b)*	*RISK (3a)*	*RISK_Mgt (3b)*	*RISK (4a)*	*RISK_Mgt (4b)*	*RISK (5a)*	*RISK_Mgt (5b)*
Durbin-Watson	1.971	1.970	1.911	1.881	1.839	1.566	1.682	1,497

All the models met the assumptions of linearity, homoscedasticity and normality of errors, as the charts available in the next sections demonstrate.

9.9.6 OLS multiple regression: SPSS report DISC_Gen and RISK

9.9.6.1 Extent of media visibility

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,390[a]	,152	,125	239,586	1,743

a. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIA_ABI_categories_sub_sample

b. Dependent Variable: DISC_gen

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1304010,060	4	326002,515	5,679	,000[b]
	Residual	7290000,932	127	57401,582		
	Total	8594010,992	131			

a. Dependent Variable: DISC_gen

b. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIA_ABI_categories_sub_sample

Coefficients[a]

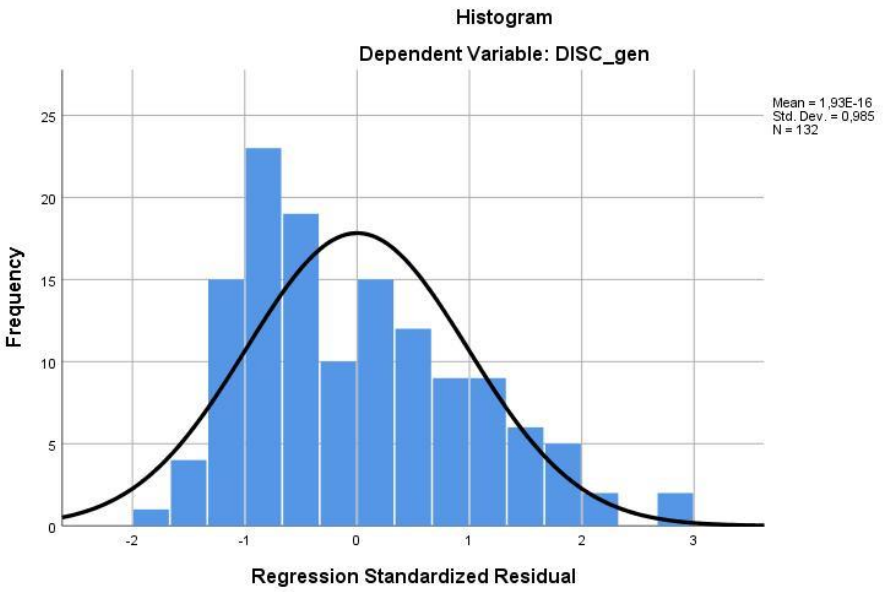
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	172,070	304,609		,565	,573		
	RISK	53,313	11,752	,411	4,536	,000	,815	1,228
	MEDIA_ABI_categories_sub_sample	27,119	24,900	,103	1,089	,278	,753	1,327
	SIZE	4,897	14,252	,032	,344	,732	,783	1,277
	LEVERAGE	1,808	1,025	,150	1,763	,080	,926	1,080

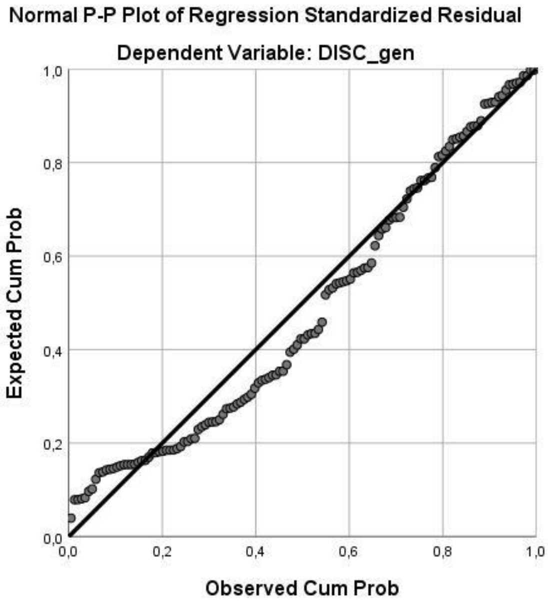
a. Dependent Variable: DISC_gen

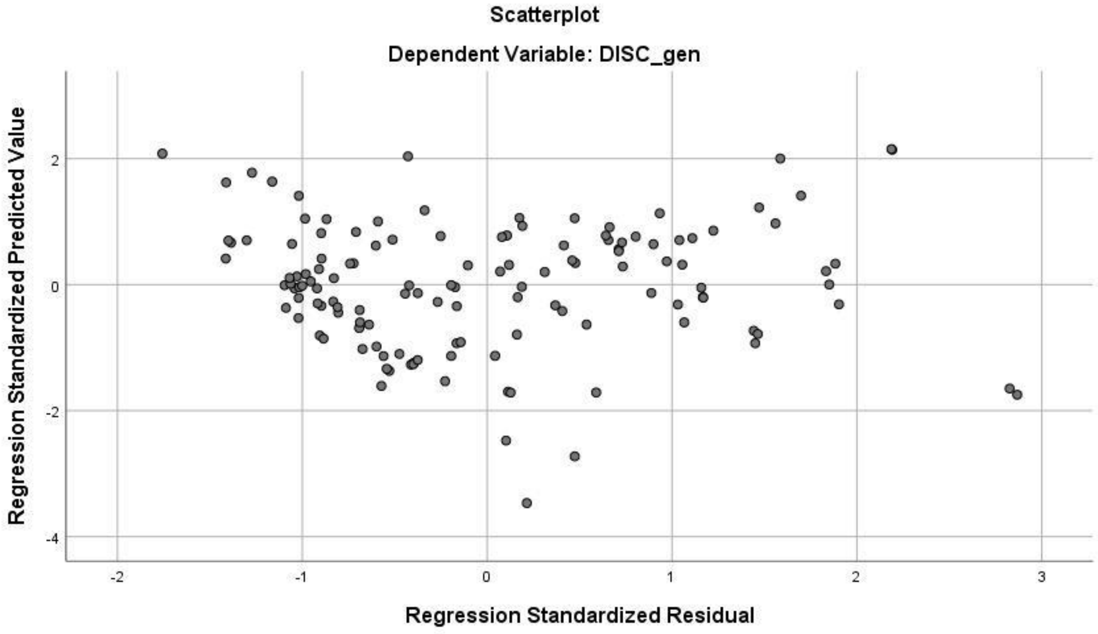
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIA_ABI_categories_sub_sample	SIZE	LEVERAGE
1	1	4,439	1,000	,00	,01	,00	,00	,01
	2	,313	3,767	,00	,84	,00	,00	,07
	3	,183	4,920	,00	,03	,03	,00	,86
	4	,063	8,391	,01	,07	,89	,01	,00
	5	,002	44,368	,98	,05	,07	,99	,06

a. Dependent Variable: DISC_gen







9.9.6.2 Media visibility considering printed souces only

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,389[a]	,151	,124	239,684	1,971

a. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIAalt

b. Dependent Variable: DISC_gen

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1298034,047	4	324508,512	5,649	,000[b]
	Residual	7295976,945	127	57448,637		
	Total	8594010,992	131			

a. Dependent Variable: DISC_gen

b. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIAalt

Coefficients[a]

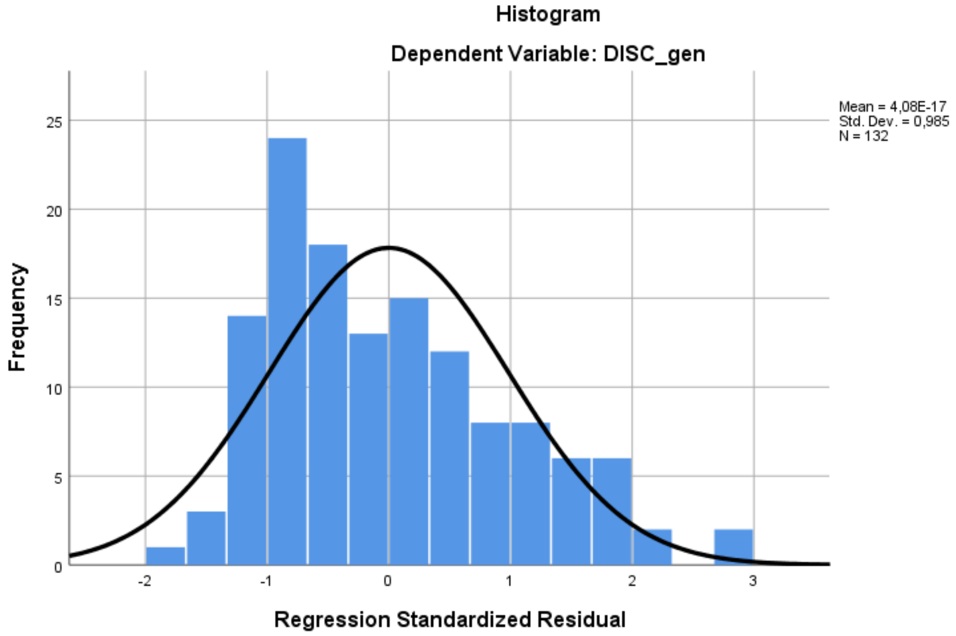
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	19,061	314,488		,061	,952		
	RISK	49,126	11,414	,379	4,304	,000	,864	1,157
	MEDIAalt	-,797	,766	-,092	-1,040	,300	,853	1,172
	SIZE	14,797	14,159	,096	1,045	,298	,794	1,259
	LEVERAGE	1,888	1,015	,156	1,860	,065	,944	1,059

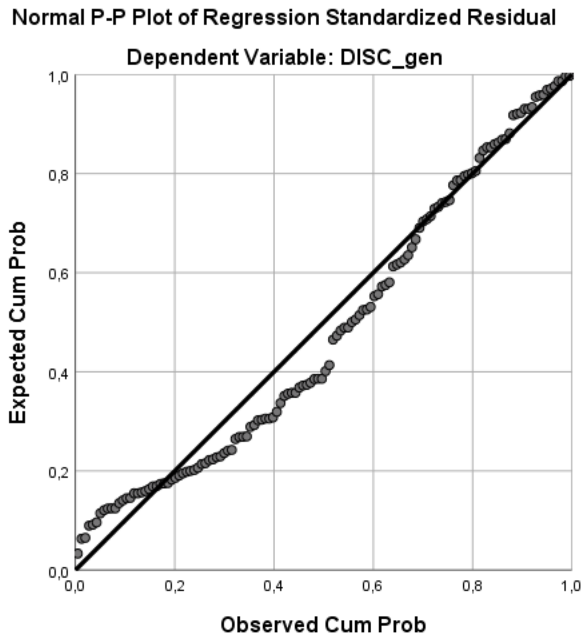
a. Dependent Variable: DISC_gen

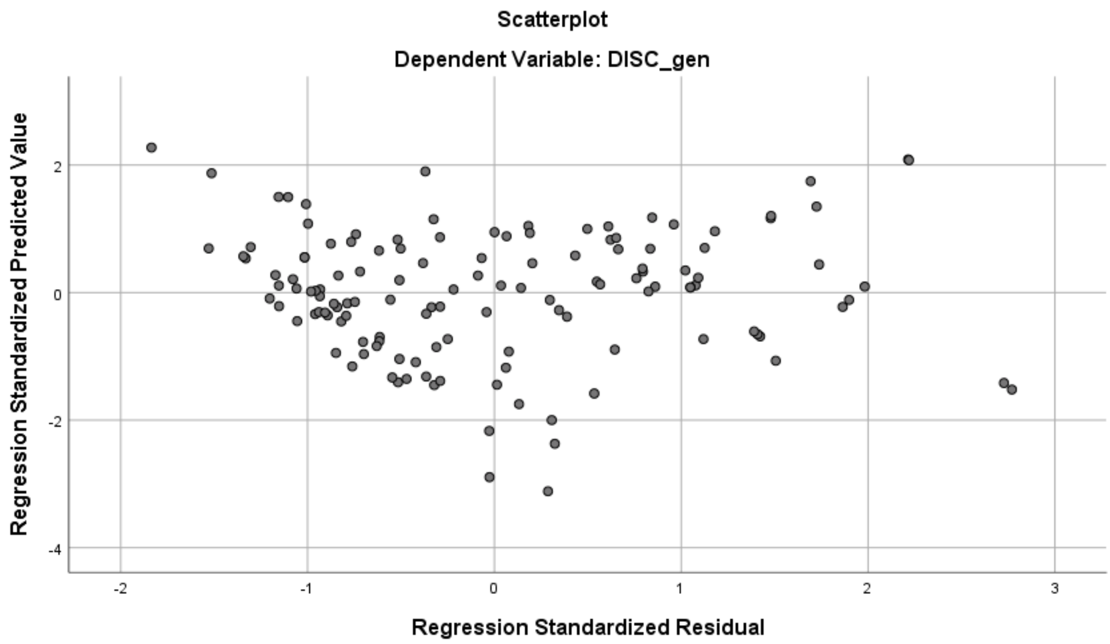
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK	MEDIAalt	SIZE	LEVERAGE
1	1	3,590	1,000	,00	,02	,01	,00	,01
	2	,942	1,952	,00	,00	,81	,00	,01
	3	,300	3,460	,00	,91	,05	,00	,06
	4	,165	4,660	,00	,01	,04	,00	,89
	5	,002	40,488	,99	,07	,10	,99	,02

a. Dependent Variable: DISC_gen







9.9.7 OLS multiple regression: SPSS report DISC_Gen and RISK_Mgt

9.9.7.1 Extent of media visibility

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson

1	,297[a]	,088	,059	248,429	1,785

a. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIA_ABI_categories_sub_sample

b. Dependent Variable: DISC_gen

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	755979,567	4	188994,892	3,062	,019[b]
	Residual	7838031,425	127	61716,783		
	Total	8594010,992	131			

a. Dependent Variable: DISC_gen

b. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIA_ABI_categories_sub_sample

