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# Risk Disclosure and Related Assurance Services

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# Abstract

Companies are exposed to various risks in their day-to-day business that can affect their financial performance, competitiveness, and long-term profitability. Trends such as globalization and rapid technological development are changing the dynamics of and uncertainties faced by companies and increasing the likelihood of crises. The COVID-19 pandemic, the Wirecard scandal, and cyberattacks are just a few recent examples. Therefore, companies must deal with risks in a structured manner using a risk management system. However, the approaches used are not standardized. Although risk management standards guide how to structure them, they still need to be customized for each company. Common risk strategies range from risk reduction and risk transfer to the avoidance of certain business activities. For example, a risk can be transferred to insurance companies or reduced by voluntary assurance of the risk management system.

With the introduction of the Financial Market Integrity Strengthening Act, risk management systems have become mandatory for listed companies in Germany. In the United States, a risk management system is not mandatory, although this is the case for an internal control system for financial reporting. Due to the high relevance of risk management systems, companies can voluntarily implement risk management system assurance to verify the effectiveness and appropriateness of the system. This can ensure that risks are adequately managed, while also sending a positive signal to stakeholders.

However, it is not the mere implementation of the risk management system that is crucial, but also the communication of the risks and measures that the company intends to take to manage them. By disclosing risk-related information, managers can demonstrate their risk management capabilities and thus reduce information asymmetries between the company and its stakeholders. In addition, risk-related information is of major interest to stakeholders, as it enables them to more effectively assess the company's risk exposure. In addition to mandatory risk disclosure and risk-related information, companies tend to supplement this with voluntary information.

Given the relevance of risk disclosure and related assurance services, this dissertation deals with these topics in two main chapters. The first five studies deal with the spectrum of risk disclosure, whereas the last two address the impact of assurance services.

The first study examines risk disclosure in the German capital market. For this purpose, the annual reports of HDAX companies from the 2018, 2019, and 2020 fiscal years were examined, using qualitative content analysis. The study focused on the volume of disclosure, the reported risk categories and individual risks over the period mentioned. The results indicate that the number of individual risks published increased significantly. Currency and cyber risks in particular were discussed frequently. Companies and stakeholders can use the results to identify

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best practices in risk disclosure. For legislators, the results offer guidance for further statutory regulation.

The second study examines the determinants of risk disclosure using regression analysis. Again, the annual reports of HDAX companies between 2018 and 2020 were used as the data base. The determinants were identified for the volume of risk disclosure, individual risks, and risk management measures. The results contribute to recognizing the influencing factors, which can help investors make informed decisions.

The third study examines textual dissimilarity in risk disclosures and its determinants in the US capital market from 2005 to 2022, with a sample of 29,070 company-year observations. The results provide empirical evidence that risk disclosure is regularly updated only to a limited extent, except for unforeseen events such as the financial crisis or the COVID-19 pandemic. Concerning the determinants, it is evident that risk variables and audit-specific variables, in particular, influence textual dissimilarity.

The fourth study describes a qualitative content analysis of HDAX companies for the 2019 fiscal year regarding disclosures on risk management systems. The results indicate rather heterogeneous reporting. An average of 6.52 of 8 basic components of the IDW assurance standard IDW AsS 981 were reported. However, only a few companies disclose that they have oriented towards a risk management standard. Notably, only four companies state that they have voluntarily assured their risk management system. Although the results indicate high reporting quality, best practices for reporting can also be identified, which also provides indications for statutory regulations.

The fifth study is dedicated to the disclosure of IT risks. Due to increasing digitalization and technological trends, considering new types of risks, such as IT risks, is of particular interest. A qualitative content analysis was used to evaluate the 2020 annual reports of DAX and MDAX companies. The results also demonstrate heterogeneous reporting. Notably, only 25 of the 90 companies follow international standards, while only twelve have been certified. Cyber insurance is rarely mentioned. This study also indicates best practices in reporting on IT risks and can serve as a basis for the regulator to initiate further standardization of risk disclosure.

The sixth study examines the voluntary assurance of risk management systems with an experiment. For this purpose, 145 German bankers were asked whether or not they trust in the risk management system, loan granting, willingness to invest, and to recommend investing in a hypothetical company. For this purpose, the assurance itself, the assurance providers, and the assurance level were manipulated. The results indicate that voluntary assurance significantly increases trust in the risk management system, the probability of a loan being granted, and the willingness to invest and investment recommendations. However, neither the auditor provider nor the assurance level play a decisive role in the participants' decision, so it can be stated that the mere presence of an assurance is sufficient. From a regulatory perspective, introducing a mandatory assurance of risk management systems could be considered. In addition, our results

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show that companies can benefit directly from voluntary assurance, as this can increase the chances of obtaining financing.