Coefficients[a]

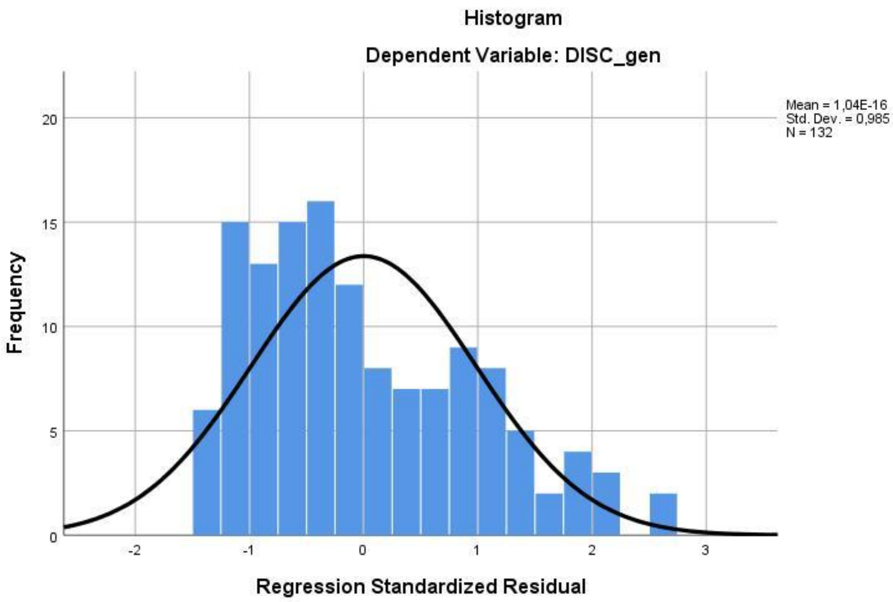
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	283,480	313,805		,903	,368		
	RISK_MGT	-63,327	19,769	-,295	-3,203	,002	,846	1,182
	MEDIA_ABI_categories_sub_sample	6,491	25,105	,025	,259	,796	,797	1,255
	SIZE	5,728	15,154	,037	,378	,706	,745	1,343
	LEVERAGE	1,617	1,062	,134	1,523	,130	,928	1,078

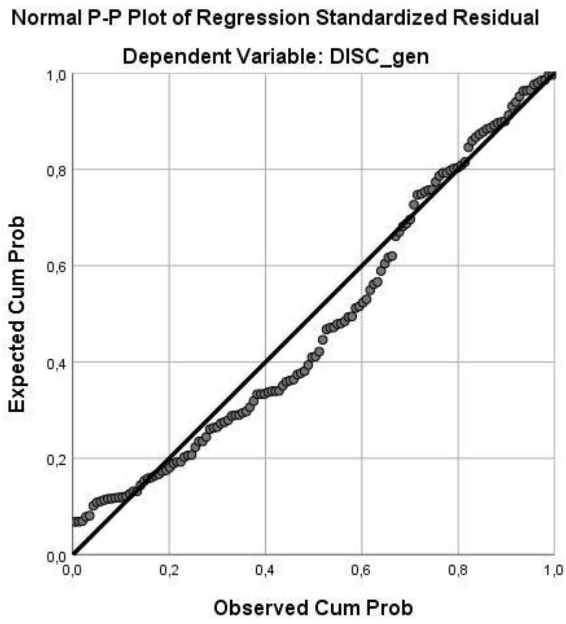
a. Dependent Variable: DISC_gen

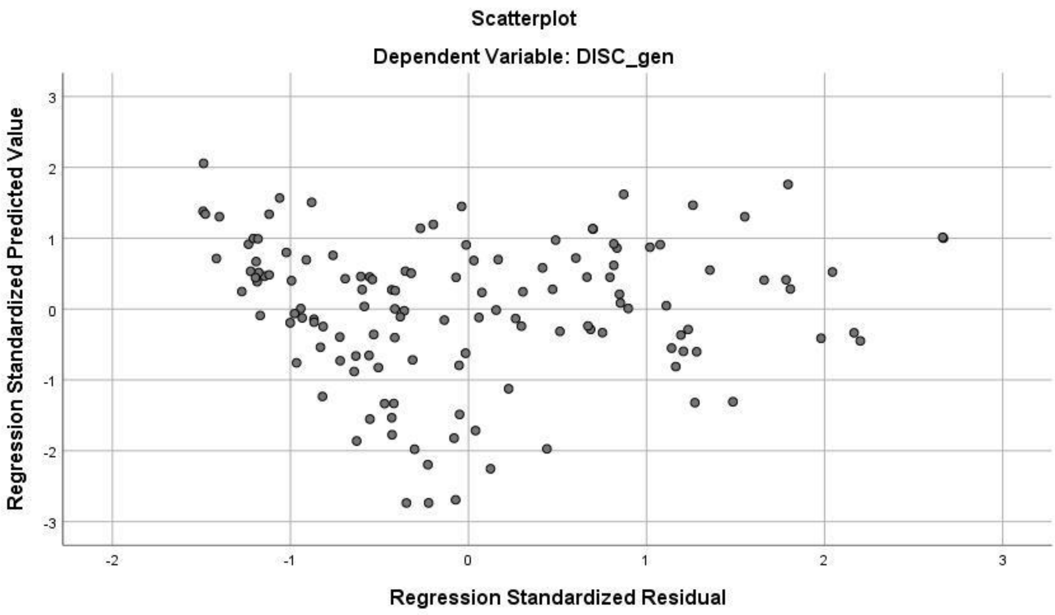
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIA_ABI_categories_sub_sample	SIZE	LEVERAGE
1	1	4,641	1,000	,00	,00	,00	,00	,01
	2	,198	4,838	,00	,05	,01	,00	,91
	3	,092	7,084	,00	,81	,22	,00	,02
	4	,066	8,411	,02	,07	,67	,01	,00
	5	,002	45,777	,98	,06	,09	,99	,06

a. Dependent Variable: DISC_gen


Histogram
Dependent Variable: DISC_gen
Mean = 1,04E-16
Std. Dev. = 0,985
N = 132
Frequency
20
15
10
5
0
-2
-1
0
1
2
3
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DISC_gen
Expected Cum Prob
1,0
0,8
0,6
0,4
0,2
0,0
0,0
0,2
0,4
0,6
0,8
1,0
Observed Cum Prob



9.9.7.2 Media visibility considering printed sources only

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,304[a]	,092	,064	247,856	1,970

a. Predictors: (Constant), LEVERAGE, SIZE, MEDIAalt, RISK_MGT

b. Dependent Variable: DISC_gen

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	792066,507	4	198016,627	3,223	,015[b]
	Residual	7801944,485	127	61432,634		
	Total	8594010,992	131			

a. Dependent Variable: DISC_gen

b. Predictors: (Constant), LEVERAGE, SIZE, MEDIAalt, RISK_MGT

Coefficients[a]

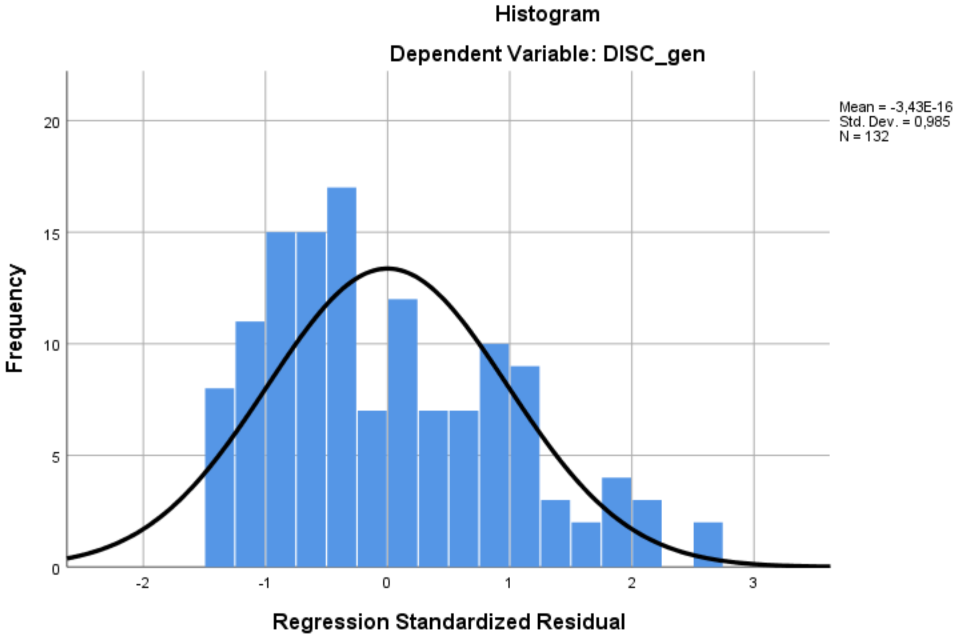
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	190,653	319,896		,596	,552		
	RISK_MGT	-60,062	19,925	-,280	-3,014	,003	,829	1,207
	MEDIAalt	-,649	,802	-,075	-,809	,420	,833	1,200
	SIZE	10,529	14,697	,068	,716	,475	,788	1,269
	LEVERAGE	1,567	1,045	,130	1,500	,136	,954	1,048

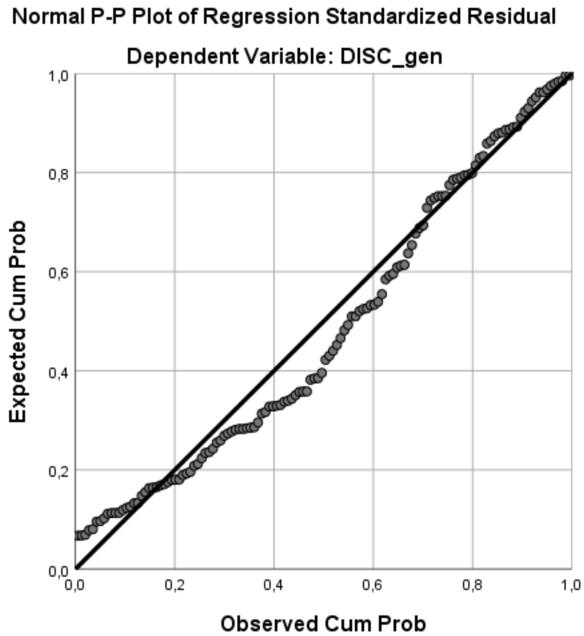
a. Dependent Variable: DISC_gen

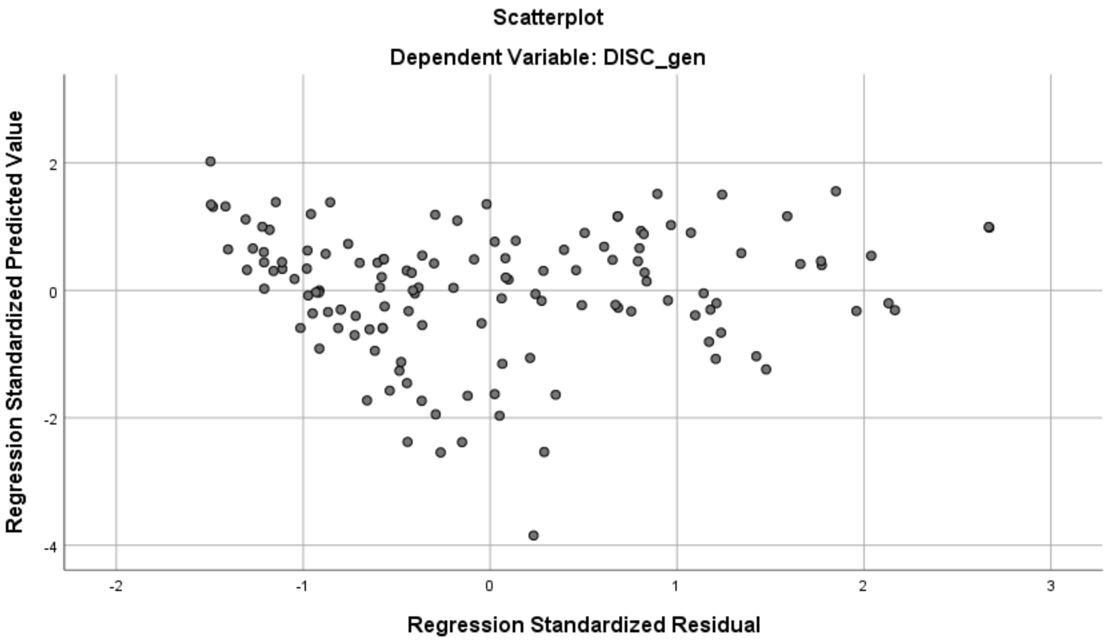
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK_MGT	MEDIAalt	SIZE	LEVERAGE
1	1	3,795	1,000	,00	,01	,01	,00	,01
	2	,942	2,008	,00	,00	,80	,00	,01
	3	,180	4,594	,00	,07	,07	,00	,95
	4	,081	6,846	,01	,88	,04	,01	,01
	5	,002	41,268	,99	,05	,08	,99	,02

a. Dependent Variable: DISC_gen







9.9.8 OLS multiple regression: SPSS report DISC_Spe and RISK

9.9.8.1 Extent of media visibility

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,269[a]	,072	,043	108,581	1,948

a. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIA_ABI_categories_sub_sample

b. Dependent Variable: DISC_spe

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	116902,195	4	29225,549	2,479	,047[b]
	Residual	1497299,138	127	11789,757		
	Total	1614201,333	131			

a. Dependent Variable: DISC_spe

b. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIA_ABI_categories_sub_sample

Coefficients[a]

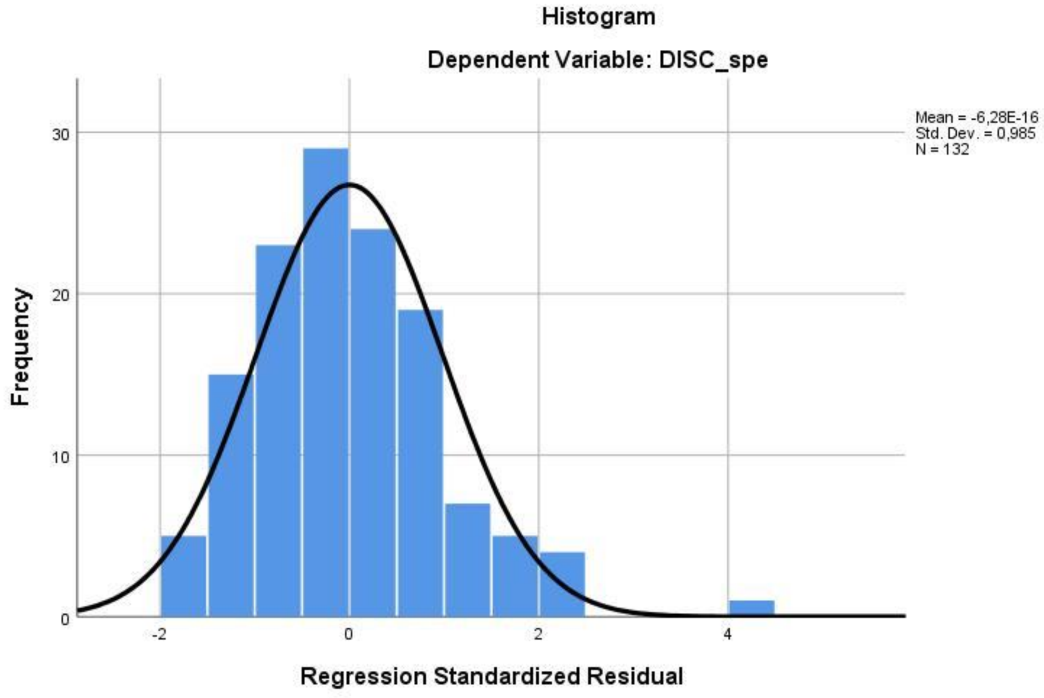
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-53,882	138,049		-,390	,697		
	RISK	12,174	5,326	,216	2,286	,024	,815	1,228
	MEDIA_ABI_categories_sub_sample	16,766	11,285	,146	1,486	,140	,753	1,327
	SIZE	11,119	6,459	,166	1,722	,088	,783	1,277
	LEVERAGE	,448	,465	,086	,964	,337	,926	1,080

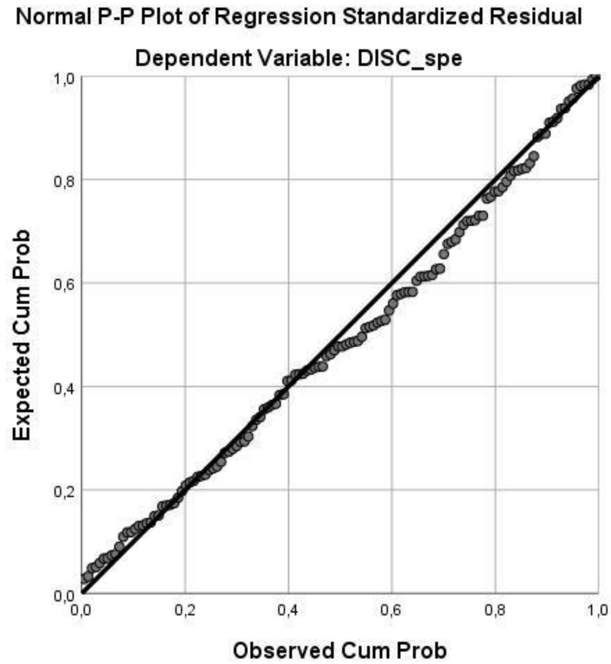
a. Dependent Variable: DISC_spe

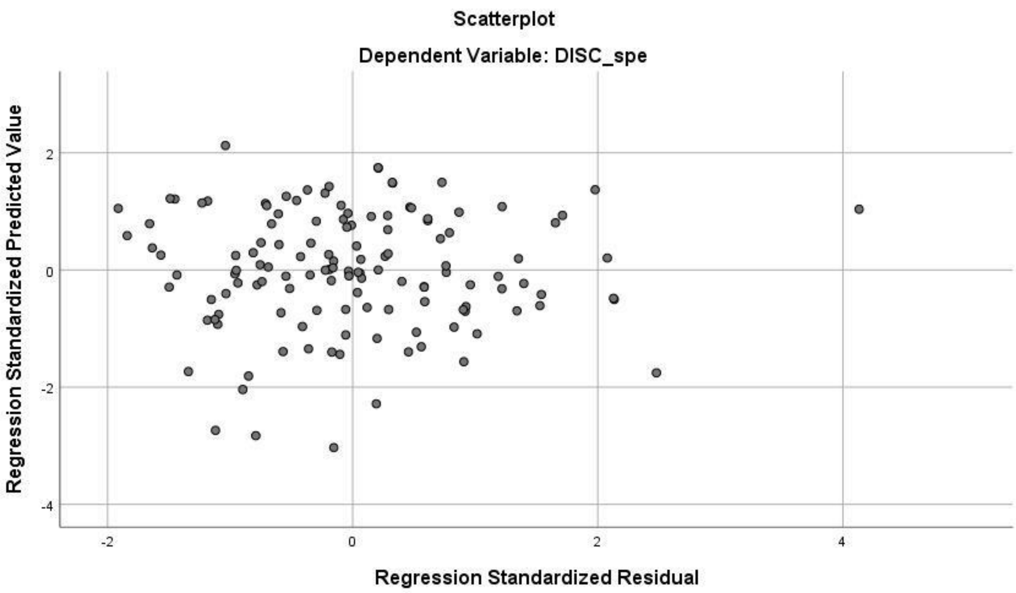
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIA_ABI_categories_sub_sample	SIZE	LEVERAGE
1	1	4,439	1,000	,00	,01	,00	,00	,01
	2	,313	3,767	,00	,84	,00	,00	,07
	3	,183	4,920	,00	,03	,03	,00	,86
	4	,063	8,391	,01	,07	,89	,01	,00
	5	,002	44,368	,98	,05	,07	,99	,06

a. Dependent Variable: DISC_spe







9.9.8.2 *Media visibility considering printed sources only*

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,237[a]	,056	,027	109,519	1,911

a. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIAalt

b. Dependent Variable: DISC_spe

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	90912,537	4	22728,134	1,895	,115[b]
	Residual	1523288,796	127	11994,400		
	Total	1614201,333	131			

a. Dependent Variable: DISC_spe

b. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIAalt

Coefficients[a]

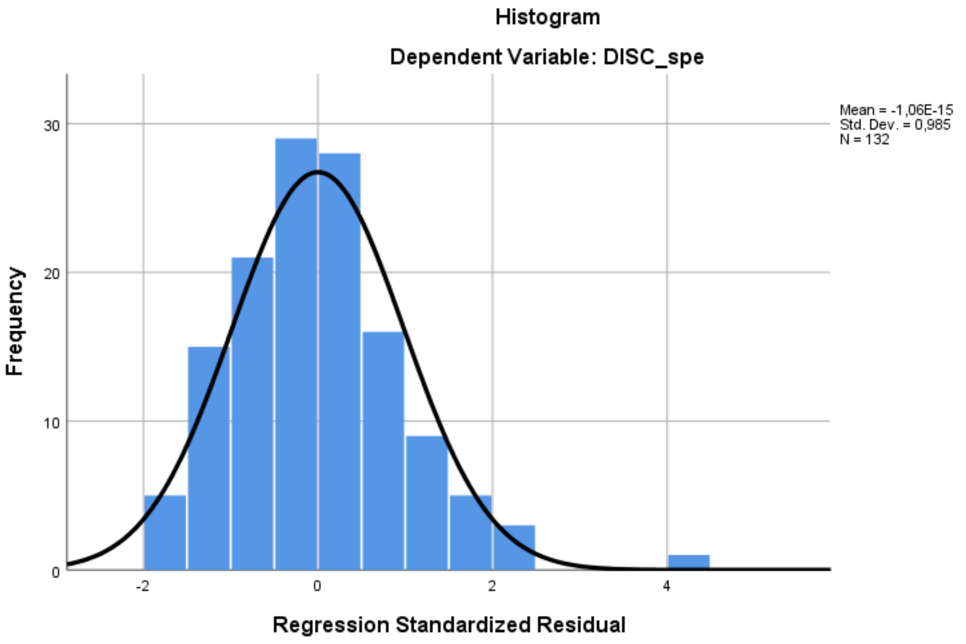
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	-86,273	143,699		-,600	,549		
	RISK	10,200	5,215	,181	1,956	,053	,864	1,157
	MEDIAalt	,019	,350	,005	,053	,958	,853	1,172
	SIZE	14,239	6,470	,213	2,201	,030	,794	1,259
	LEVERAGE	,575	,464	,110	1,239	,218	,944	1,059

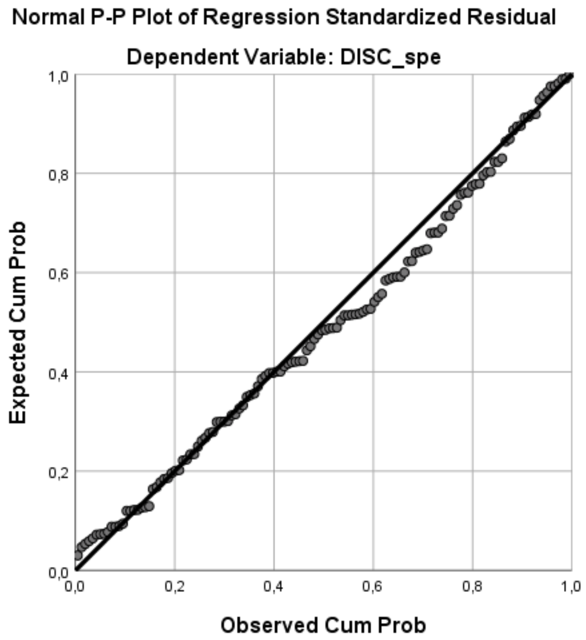
a. Dependent Variable: DISC_spe

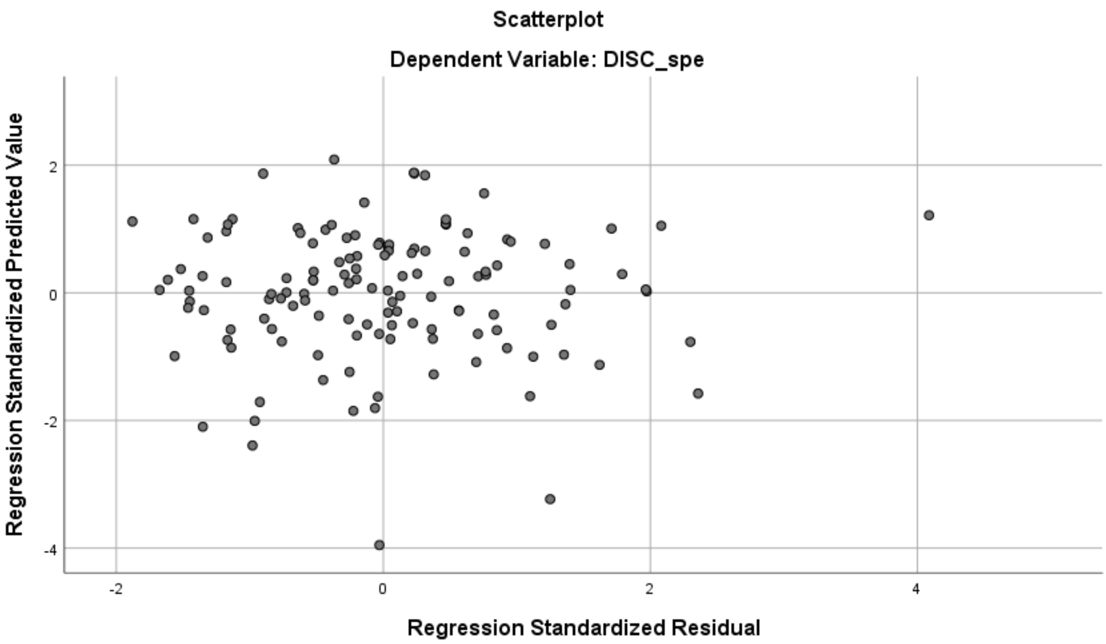
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK	MEDIAalt	SIZE	LEVERAGE
1	1	3,736	1,000	,00	,02	,01	,00	,01
	2	,791	2,173	,00	,00	,84	,00	,02
	3	,308	3,482	,00	,92	,03	,00	,05
	4	,162	4,795	,00	,00	,05	,00	,90
	5	,002	41,816	,99	,06	,07	,99	,02

a. Dependent Variable: DISC_spe







9.9.9 OLS multiple regression: SPSS report DISC_Spe and RISK_Mgt

9.9.9.1 Extent of media visibility

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson

1	,242[a]	,059	,029	109,383	1,749

a. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIA_ABI_categories_sub_sample

b. Dependent Variable: DISC_spe

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	94691,246	4	23672,811	1,979	,102[b]
	Residual	1519510,087	127	11964,646		
	Total	1614201,333	131			

a. Dependent Variable: DISC_spe

b. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIA_ABI_categories_sub_sample