Also using an experiment, the seventh study examines voluntary cybersecurity assurance and the purchase of cyber risk insurance. For this purpose, 100 non-professional investors were asked about their willingness to invest. The presence of assurance and the presence of cyber insurance were manipulated. An additional experiment varied the assurance provider. The experimental results indicate positive perceptions of a voluntary cybersecurity audit and cyber insurance. Non-professional investors are more willing to invest in a company if it has engaged an assurance or has purchased insurance against cyber risks. In contrast, the specific assurance provider is irrelevant to our participants, revealing that the mere existence of the assurance is considered sufficient. From a regulatory perspective, introducing a mandatory cybersecurity assurance and/or mandatory cyber risk insurance could be considered, due to the high relevance of cyber risks. The results also demonstrate that companies can benefit directly from voluntary assurance, as this could increase equity financing.

# Zusammenfassung

Unternehmen sind in ihrem Tagesgeschäft verschiedenen Risiken ausgesetzt, die ihre finanzielle Leistungsfähigkeit, Wettbewerbsfähigkeit und langfristige Rentabilität beeinträchtigen können. Trends wie die Globalisierung und die rasante technologische Entwicklung verändern die Dynamik und die Unsicherheiten von Unternehmen und erhöhen die Wahrscheinlichkeit von Krisen. Dabei stellen die COVID-19 Pandemie, der Wirecard-Skandal oder Cyberattacken nur einzelne Beispiele solcher Risiken dar. Daher ist ein strukturierter Umgang mit Risiken mittels eines Risikomanagementsystems für Unternehmen unerlässlich. Die Ansätze zur Implementierung solcher Systeme sind jedoch nicht standardisiert. Zwar geben Risikomanagementstandards Empfehlungen zur Ausgestaltung, nichtsdestotrotz muss eine Anpassung an das jeweilige Unternehmen erfolgen. Bekannte Risikostrategien reichen von der Risikoreduktion, über den Risikotransfer hin zur Vermeidung der Geschäftstätigkeit. Ein Risiko bzw. das Schadensausmaß kann z.B. auf Versicherungsgesellschaften übertragen oder durch Sicherstellung funktionierender Managementsysteme durch eine freiwillige Assurance reduziert werden.

Seit Inkrafttreten des Finanzmarktintegritätsstärkungsgesetzes sind Risikomanagementsysteme in Deutschland für börsennotierte Unternehmen gesetzlich verpflichtend. In den USA ist ein Risikomanagementsystem nicht zwingend vorgeschrieben, wohl aber ein internes Kontrollsystem für die Finanzberichterstattung. Aufgrund der großen Relevanz von Risikomanagementsystemen für Unternehmen können diese eine freiwillige Assurance beauftragen wodurch die Wirksamkeit und Angemessenheit des Systems testiert werden kann. Dies kann einerseits einen adäquaten Umgang mit Risiken sicherstellen und andererseits ein positives Signal für Stakeholder darbieten.

Es ist jedoch nicht nur die bloße Umsetzung des Risikomanagementsystems von Bedeutung, sondern auch die Kommunikation der Risiken und der Maßnahmen, die das Unternehmen zur Bewältigung der Risiken zu ergreifen gedenkt. Durch die Offenlegung risikobezogener Informationen können Manager ihre Risikomanagementfähigkeiten unter Beweis stellen und so Informationsasymmetrien zwischen dem Unternehmen und seinen Stakeholdern abbauen. Daneben sind risikobezogene Informationen für Stakeholder von hohem Interesse, da sie es ermöglichen, die Risikoexposition des Unternehmens besser einschätzen zu können. Neben einer gesetzlich vorgeschriebenen Berichterstattung über Risiken und risikobezogenen Informationen tendieren Unternehmen dazu, diese, um freiwillige Angaben zu ergänzen.

Vor dem Hintergrund der Relevanz der Risikoberichterstattung sowie von Assurance Leistungen im Kontext von Risikomanagementsystemen beschäftigt sich diese Dissertation in zwei Hauptkapiteln mit diesen Themen. Die ersten fünf Studien gehen auf das Themenspektrum der Risikoberichterstattung ein, wohingegen die letzten beiden Studien sich mit der Frage hinsichtlich der Auswirkung von Assurance Leistung auseinandersetzen.

Die erste Studie untersucht die Risikooffenlegung am deutschen Kapitalmarkt. Hierzu wur-

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den die HDAX-Geschäftsberichte aus den Geschäftsjahren 2018, 2019 und 2020 mittels einer qualitativen Inhaltsanalyse ausgewertet. Untersuchungsgegenstand waren das Volumen der Offenlegung, die berichteten Risikokategorien sowie Einzelrisiken über den genannten Zeitraum. Die Ergebnisse deuten darauf hin, dass die Anzahl der publizierten Einzelrisiken signifikant über die Jahre gestiegen ist. Besonders häufig wurden Währungsrisiken und Cyberrisiken thematisiert. Die Ergebnisse können Unternehmen und Stakeholder nutzen, um Best Practices der Risikoberichterstattung zu identifizieren. Dem Gesetzgeber bieten sie Anhaltspunkte für weitere gesetzliche Regulierung.

Die zweite Studie untersucht mittels einer Regressionsanalyse die Determinanten der Risikooffenlegung. Als Datengrundlage dienten ebenfalls die Geschäftsberichte der HDAX-Unternehmen zwischen 2018 und 2020. Die Determinanten wurden für das Volumen der Risikoberichterstattung, der Einzelrisiken sowie zu Maßnahmen zur Risikosteuerung ermittelt. Die Ergebnisse tragen dazu bei, die Einflussfaktoren zu erkennen, was wiederum z.B. Anlegern dabei unterstützen kann, fundierte Entscheidungen zu treffen.

Die dritte Studie untersucht die Textunähnlichkeit sowie deren Determinanten der Risikoberichterstattung am US-amerikanischen Kapitalmarkt im Zeitraum von 2005 bis 2022. Die Gesamtstichprobe beträgt 29.070 Unternehmensjahrbeobachtungen. Die Ergebnisse bieten empirische Belege, dass die Risikoberichterstattung nur zu wenigen Teilen regelmäßig angepasst wird, es sei denn es kommt zu unvorhergesehenen Ereignissen wie der Finanzkrise oder der COVID-19 Pandemie. Hinsichtlich der Determinanten zeigt sich, dass insbesondere Risikokennzahlen sowie auditspezifische Kennzahlen die Textunähnlichkeit beeinflussen.

Die vierte Studie beschreibt die Ergebnisse einer qualitativen Inhaltsanalyse der Unternehmen im HDAX für das Geschäftsjahr 2019 hinsichtlich der Berichterstattung über Risikomanagementsysteme. Die Ergebnisse deuten auf eine heterogene Berichterstattung hin. Hinsichtlich der Basiselemente des IDW Prüfungsstandards IDW PS 981 zeigt sich, dass durchschnittlich 6,52 von 8 Elemente berichtet werden. Es ist jedoch zu erkennen, dass nur wenige Unternehmen berichten, dass sie sich an einem Risikomanagementstandard orientiert haben. Ebenfalls auffällig ist, dass ausschließlich vier Unternehmen angeben, ihr Risikomanagementsystem freiwillig geprüft zu haben. Auch wenn die Ergebnisse eine grundsätzlich hohe Berichterstattungsqualität erkennen lassen, können Best Practices für die Berichterstattung identifiziert werden, was ebenfalls Anhaltspunkte für gesetzliche Regulierungen bietet.

Die fünfte Studie widmet sich der Berichterstattung von IT-Risiken. Durch zunehmende Digitalisierung und technologische Trends ist die Betrachtung von neuartigen Risiken, wie IT-Risiken, von besonderer Relevanz. Mittels einer qualitativen Inhaltsanalyse wurden die Geschäftsberichte des Jahres 2020 der DAX- und MDAX-Unternehmen ausgewertet. Die Ergebnisse zeigen ebenfalls eine heterogene Berichterstattung. Besonders auffällig ist, dass nur 25 der 90 Unternehmen angeben, sich an internationalen Standards zu orientieren, wohingegen sich sogar nur zwölf zertifiziert haben lassen. Eine Cyberversicherung wird ebenfalls nur selten



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thematisiert. Auch diese Studie bietet Hinweise auf Best Practices der Berichterstattung über IT-Risiken und kann für den Regulator eine Grundlage sein, weitergehende Normierung der Risikoberichterstattung anzustoßen.

Auf Basis eines Experiments untersucht die sechste Studie, wie deutsche Banker die freiwillige Prüfung des Risikomanagementsystems wahrnehmen. Dazu wurden 145 Banker zu ihrer Einschätzung hinsichtlich des Vertrauens, der Kreditvergabe, der Investitionsbereitschaft sowie der Anlageempfehlung eines hypothetischen Unternehmens befragt. Hierfür wurden die Prüfung selbst, die Anbieter der Prüfungsleistung sowie das Assurance Level manipuliert. Die Ergebnisse deuten darauf hin, dass eine freiwillige Prüfung das Vertrauen in das Risikomanagementsystem, die Wahrscheinlichkeit zur Gewährleistung eines Kredites sowie die Investitionsbereitschaft und Anlageempfehlung signifikant erhöht. Obgleich scheint bei der Entscheidung der Teilnehmer sowohl der Prüfer sowie das Assurance Level keine entscheidende Rolle zu spielen, so dass konstatiert werden kann, dass das bloße Vorhandensein der Prüfung als hinreichend angesehen wird. Aus regulatorischer Sicht könnte die Einführung einer obligatorischen Prüfung des Risikomanagementsystems in Betracht gezogen werden. Darüber hinaus zeigen die Ergebnisse, dass Unternehmen von der freiwilligen Prüfung direkt profitieren können, da sich dadurch die Chancen auf eine Finanzierung erhöhen können.