Coefficients[a]

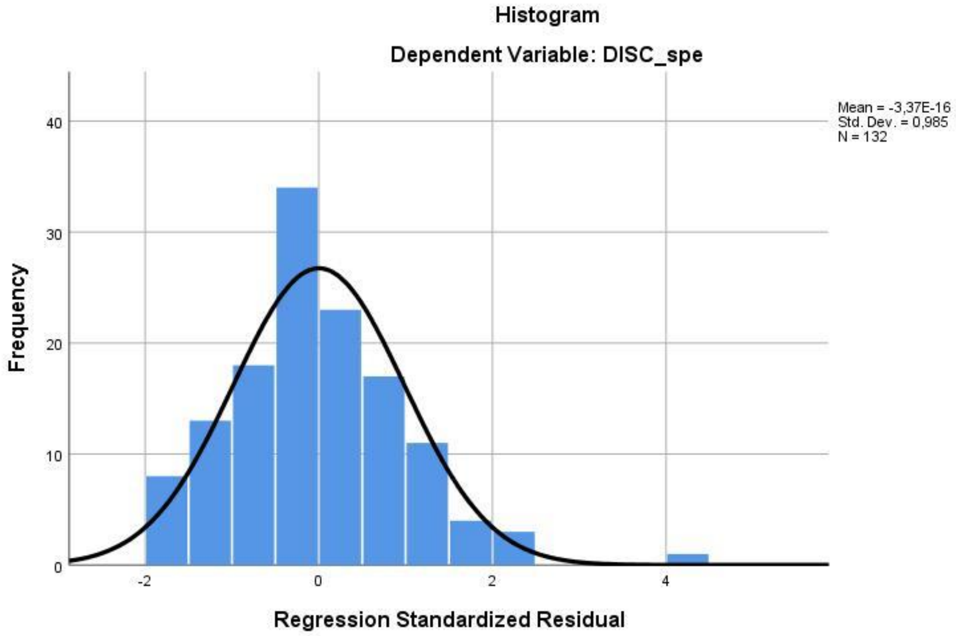
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-32,183	138,168		-,233	,816		
	RISK_MGT	-15,792	8,704	-,170	-1,814	,072	,846	1,182
	MEDIA_ABI_categories_sub_sample	12,221	11,054	,107	1,106	,271	,797	1,255
	SIZE	11,622	6,672	,174	1,742	,084	,745	1,343
	LEVERAGE	,413	,468	,079	,884	,378	,928	1,078

a. Dependent Variable: DISC_spe

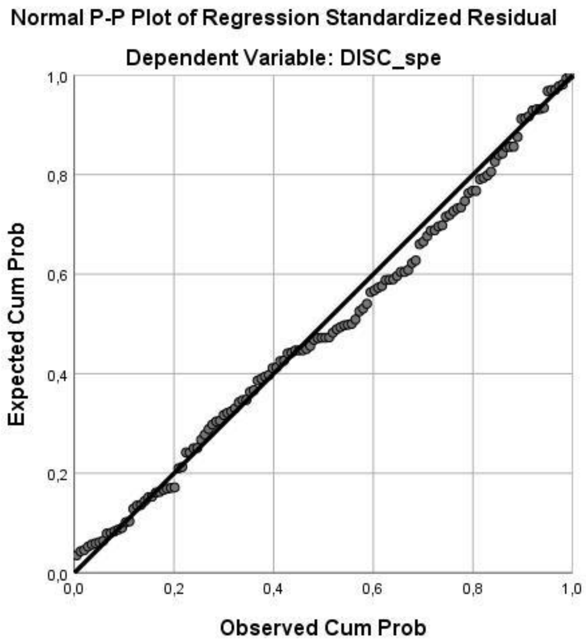
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIA_ABI_categories_sub_sample	SIZE	LEVERAGE
1	1	4,641	1,000	,00	,00	,00	,00	,01
	2	,198	4,838	,00	,05	,01	,00	,91
	3	,092	7,084	,00	,81	,22	,00	,02
	4	,066	8,411	,02	,07	,67	,01	,00
	5	,002	45,777	,98	,06	,09	,99	,06

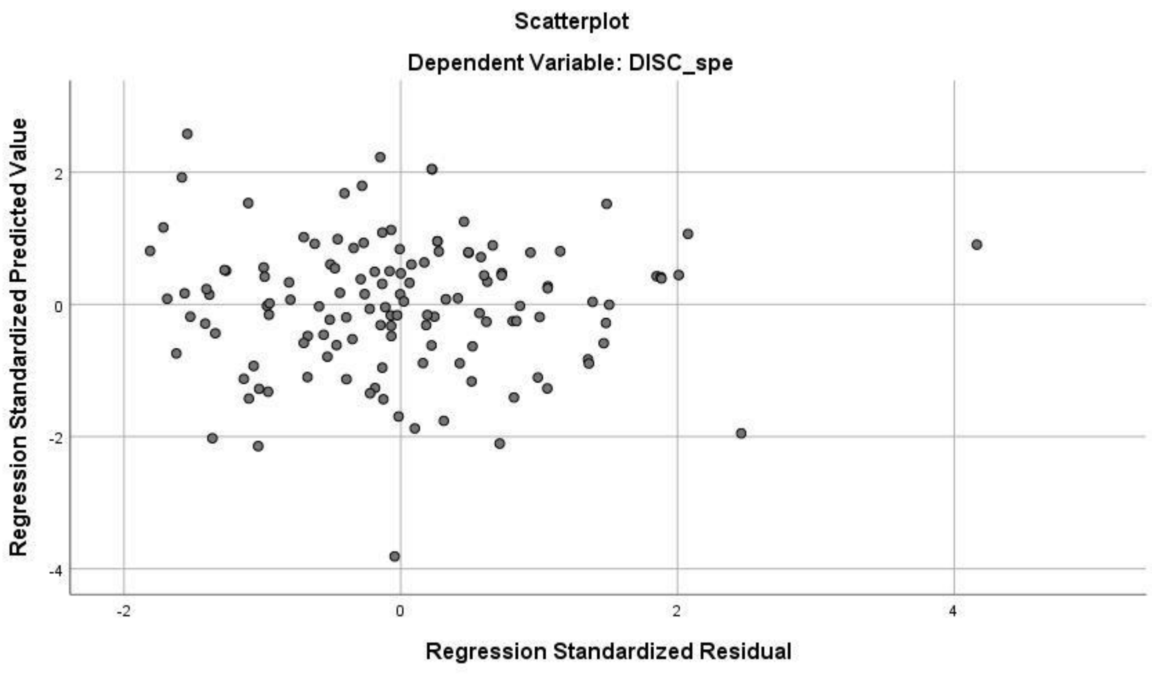
a. Dependent Variable: DISC_spe



Histogram
Dependent Variable: DISC_spe
Mean = -3,37E-16
Std. Dev. = 0,985
N = 132
Frequency
Regression Standardized Residual



Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DISC_spe
Expected Cum Prob
Observed Cum Prob



9.9.9.2 Media visibility considering printed sources only

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,253[a]	,064	,034	100,642	1,881

a. Predictors: (Constant), LEVERAGE, SIZE, MEDIAalt, RISK_MGT

b. Dependent Variable: DISC_spe

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	86219,191	4	21554,798	2,128	,081[b]
	Residual	1266100,809	125	10128,806		
	Total	1352320,000	129			

a. Dependent Variable: DISC_spe

b. Predictors: (Constant), LEVERAGE, SIZE, MEDIAalt, RISK_MGT

Coefficients[a]

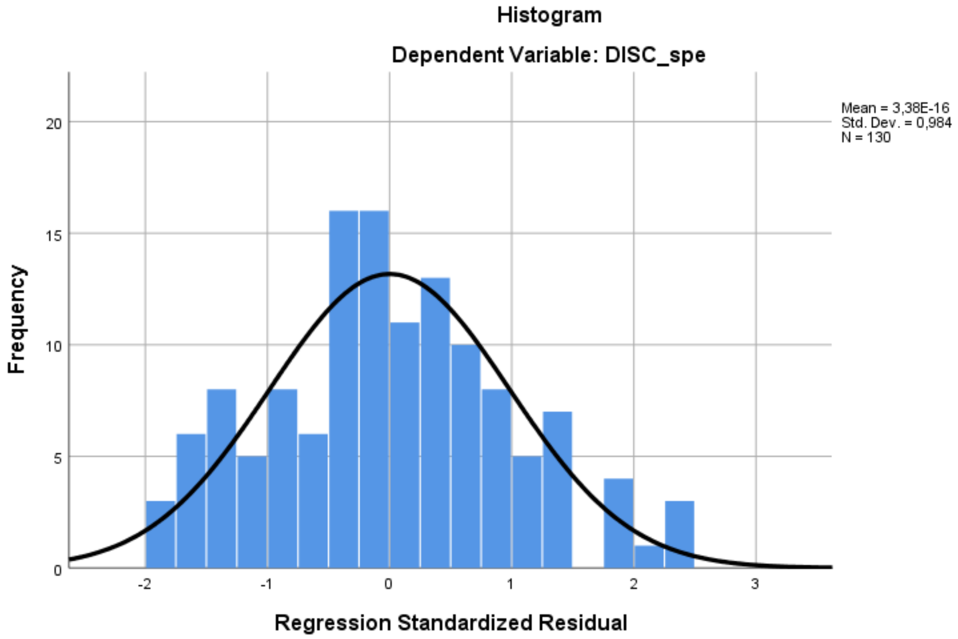
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-39,186	132,397		-,296	,768		
	RISK_MGT	-15,523	8,214	-,178	-1,890	,061	,845	1,183
	MEDIAalt	-1,601	1,274	-,118	-1,257	,211	,854	1,171
	SIZE	13,712	6,081	,213	2,255	,026	,837	1,195
	LEVERAGE	,335	,427	,069	,784	,434	,957	1,045

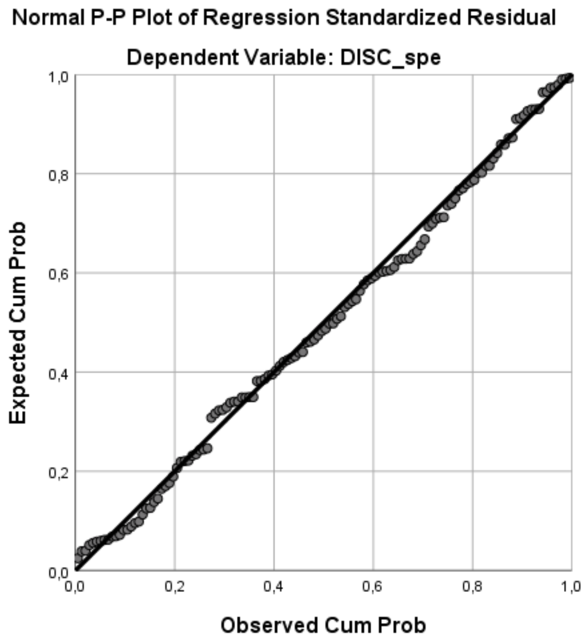
a. Dependent Variable: DISC_spe

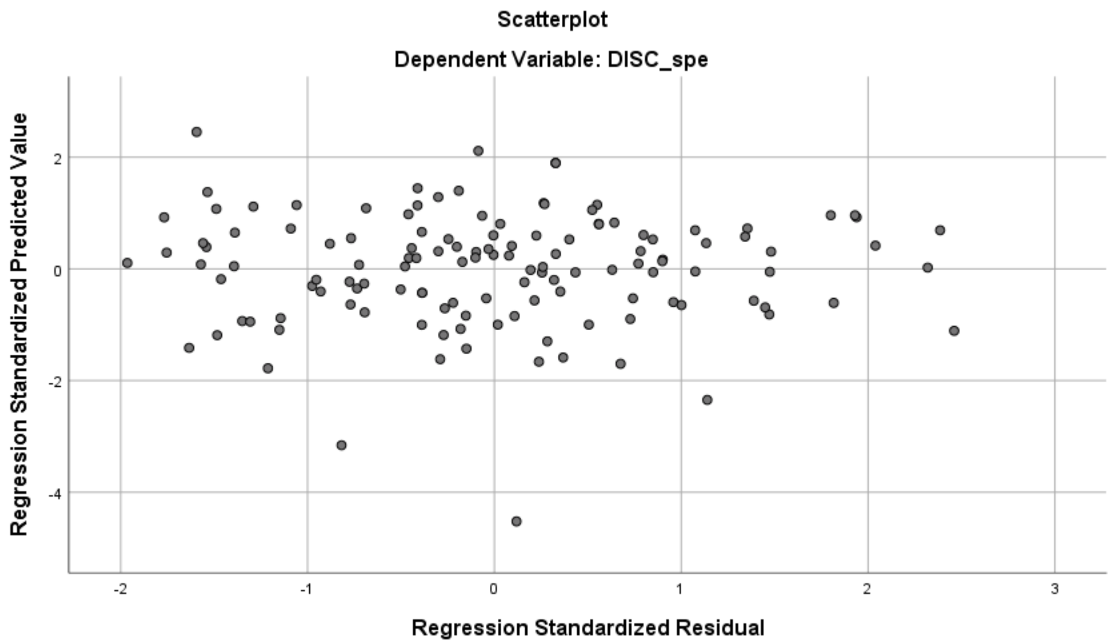
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIAalt	SIZE	LEVERAGE
1	1	3,949	1,000	,00	,01	,01	,00	,01
	2	,792	2,233	,00	,00	,81	,00	,02
	3	,175	4,747	,00	,06	,08	,00	,95
	4	,082	6,955	,01	,89	,03	,01	,01
	5	,002	42,507	,99	,03	,06	,99	,02

a. Dependent Variable: DISC_spe







9.9.10 OLS multiple regression: SPSS report DISC_Tot and RISK

9.9.10.1 Extent of media visibility

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,419[a]	,176	,150	267,158	1,491

a. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIA_ABI_categories_sub_sample

b. Dependent Variable: DISC_total

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1935477,025	4	483869,256	6,779	,000[b]
	Residual	9064425,967	127	71373,433		
	Total	10999902,99	131			

a. Dependent Variable: DISC_total

b. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIA_ABI_categories_sub_sample

Coefficients[a]

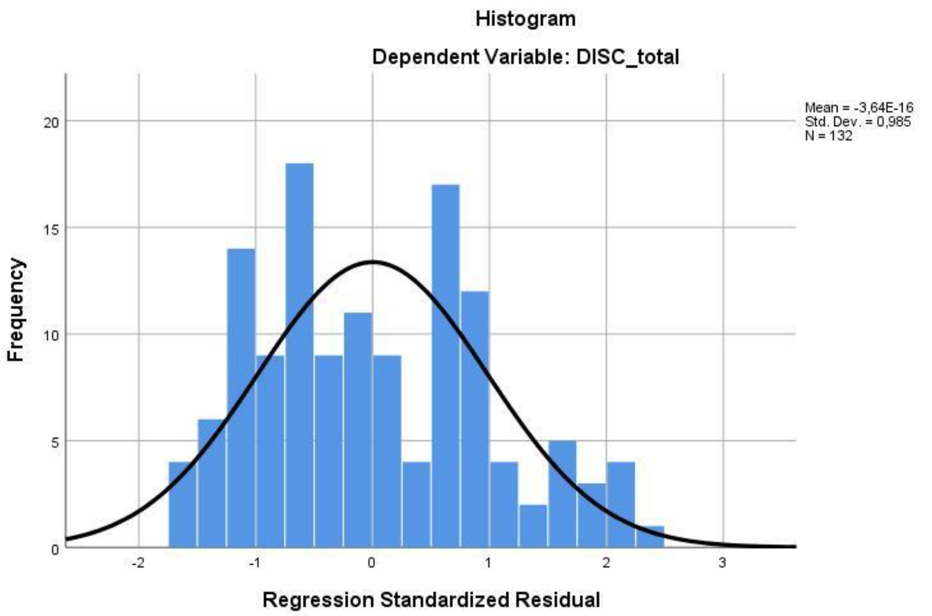
Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	118,189	339,664		,348	,728		
	RISK	65,487	13,105	,446	4,997	,000	,815	1,228
	MEDIA_ABI_categories_sub_sample	43,885	27,766	,147	1,581	,116	,753	1,327
	SIZE	16,017	15,892	,092	1,008	,315	,783	1,277
	LEVERAGE	2,255	1,143	,165	1,973	,051	,926	1,080

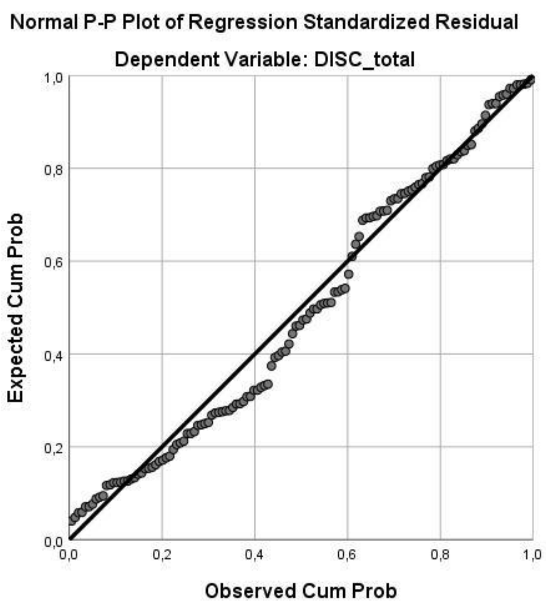
a. Dependent Variable: DISC_total

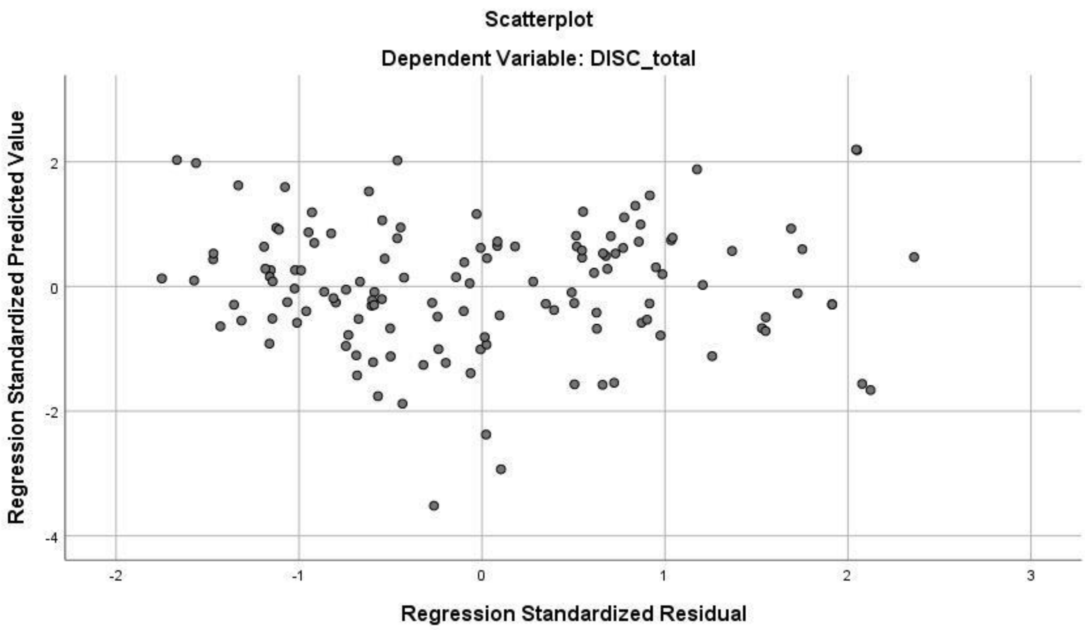
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIA_ABI_categories_sub_sample	SIZE	LEVERAGE
1	1	4,439	1,000	,00	,01	,00	,00	,01
	2	,313	3,767	,00	,84	,00	,00	,07
	3	,183	4,920	,00	,03	,03	,00	,86
	4	,063	8,391	,01	,07	,89	,01	,00
	5	,002	44,368	,98	,05	,07	,99	,06

a. Dependent Variable: DISC_total


Histogram
Dependent Variable: DISC_total
Mean = -3,64E-16
Std. Dev. = 0,985
N = 132
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DISC_total
Expected Cum Prob
Observed Cum Prob



9.9.10.2 Media visibility considering printed sources only

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,464[a]	,215	,190	259,886	1,839

a. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIAalt

b. Dependent Variable: DISC_total

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2297502,861	4	574375,715	8,504	,000[b]
	Residual	8375019,945	124	67540,483		
	Total	10672522,806	128			

a. Dependent Variable: DISC_total

b. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIAalt

Coefficients[a]

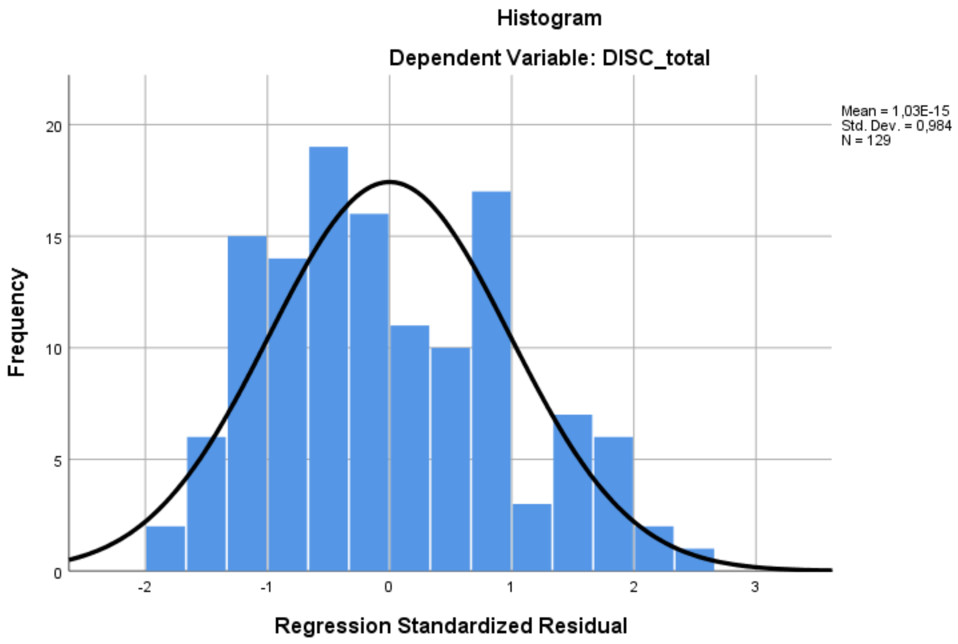
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-507,556	399,592		-1,270	,206		
	RISK	60,212	12,467	,411	4,830	,000	,873	1,146
	MEDIAalt	-8,752	3,322	-,229	-2,635	,009	,840	1,191
	SIZE	50,249	18,084	,249	2,779	,006	,788	1,270
	LEVERAGE	2,174	1,107	,160	1,964	,052	,949	1,054

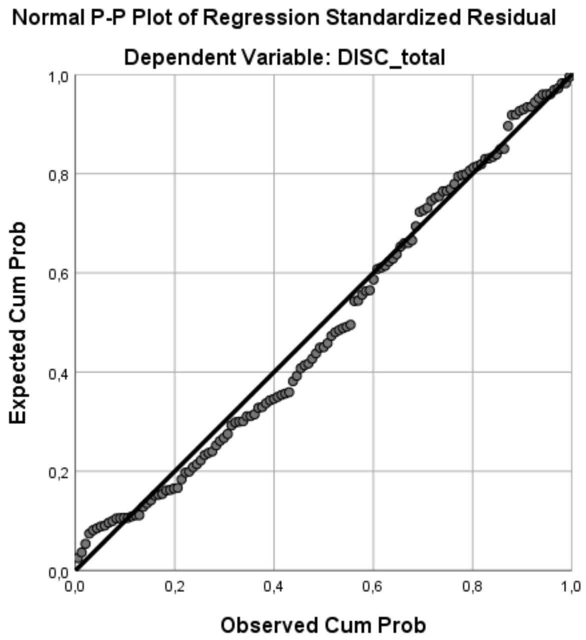
a. Dependent Variable: DISC_total

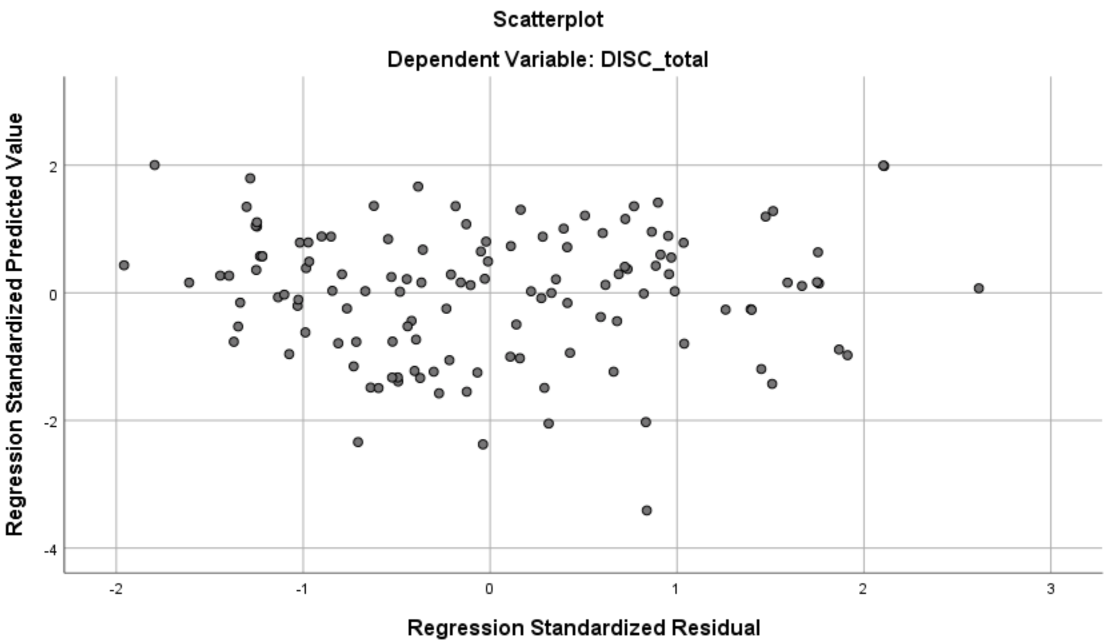
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIAalt	SIZE	LEVERAGE
1	1	3,732	1,000	,00	,02	,01	,00	,01
	2	,795	2,166	,00	,00	,80	,00	,02
	3	,308	3,482	,00	,92	,03	,00	,05
	4	,163	4,781	,00	,00	,05	,00	,90
	5	,002	47,956	1,00	,06	,11	1,00	,02

a. Dependent Variable: DISC_total




Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DISC_total
Expected Cum Prob
Observed Cum Prob
0,0
0,2
0,4
0,6
0,8
1,0


Scatterplot
Dependent Variable: DISC_total
Regression Standardized Predicted Value
Regression Standardized Residual
-4
-2
0
2
-2
-1
0
1
2
3