Die siebte Studie untersucht die freiwillige Prüfung der Cybersecurity sowie den Kauf einer Cyberberrisikoversicherung ebenfalls mittels eines Experiments. Hierzu wurden 100 Privatinvestoren hinsichtlich ihrer Aktienkaufwahrscheinlichkeit befragt. Manipuliert wurde das Vorhandensein einer Prüfung sowie das Vorhandensein einer Cyberversicherung. Ein zusätzliches Experiment variierte den Assurance Provider. Die Ergebnisse des Experiments deuten auf eine positive Wahrnehmung einer freiwilligen Cybersecurity Prüfung und Cyberversicherung hin. So sind Privatinvestoren eher geneigt, in geprüfte oder versicherte Unternehmen zu investieren. Dagegen scheint der Assurance Provider für unsere Teilnehmer irrelevant zu sein, so dass das bloße Vorhandensein der Prüfung als hinreichend betrachtet wird. Aus regulatorischer Sicht könnte aufgrund der hohen Relevanz von Cyber-Risiken die Einführung einer obligatorischen Prüfung der Cybersecurity und/oder einer obligatorischen Cyber-Risikoversicherung in Betracht gezogen werden. Außerdem zeigt sich, dass die Unternehmen unmittelbar von der freiwilligen Prüfung profitieren können, da sich dadurch eine Eigenkapitalfinanzierung erhöhen könnte.

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# List of Abbreviations

AICPA	American Institute of Certified Public Accountants
AktG	German Stock Corporation Act
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
CC	Comprehension Check
COSO	Committee of Sponsoring Organizations of the Treadway Commission
CPA	Certified Public Accountants
CSRD	Corporate Sustainability Reporting Directive
DFG	German Research Foundation
EDGAR	Electronic Data Gathering, Analysis, and Retrieval
ESG	Environmental, Social, Governance
FISG	The Financial Market Integrity Strengthening Act
GAAP	Generally Accepted Accounting Principles
GAS	German Accounting Standards
GBP	Great British Pound
HGB	German Commercial Code
IDW	Institute of Public Auditors in Germany
IFRS	International Financial Reporting Standards
ISO	International Organization for Standardization
IT	Information Technology
KonTrag	Law on Control and Transparency in Business
OLS	Ordinary Least Squares
RMS	Risk Management System
RQ	Research Question
SEC	Securities and Exchange Commission
SOX	Sarbanes-Oxley Act of 2002
TCB	Technical Control Board
UK	United Kingdom
US	United States

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# Chapter 1

## Introduction

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## 1.1 Motivation and Overall Research Question

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Companies face various operational and strategic risks<sup>1</sup> in their day-to-day business operations that can affect their financial performance, competitiveness, and long-term profitability. Trends such as globalization and rapid technological development are changing the dynamics of and uncertainties facing businesses, as well as increasing the likelihood of crises (Meyer, 1982; Kunc and Bhandari, 2011; Nair et al., 2014). Examples include the far-reaching COVID-19 pandemic (Alles, 2021; Dutta et al., 2023; Roberts et al., 2023), large-scale cyberattacks (Chen et al., 2023), accelerating climate change (Kim et al., 2023) and geopolitical conflicts (Caldara and Iacoviello, 2022). Furthermore, the global financial crisis of 2008 revealed significant weaknesses in risk management practices as a part of corporate governance (Kirkpatrick, 2009; Soin and Collier, 2013). As demonstrated by notorious business scandals at Enron (2001), Lehman Brothers (2008), Wells Fargo (2016), Carillion (2017), and at Wirecard (2020), risk management remains an ongoing subject for practitioners and academics. Given the relevance of and rapidly changing exposure to risks, it is essential for managers to carefully analyze information about risk sources and impacts (Ibrahim and Aboud, 2023). Additionally, corporate failures and crises have drawn the attention of stakeholders to the importance of risk-related information (Dobler, 2008; Said Mokhtar and Mellett, 2013).

Effective risk management is an essential mechanism for addressing these challenges (Liebenberg and Hoyt, 2003; Fraser and Simkins, 2007; Baxter et al., 2013; Lundqvist, 2014; Lundqvist, 2015). Therefore, the importance of risk management systems as an element of corporate governance is increasing (Brown et al., 2009; Manab et al., 2010; Mikes and Kaplan, 2015). Originally limited mainly to banks and financial institutions, risk management has now expanded its reach across various industries and organizational structures (Huber and Scheytt, 2013). Beyond implementing organizational and operational structures for identifying, assessing, and managing risks, elevating awareness among individuals within the company is equally fundamental. However, approaches to risk management are not standardized across organizations. Some organizations invest substantially in developing formal and strategically focused company-wide risk management processes. In contrast, others adopt a less formal and less focused approach, allowing for less structured risk management (Beasley et al., 2023). The concrete implementation of risk management is determined by the individual company. However, a study by Nair et al. (2014) demonstrated that companies with a well-established risk management system are more capable of managing crises. To support companies in implementing such systems, several risk management standards have been published and disseminated

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<sup>1</sup> The term risk is not consistently defined in the literature. The ISO 31000 (2018) risk management standard defines risk as the impact of uncertainty on objectives, which refers to a deviation from expectations. This deviation can be positive, negative, or both. In contrast, the COSO (2004) defines risk as the possibility that an event will occur and have a negative impact on the achievement of objectives.

across countries in recent years (e.g., COSO, 2004, IDW AsS 981, 2017, ISO 31000, 2018).<sup>2</sup> For instance, the basic components of a risk management system suggested by IDW AsS 981 (2017) are “risk culture”, “objectives”, “organization”, “risk identification”, “risk assessment”, “risk response”, “risk communication” and “monitoring and improvement of the risk management system”. Regarding the “risk response” various risk management strategies exist for dealing with risks, depending on the company’s risk diagnosis and acceptance (IDW AsS 981, 2017; ISO 31000, 2018). For example, risks can be avoided by restricting certain business activities, or reduced to third parties by purchasing insurance. Furthermore, the effectiveness and appropriateness of the risk management system can be ensured through voluntary assurance, which can directly reduce risks through appropriate risk management practices.

However, it is not the mere implementation of the risk management system that is relevant, but also the communication of risks and measures that the company intends to take to manage them (Beretta and Bozzolan, 2004). By disclosing risk-related information, managers can demonstrate their risk management capabilities and thus mitigate the information asymmetry between the company and its stakeholders (Elshandidy et al., 2013). For external stakeholders, corporate communication such as risk disclosures in annual reports constitutes important publicly available information for assessing a company’s risk exposure. Risk disclosures are forward-looking and have the potential to narrow the gap between investor demand for and the supply of credible forward-looking information. Investors need this risk information, as it allows them to assess uncertainties related to a potential investment (Linsmeier et al., 2002; Elshandidy and Zeng, 2022). High-quality risk disclosures enable investors to invest in accordance with their risk preferences, and analysts frequently substantiate their stock recommendations with specific references to company risks (Yeo, 2021). Thus, management must ensure that investors are confident that risks and uncertainties are well managed (Beretta and Bozzolan, 2004).

Due to stakeholder pressure to disclose risks in periodic reports, national general accepted accounting principles (GAAP) or formal corporate governance best practice codes are increasingly being required worldwide (Moumen et al., 2015; Ibrahim and Aboud, 2023). However, corporate risk disclosure requirements vary widely around the world, ranging from purely discretionary to strictly mandatory (Moumen et al., 2015; Mazumder and Hossain, 2018).<sup>3</sup> As major economies in the world, the USA and Germany are at the forefront of regulation in the context of risk disclosure. The two countries differ in the use of common law in the USA and civil law in Germany.<sup>4</sup> Germany was the first country to issue an accounting standard (GAS 5, replaced by GAS 20) that requires companies to disclose risks (Ibrahim and Aboud, 2023). Risk

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<sup>2</sup> A comparison of risk management frameworks is discussed by Efe (2023).

<sup>3</sup> Several studies examine risk disclosure in mandatory and voluntary settings, see e.g., Elshandidy et al. (2013), Elshandidy et al. (2015), Elshandidy and Neri (2015), Nelson and Pritchard (2016), Cordazzo et al. (2017), Arena et al. (2023).

<sup>4</sup> This dissertation focuses primarily on research papers in the German and US contexts, which is why only their legal framework is explained as follows.



disclosure in Germany is mandatory for large and medium-sized companies in the management report in accordance with the German Commercial Code (Section 289 (1) HGB and Section 315 (1) HGB). GAS 20 specifies that companies should report not only on risks but also on their risk management system. Since 2005, the Securities and Exchange Commission (SEC) has required registered companies to disclose in their annual report (Form 10-K) the most important risks that could affect their business in Item 1A: Risk Factors (SEC, 2005). Thus, a key difference between the US and German approach is that in the former, managers consider only the impact of disclosing the risk, while in the latter they must consider the combined impact of disclosing the risk and mitigating it (SEC, 2016; Yeo, 2021). A study by Elshandidy et al. (2015) indicates that German companies are more inclined to supplement mandatory risk disclosure with voluntary disclosure than US companies.

In response to the Wirecard scandal, the German legislator introduced the Financial Market Integrity Strengthening Act (FISG) in 2021, which directly obliges listed companies to implement a risk management system. Before 2021, there was no direct obligation to implement such a system, only an implicit one that could be implied from management's general duty of care.<sup>5</sup> In the US, a risk management system is not mandatory, but rather an internal control system for financial reporting in accordance with SOX 404.<sup>6</sup> Despite the relevance to efficiently managing risks as discussed, an assurance of the risk management system is not mandatory in either Germany or the US.