9.9.11 OLS multiple regression: SPSS report DISC_Tot and RISK_Mgt

9.9.11.1 Extent of media visibility

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,322[a]	,104	,076	278,612	1,635

a. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIA_ABI_categories_sub_sample

b. Dependent Variable: DISC_total

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1141599,176	4	285399,794	3,677	,007[b]
	Residual	9858303,817	127	77624,440		
	Total	10999902,99	131			

a. Dependent Variable: DISC_total

b. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIA_ABI_categories_sub_sample

Coefficients[a]

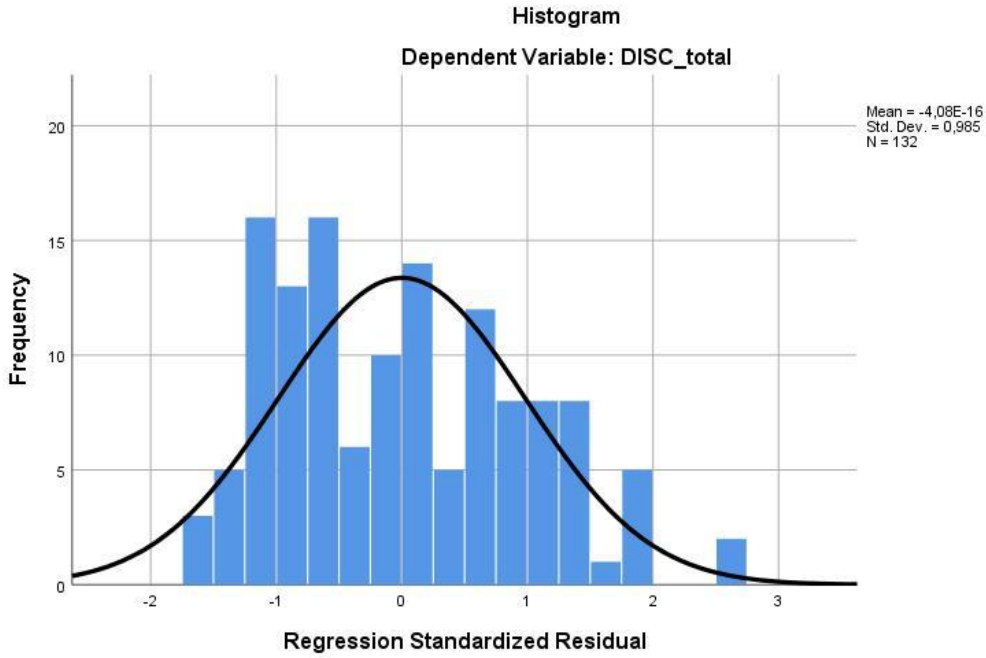
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	251,297	351,931		,714	,477		
	RISK_MGT	-79,119	22,171	-,326	-3,569	,001	,846	1,182
	MEDIA_ABI_categories_sub_sample	18,713	28,155	,063	,665	,507	,797	1,255
	SIZE	17,350	16,995	,099	1,021	,309	,745	1,343
	LEVERAGE	2,030	1,191	,149	1,705	,091	,928	1,078

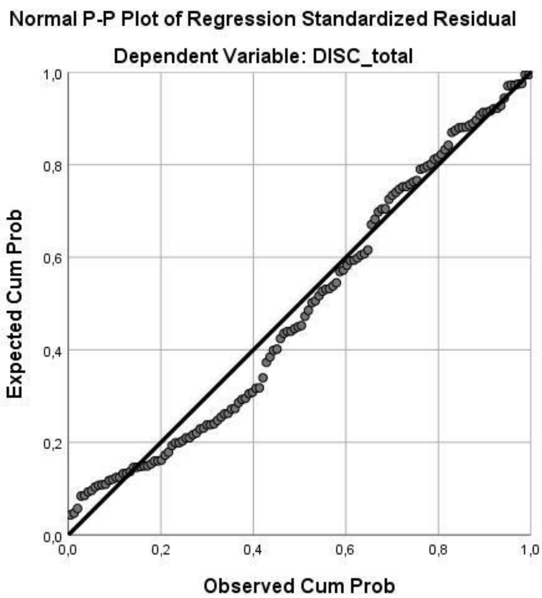
a. Dependent Variable: DISC_total

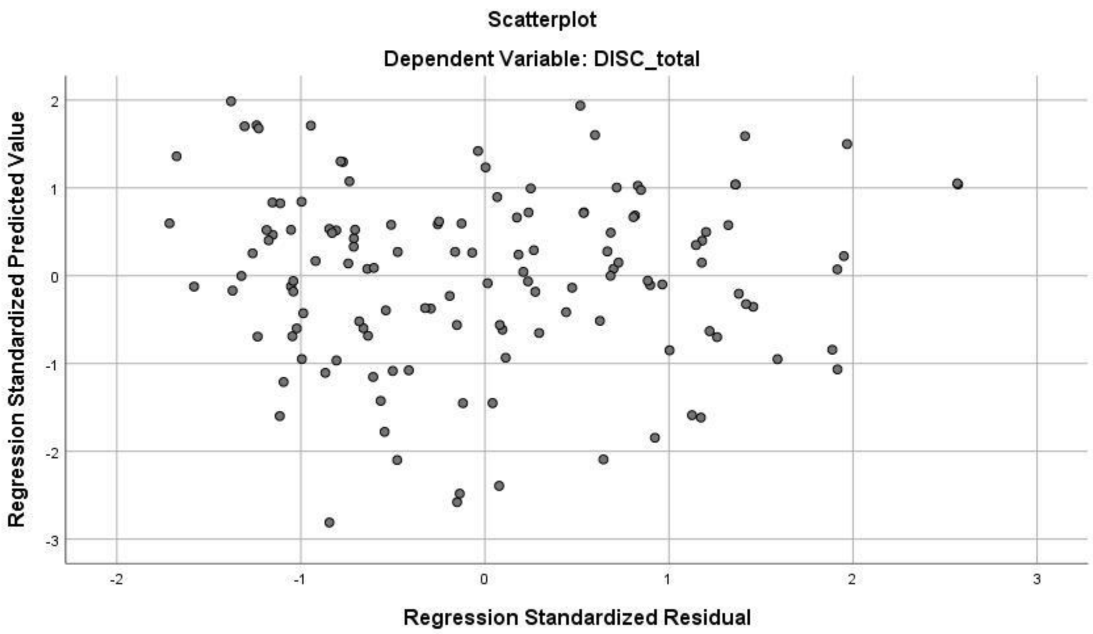
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK_MGT	MEDIA_ABI_categories_sub_sample	SIZE	LEVERAGE
1	1	4,641	1,000	,00	,00	,00	,00	,01
	2	,198	4,838	,00	,05	,01	,00	,91
	3	,092	7,084	,00	,81	,22	,00	,02
	4	,066	8,411	,02	,07	,67	,01	,00
	5	,002	45,777	,98	,06	,09	,99	,06

a. Dependent Variable: DISC_total


Histogram
Dependent Variable: DISC_total
Mean = -4,08E-16
Std. Dev. = 0,985
N = 132
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DISC_total
Expected Cum Prob
Observed Cum Prob



9.9.11.2 *Media visibility considering printed sources only*

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,384[a]	,148	,120	270,838	1,566

a. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIAalt

b. Dependent Variable: DISC_total

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1576756,580	4	394189,145	5,374	,001[b]
	Residual	9095766,226	124	73352,953		
	Total	10672522,806	128			

a. Dependent Variable: DISC_total

b. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIAalt

Coefficients[a]

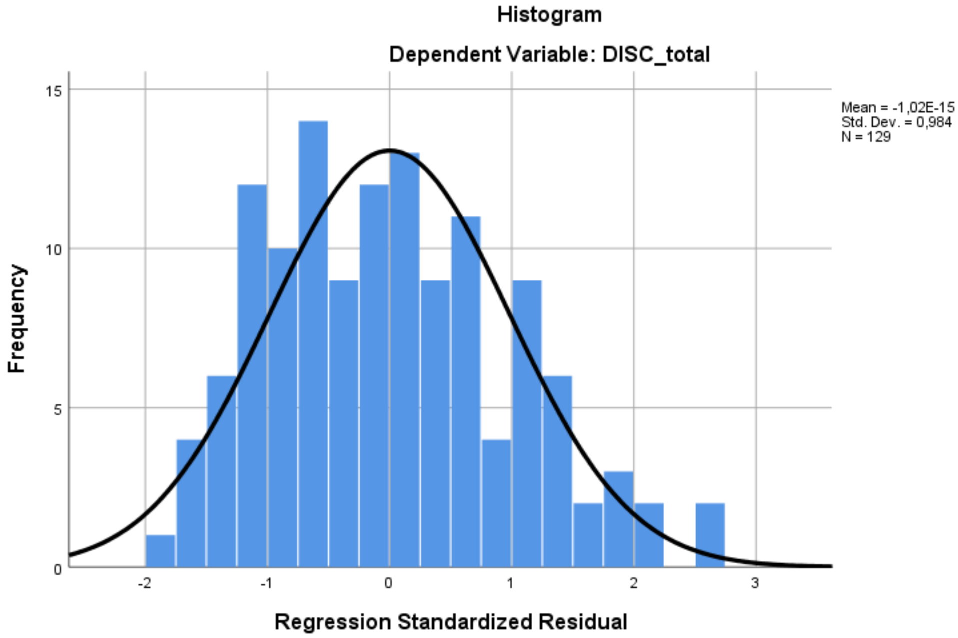
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	-294,557	410,923		-,717	,475		
	RISK_MGT	-76,074	22,285	-,310	-3,414	,001	,832	1,203
	MEDIAalt	-7,884	3,504	-,206	-2,250	,026	,820	1,219
	SIZE	45,069	18,927	,223	2,381	,019	,781	1,281
	LEVERAGE	1,816	1,150	,134	1,580	,117	,956	1,046

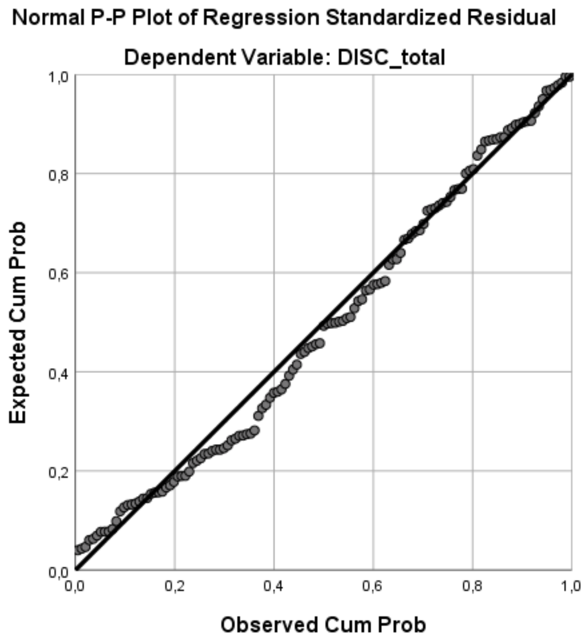
a. Dependent Variable: DISC_total

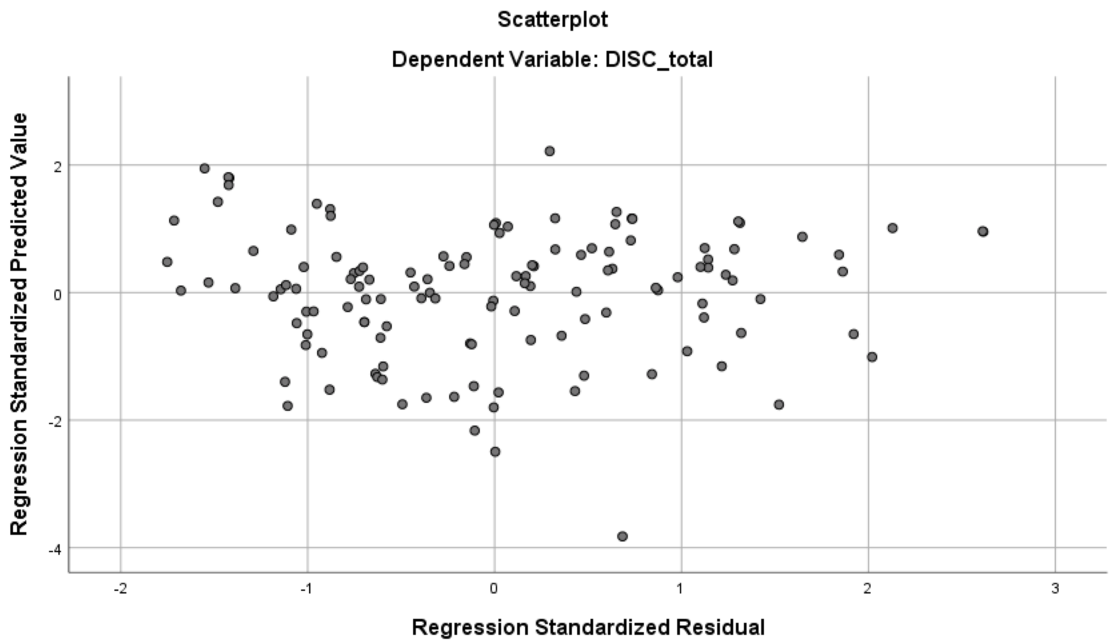
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK_MGT	MEDIAalt	SIZE	LEVERAGE
1	1	3,944	1,000	,00	,01	,01	,00	,01
	2	,796	2,226	,00	,00	,78	,00	,02
	3	,176	4,732	,00	,06	,08	,00	,95
	4	,082	6,930	,01	,88	,03	,01	,01
	5	,002	49,002	,99	,05	,10	,99	,02

a. Dependent Variable: DISC_total







9.9.12 OLS multiple regression: SPSS report DISCgenR and RISK

9.9.12.1 Extent of media visibility

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,305[a]	,093	,065	23,45447%	1,926

a. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIA_ABI_categories_sub_sample

b. Dependent Variable: DIS_gen%

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7172,894	4	1793,223	3,260	,014[b]
	Residual	69864,247	127	550,112		
	Total	77037,141	131			

a. Dependent Variable: DIS_gen%

b. Predictors: (Constant), LEVERAGE, SIZE, RISK, MEDIA_ABI_categories_sub_sample

Coefficients[a]