As outlined, risk management systems and the associated risk disclosure are essential to corporate governance and are the focus of stakeholder interest. There has also been considerable academic interest in this topic for decades.<sup>7</sup> However, there is always a need for new research, as the corporate landscape is constantly evolving, and the regulatory environment has changed significantly in recent years. Several studies confirm the usefulness of risk reports for addressees such as investors (Kravet and Muslu, 2013; Miihkinen, 2013; Campbell et al., 2014). Nonetheless, many studies have raised concerns that risk disclosures lack usefulness, because they are too long, partly redundant, generic, and use boilerplate language (Linsley and Shrivess, 2005; Dyer et al., 2017). Considering these concerns it is relevant to shed light on textual properties and possible determinants in order to gain insights into potential factors influencing disclosure. Furthermore, numerous empirical research findings indicate a positive impact of (various) voluntary assurance services, but mainly in the CSR context (Moroney et al., 2012; Casey and

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<sup>5</sup> With the introduction of the Law on Control and Transparency in Business in 1998 (KonTraG), Section 91 (2) of the German Stock Corporation Act (AktG) required the Management Board to establish a monitoring system to identify risks to the company's continued existence at an early stage. However, this only referred to an early risk detection system.

<sup>6</sup> SOX 404 mandates that management of public companies evaluate the efficiency of their internal control systems and procedures for financial reporting. Additionally, the financial statement auditors of most public companies must validate and disclose the evaluation conducted by client management. There is extensive research on the effects of SOX 404 reporting, see Schneider et al. (2009).

<sup>7</sup> For a detailed overview of the literature in the context of risk disclosure, see e.g., Elshandidy et al. (2018), Isiaka (2021), Ibrahim et al. (2022), Ahmad Jaber and Mohammed Shah (2024).

Grenier, 2015; Quick and Inwinkl, 2020). However, risk management system assurance differs fundamentally from other assurance services in that it verifies the appropriateness and effectiveness of a management system, rather than whether a report is free from misstatements. The assurance of risk management systems and cybersecurity, as a subsystem of the risk management system, has so far received little attention in the academic landscape, but nonetheless represents a crucial determinant of success for the security and stability of companies due to high-risk exposure. This is further emphasized by Hay (2019) suggestion that there is a research gap regarding new forms of assurance. Knechel et al. (2020) comments further on the relevance and need for research related to cybersecurity risk management. In consideration of the above-mentioned reasons, this dissertation focuses on the disclosure of risks and the assurance of the risk management system, which results in the following two overarching research questions (RQ):

**Research Question 1: What exactly do companies disclose regarding their risk and risk management, and how do they do so?**

**Research Question 2: What is the impact of a risk management system assurance on various stakeholders?**

In the next section, I outline the general theoretical foundations of my dissertation. I briefly summarize the research papers included in this dissertation and classify them in relation to the overarching research questions.

## 1.2 Theoretical Background

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### 1.2.1 Theories of Risk Disclosure

Various theories explain why companies disclose risk-related information, generally assuming they will benefit from it. These include agency theory, signalling theory, and legitimacy theory (Urquiza et al., 2010; Cotter et al., 2011; Ibrahim et al., 2022; Isiaka, 2021; Shivaani et al., 2019).<sup>8</sup> In the following section, the theories are briefly summarized.

#### 1.2.1.1 Agency Theory

Agency theory deals with the relationship between the owners of a company (principals) and the managers (agents) who act on behalf of the owners (Jensen and Meckling, 1976; Fama and Jensen, 1983). The most commonly considered principal-agent relationship is between shareholders (as principals) and the management (as agents) of an organization. Other common principal-agent relationships include the relationship between creditors and shareholders (or management) and the relationship between management and employees (An et al., 2011). The separation of ownership and management, or the separation of risk-taking, decision-making and management functions, results in agency conflicts between the two parties (Jensen and Meckling, 1976; Fama and Jensen, 1983; Morris, 1987; An et al., 2011), and occurs when information is asymmetrically distributed and management takes actions to maximize its benefits at the expense of total shareholder wealth (Watts and Zimmermann, 1990; Shleifer and Vishny, 1997).

Numerous studies have been theoretically based on agency theory in the context of voluntary risk disclosure (Deumes and Knechel, 2008; Taylor et al., 2010; Elshandidy et al., 2013; Nahar et al., 2016; Achmad et al., 2017; Shivaani et al., 2019). Agency theory argues that the disclosure of risk-related information and risk management practices can reduce information asymmetry between management and reporting users (Singhvi and Desai, 1971; Tao and Hutchinson, 2013; Sekome and Tadesse Lemma, 2014; Elshandidy and Neri, 2015; Saggar and Singh, 2017; Shivaani et al., 2019). This disclosure enables report addressees to understand the company's risk exposure and the measures it takes to reduce it. As a result, well-founded investment decisions can be made, leading to efficient investments (Khan et al., 2023).

#### 1.2.1.2 Legitimacy Theory

Organizations strive for legitimacy for many reasons. The significance, complexity, and efficiency of legitimization endeavors may vary, depending on the criteria against which they are

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<sup>8</sup> The results of the systematic literature review by Ibrahim et al. (2022) reveal that agency theory, signalling theory, and legitimacy theory are the most frequently used in risk disclosure studies. These theories are also primarily used in the papers of this dissertation.

measured. In this context, legitimacy refers to the widespread perception or assumption that organizational actions align with accepted standards, values, and beliefs within a socially constructed system of norms and definitions (Suchman, 1995). Hence, legitimacy theory explains the voluntary action of a company to achieve a positive perception from society (Deegan, 2002). This voluntary behavior creates an implicit social contract between the organization and society, which requires adherence to established the rules, norms, and values (Cuganesan et al., 2010).

Voluntary disclosure has often been investigated using legitimacy theory (Oliveira et al., 2011a; Oliveira et al., 2011b; Said Mokhtar and Mellett, 2013; Shivaani et al., 2019). For instance, Oliveira et al. (2011b) conclude that voluntary risk disclosure increases legitimacy by allowing stakeholders to monitor the company and improve stakeholder perceptions of the company and its reputation.

### **1.2.1.3 Signalling Theory**

Signalling theory was initially developed to understand labor market behavior (Spence, 1973), and over time has been extended to other economic settings (e.g., accounting) (Connelly et al., 2011). Signalling theory explains the intentional reduction of information asymmetries through disclosing information as signals to the market (Spence, 1973). However, a signal is a costly behavior by the sender to communicate information to the receiver. The receiver is generally aware that only specific senders can afford to send such a signal (Moore, 2003). Signalling theory suggests that companies can build trust by performing regular actions perceived by others as positive relationship signals (Six et al., 2010). By sending a voluntary signal, the partner communicates trust, which enhances reciprocal interest in maintaining the partnership (Vosselman and van der Meer-Kooistra, 2009; Six et al., 2010; Diong et al., 2018). However, should a false signal be sent and detected, further disclosure will be considered untrustworthy (Watson et al., 2002). Research shows that companies adapt their signal to the specific information needs of users (Ross, 1977; Thakor, 1990; Cho et al., 2014; Cheng et al., 2015).

Managers can signal their quality and ability to identify, measure, and manage risk, differentiating themselves from other managers who may be perceived as less effective in risk management (Elshandidy et al., 2013). Voluntary disclosure of risk-related information offers such signal to the market, which might provide information to stakeholders for enabling them to make.

## **1.2.2 Theories of Assurance**

Regarding assurance engagement, agency theory, legitimacy theory, and signalling theory are relevant. While the theories themselves have already been described in the previous section, they will be discussed below in the specific context of assurance. In addition to the mere engagement of an assurance service, the characteristics of the assurance provider play a decisive role. Therefore, source credibility theory and the theory of professions are described below. Finally, the relevance of the assurance level is also included in this section.

### **1.2.2.1 Agency Theory**

Mechanisms, like the engagement of assurance services, are intended to control and reduce opportunistic managerial behavior. Previous research has demonstrated that management tend to act in their own interest when they have the incentive and opportunity (Jensen and Meckling, 1976; Booth and Schulz, 2004; Agoglia et al., 2015). That is why there is a moral hazard problem, namely that management does not take care of its risk management appropriately, due to the tendency to prioritize its own interest, such as short-term earnings. Therefore, voluntary assurance can reduce information asymmetries between management and stakeholders (Booth and Schulz, 2004; Cuadrado-Ballesteros et al., 2017; Carey et al., 2021). Furthermore, stakeholders are not able to assess the risk management themselves because, such monitoring is costly. Thus, an external assurance can ensure the effectiveness of the management system (Jensen and Meckling, 1976).

### **1.2.2.2 Legitimacy Theory**

Some studies suggest that voluntary assurance service can positively influence the legitimacy of a company or the object of the assurance (Kolk and Perego, 2010; O'Dwyer et al., 2011; Quick and Sayar, 2021). Assurance supports monitoring by stakeholders, which in turn promotes perceived legitimacy. External assurance can be a valuable instrument for addressing concerns about the appropriate treatment of risks, thereby legitimizing the company's risk management system. Voluntary assurance can enhance the company's reputation. Reputation is vital in the context of competition, because it is inherently difficult to imitate (Branco and Rodrigues, 2006). Regarding legitimacy theory, risk management system assurance can be considered as a management instrument that deflects various social pressures from a company.

### **1.2.2.3 Signalling Theory**

Prior research has demonstrated that voluntary assurance conveys a signal to stakeholders (Datar et al., 1991; Libby et al., 2004; Alon and Vidovic, 2015; Cheng et al., 2015). Therefore, the engagement of voluntary assurance of a risk management system and the related disclosure of the outcomes can be understood as a signal that increases trust in the respective management system (Alon and Vidovic, 2015). This signal indicates the active management of risks within the company, which, if implemented adequately, should lead to more positive perceptions by stakeholders.