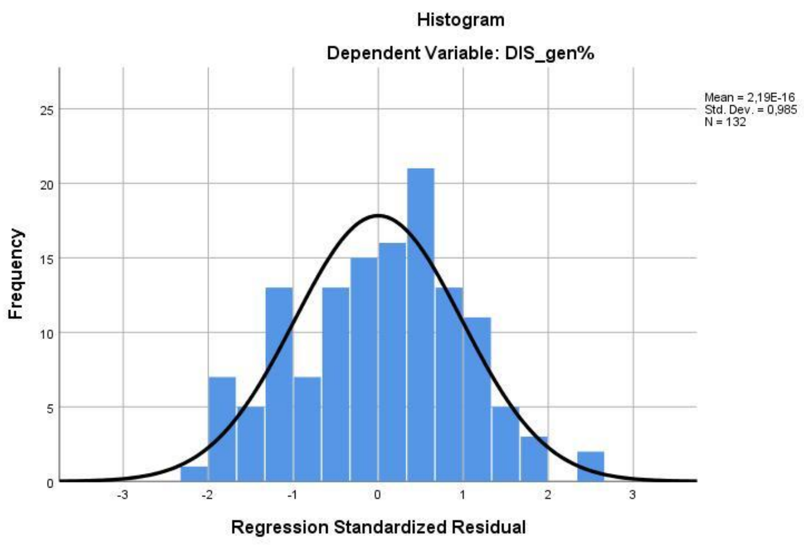
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	66,328	29,820		2,224	,028		
	RISK	3,744	1,150	,305	3,254	,001	,815	1,228
	MEDIA_ABI_categories_sub_sample	1,482	2,438	,059	,608	,544	,753	1,327
	SIZE	-,733	1,395	-,050	-,525	,600	,783	1,277
	LEVERAGE	,078	,100	,068	,778	,438	,926	1,080

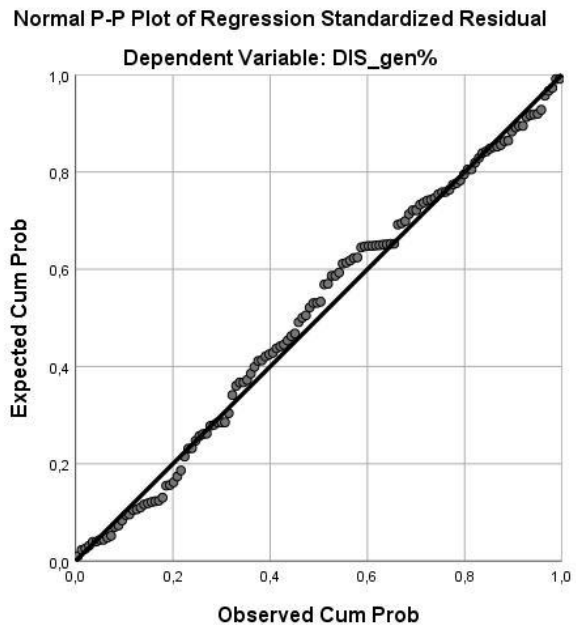
a. Dependent Variable: DIS_gen%

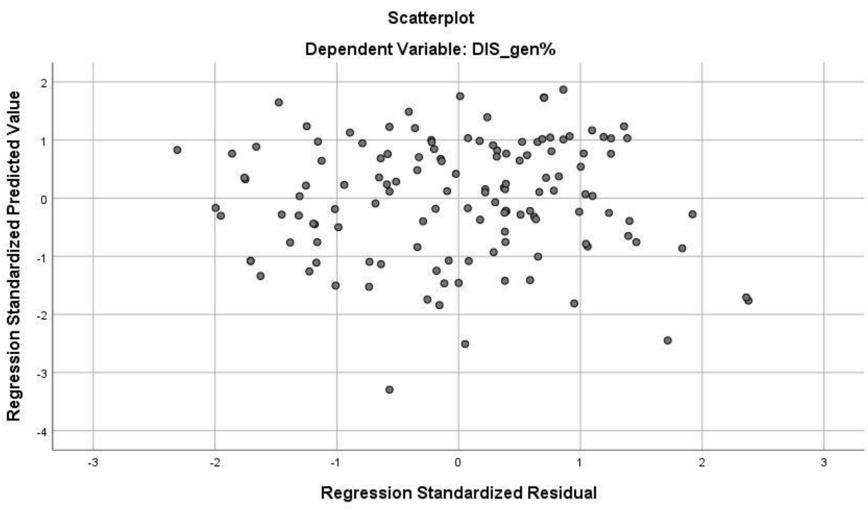
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	RISK	MEDIA_ABI_categories_sub_sample	SIZE	LEVERAGE
1	1	4,439	1,000	,00	,01	,00	,00	,01
	2	,313	3,767	,00	,84	,00	,00	,07
	3	,183	4,920	,00	,03	,03	,00	,86
	4	,063	8,391	,01	,07	,89	,01	,00
	5	,002	44,368	,98	,05	,07	,99	,06

a. Dependent Variable: DIS_gen%


Histogram
Dependent Variable: DIS_gen%
Mean = 2,19E-16
Std. Dev. = 0,985
N = 132
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DIS_gen%
Expected Cum Prob
Observed Cum Prob


Scatterplot
Dependent Variable: DIS_gen%
Regression Standardized Predicted Value
Regression Standardized Residual

9.9.12.2 Media visibility considering printed sources only

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,315[a]	,099	,071	23,46594%	1,682

a. Predictors: (Constant), LEVERAGE, MEDIAalt, RISK, SIZE

b. Dependent Variable: DIS_gen%

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7643,985	4	1910,996	3,470	,010[b]
	Residual	69381,953	126	550,650		
	Total	77025,938	130			

a. Dependent Variable: DIS_gen%

b. Predictors: (Constant), LEVERAGE, MEDIAalt, RISK, SIZE

Coefficients[a]

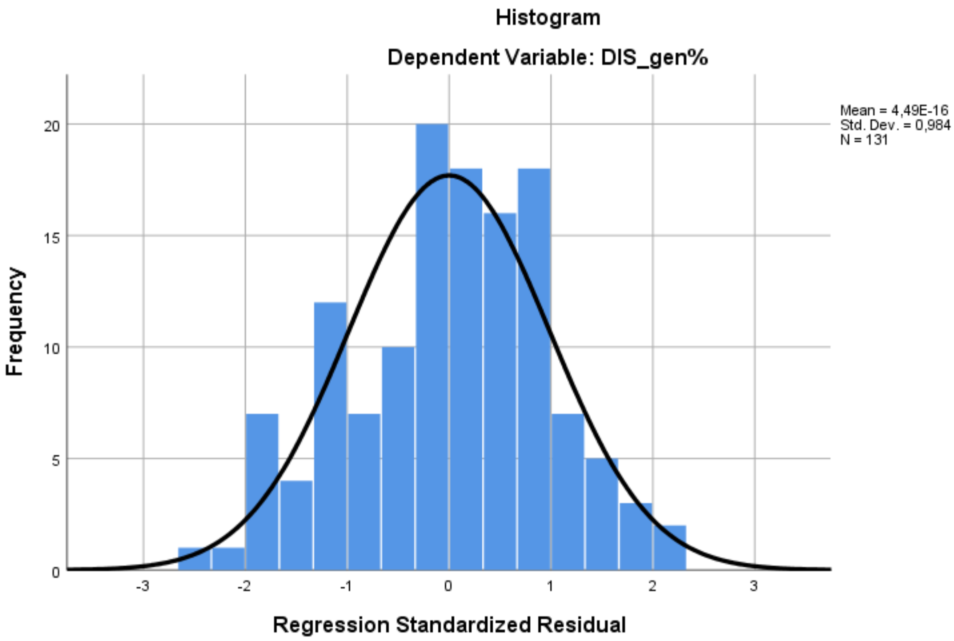
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	58,633	31,101		1,885	,062		
	RISK	3,489	1,120	,283	3,116	,002	,866	1,154
	MEDIAalt	-,126	,137	-,083	-,918	,360	,879	1,138
	SIZE	-,234	1,401	-,016	-,167	,868	,818	1,223
	LEVERAGE	,093	,099	,081	,936	,351	,959	1,043

a. Dependent Variable: DIS_gen%

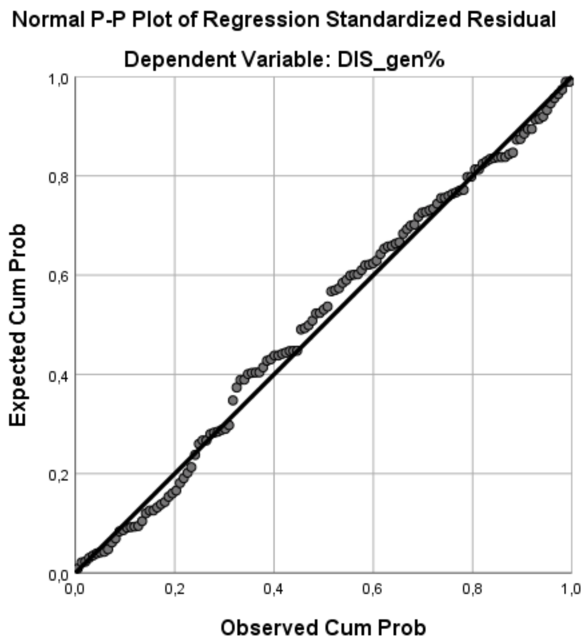
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK	MEDIAalt	SIZE	LEVERAGE
1	1	3,638	1,000	,00	,02	,01	,00	,01
	2	,891	2,020	,00	,00	,85	,00	,01
	3	,302	3,469	,00	,91	,04	,00	,06
	4	,167	4,672	,00	,01	,01	,00	,89
	5	,002	40,992	,99	,06	,08	,99	,03

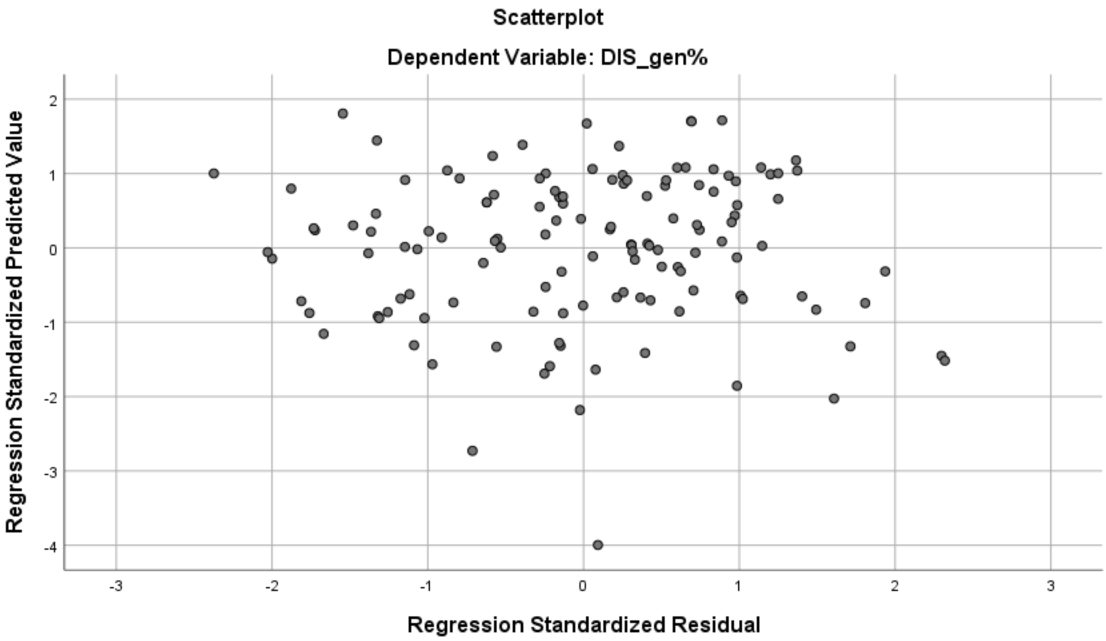
a. Dependent Variable: DIS_gen%



Histogram
Dependent Variable: DIS_gen%
Mean = 4,49E-16
Std. Dev. = 0,984
N = 131
Frequency
0
5
10
15
20
-3
-2
-1
0
1
2
3
Regression Standardized Residual



Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DIS_gen%
Expected Cum Prob
0,0
0,2
0,4
0,6
0,8
1,0
Observed Cum Prob



9.9.13 OLS multiple regression: SPSS report DISCgenR and RISK_Mgt

9.9.13.1 Extent of media visibility

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,232[a]	,054	,024	23,95614%	1,824

a. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIA_ABI_categories_sub_sample

b. Dependent Variable: DIS_gen%

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4152,295	4	1038,074	1,809	,131[b]
	Residual	72884,846	127	573,896		
	Total	77037,141	131			

a. Dependent Variable: DIS_gen%

b. Predictors: (Constant), LEVERAGE, SIZE, RISK_MGT, MEDIA_ABI_categories_sub_sample

Coefficients[a]

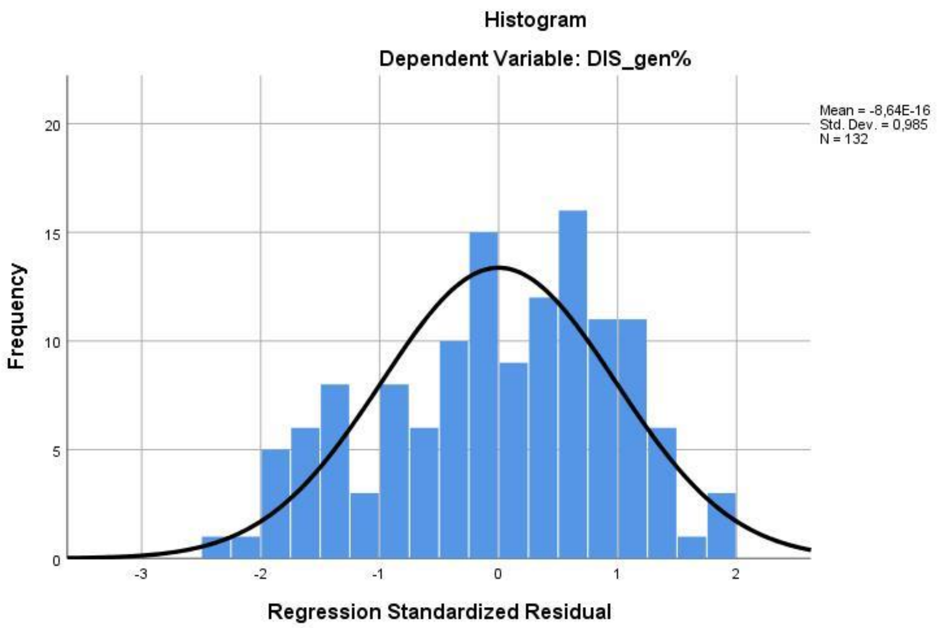
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	74,804	30,260		2,472	,015		
	RISK_MGT	-4,214	1,906	-,207	-2,211	,029	,846	1,182
	MEDIA_ABI_categories_sub_sample	,005	2,421	,000	,002	,998	,797	1,255
	SIZE	-,729	1,461	-,050	-,499	,619	,745	1,343
	LEVERAGE	,063	,102	,055	,616	,539	,928	1,078

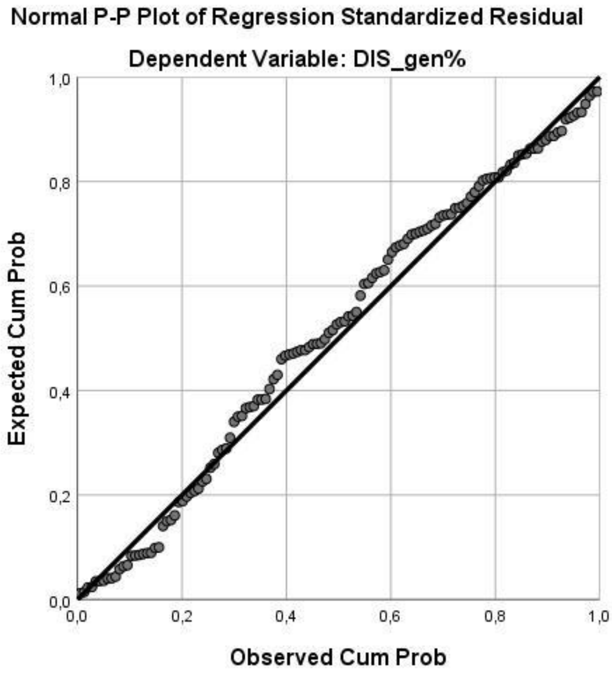
a. Dependent Variable: DIS_gen%

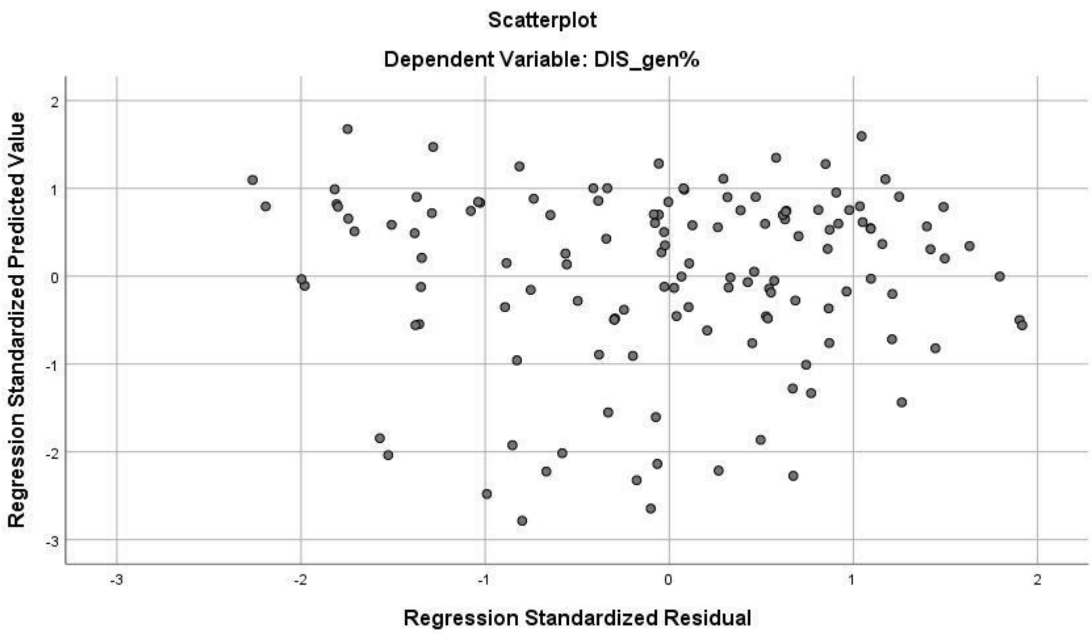
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Variance Proportions RISK_MGT	Variance Proportions MEDIA_ABI_categories_sub_sample	Variance Proportions SIZE	Variance Proportions LEVERAGE
1	1	4,641	1,000	,00	,00	,00	,00	,01
	2	,198	4,838	,00	,05	,01	,00	,91
	3	,092	7,084	,00	,81	,22	,00	,02
	4	,066	8,411	,02	,07	,67	,01	,00
	5	,002	45,777	,98	,06	,09	,99	,06

a. Dependent Variable: DIS_gen%







9.9.13.2 Media visibility considering printed sources only

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,249[a]	,062	,032	23,94597%	1,497

a. Predictors: (Constant), LEVERAGE, MEDIAalt, RISK_MGT, SIZE

b. Dependent Variable: DIS_gen%

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4776,315	4	1194,079	2,082	,087[b]
	Residual	72249,624	126	573,410		
	Total	77025,938	130			

a. Dependent Variable: DIS_gen%

b. Predictors: (Constant), LEVERAGE, MEDIAalt, RISK_MGT, SIZE

Coefficients[a]

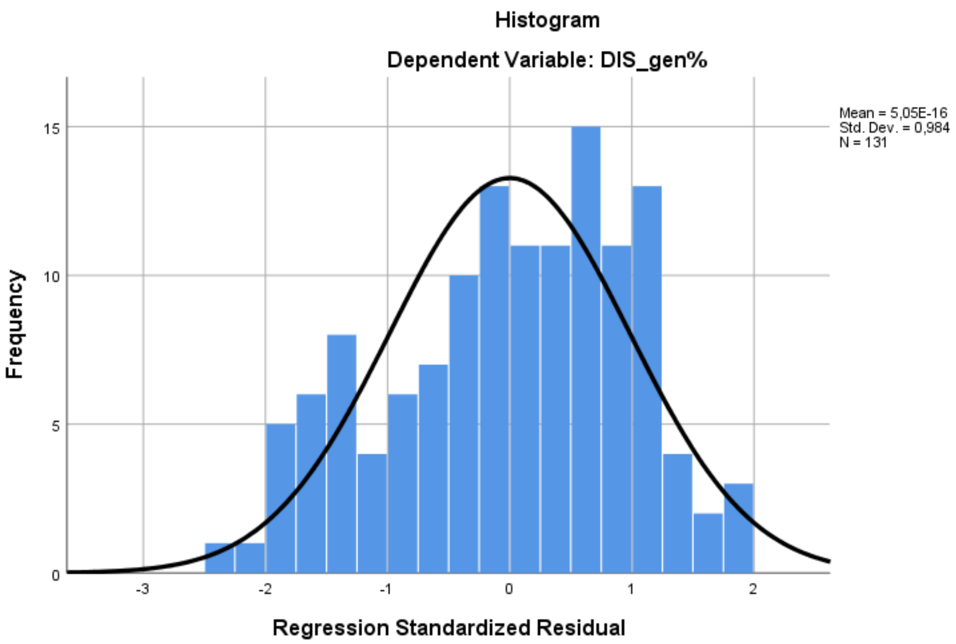
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	71,593	31,225		2,293	,024		
	RISK_MGT	-4,030	1,938	-,197	-2,079	,040	,833	1,201
	MEDIAalt	-,112	,142	-,073	-,786	,434	,855	1,170
	SIZE	-,600	1,432	-,040	-,419	,676	,815	1,226
	LEVERAGE	,068	,101	,059	,673	,502	,969	1,032

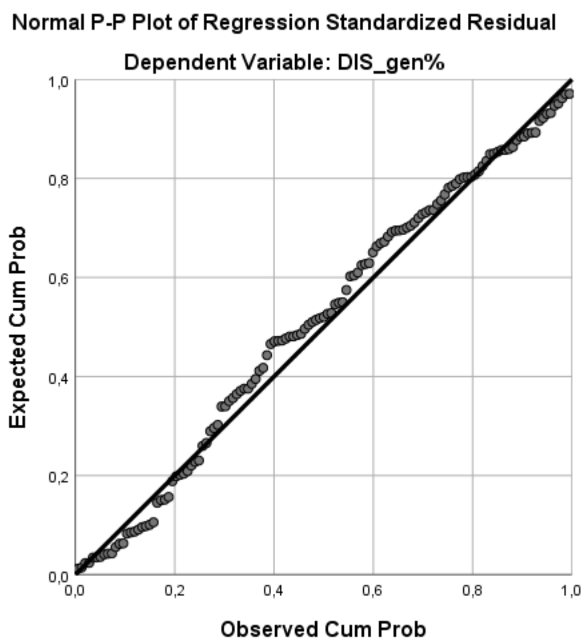
a. Dependent Variable: DIS_gen%

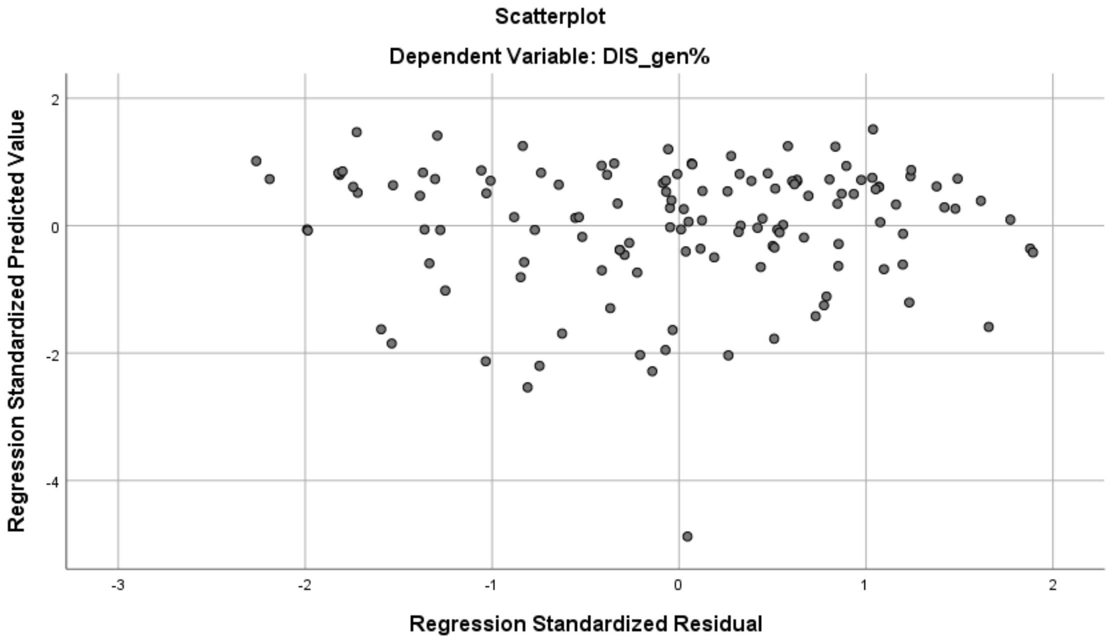
Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions				
				(Constant)	RISK_MGT	MEDIAalt	SIZE	LEVERAGE
1	1	3,844	1,000	,00	,01	,01	,00	,01
	2	,891	2,077	,00	,00	,84	,00	,01
	3	,182	4,602	,00	,07	,03	,00	,95
	4	,081	6,900	,01	,88	,05	,01	,01
	5	,002	41,727	,99	,04	,07	,99	,02

a. Dependent Variable: DIS_gen%




Normal P-P Plot of Regression Standardized Residual
Dependent Variable: DIS_gen%
Expected Cum Prob
Observed Cum Prob
0,0
0,2
0,4
0,6
0,8
1,0


Scatterplot
Dependent Variable: DIS_gen%
Regression Standardized Predicted Value
Regression Standardized Residual
2
0
-2
-4
-3
-1
1