### **1.2.2.4 Theory of Professions**

The theory of professions examines and explains the features, dynamics, and institutions that characterize and influence certain professions. The public has a legitimate and substantial interest in professional regulations which ensure that activities are carried out efficiently and effectively and with high integrity. At the same time, the public cannot always assess the quality

of services. Nevertheless, they can normally assume that they can rely on professional designations (Canning and O’Dwyer, 2001). Formal education and training are crucial characteristics of a profession (Canning and O’Dwyer, 2001; Chen and van Akkeren, 2012). This is usually bindingly defined by law and certified, for example, in Germany by the Chamber of Public Accountants or in the US by the American Institute of Certified Public Accountants (Marten et al., 2020). Accordingly, a profession is recognized as an authority in its discipline and has a particular credibility. In addition, the members of a profession are obliged to work according to defined ethical codes (i.e., certain norms, values, and expectations regarding behavior). Professional bodies develop and issue professional, ethical standards which their members are expected to adhere to. Also, professional bodies usually supervise and assess their members, and if necessary, take disciplinary action if their performance is inadequate or inappropriate. Furthermore, a profession strives to implement skills and knowledge in an ethical and altruistic manner, i.e., neither in its own interests nor in those of the client, but in the interests of society (Aranya et al., 1981; Abbott, 1988; Freidson, 1989; Macdonald, 1995; Ackroyd, 2016; Saks, 2016). Another characteristic of a profession is that it is trusted by the public (Maurice, 1996).

The provision of voluntary assurance services, such as risk management system assurances, is typically not limited to audit firms.<sup>9</sup> Besides audit firms, third-party assurance providers also provide such services on the open market. According to the above criteria of the theory of professions, auditors belong to a profession, which can and should result in a positive perception, e.g., by investors.

#### **1.2.2.5 Source Credibility Theory**

The credibility of information sources plays a pivotal role in decision-making (Pornpitakpan, 2004; Schwarzkopf, 2006). Source credibility theory posits that a source is perceived as more credible if it has more expertise, which pertains to the perceived competence of the source providing the information and that it has higher trustworthiness (Birnbaum and Stegner, 1979; McGinnies and Ward, 1980; Pornpitakpan, 2004). The theory has already been examined in various dimensions, such as bankers’ lending decisions (Beaulieu, 1994; Beaulieu and Rosman, 2003), investor behavior (Christensen et al., 2014) or in the context of audit committee members (DeZoort et al., 2003). Since the theory is based on the competence of a particular source, one can expect information regarding voluntary assurance engagement to be viewed with skepticism if it originates from a source with low credibility. For example, a company’s internal audit department may be less able to assess the quality of its management system by itself than an external assurance provider. In addition, the addressees (e.g., investors or lenders) of assured information may not be able to assess the level of competence of a certain assurance provider (i.e., a specific audit firm). Therefore, the credibility of the source as perceived by investors is likely to be influenced by the group to which the source belongs (e.g., audit firms). In terms

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<sup>9</sup> Only certified public accountants are permitted to carry out audits of financial statements. Usually, other audits can be carried out by anyone with sufficient experience and expertise (Marten et al., 2020).

of the provision of assurance services by an audit firm, the associated assessments regarded as of higher quality than those of a third-party provider (non-audit firm), based on the depth of expertise (Brierley and Gwilliam, 2003).

When a company engages voluntary assurance and discloses the results, the credibility of the assurance subject, e.g., the management system, can potentially be increased. The source of the assessment, i.e., the assurance provider, is decisive in this respect. A positive perception may be indicated if a perceived high level of competence can be attributed to the assurance provider. As a result, the addressees can assess the management system even more effectively with information about the assurance provider, which in turn influences their decision (e.g., willingness to invest, granting of credit).

#### **1.2.2.6 Assurance Level**

An assurance's primary goal is to enhance stakeholder confidence in a company by providing an opinion on the effectiveness of the assured object. A crucial aspect of this assurance is its level, which refers to the providers' self-declared confidence in their opinion. The different assurance levels, defined by national and international assurance standards, are mostly "reasonable" and "limited" assurance (ISAE 3000, 2013).<sup>10</sup> Both reasonable and limited assurance offer an acceptable level of confidence in the information. However, it is important to note that a limited assurance engagement yields a lower level of confidence than a reasonable assurance engagement. Reasonable assurance engagement reflects an opinion on the outcome of the measurement or evaluation of the underlying matter. On the other hand, limited assurance engagement indicates that the auditor has not become aware of any matters suggesting that the subject-matter information has not been prepared, in all material respects, in accordance with the applicable criteria. The auditor's conclusion of a reasonable assurance engagement should be formulated in a positive form, while a limited assurance engagement should be formulated in a negative form (ISAE 3000, 2013).

Assurance services are considered a credence good, meaning that the actual level of assurance cannot be observed (Causholli and Knechel, 2012). This leads to agency-theoretical problems in the form of hidden actions, as the audit effort remains unclear (Arrow, 1984; Grossman and Hart, 1986). However, assurance standards regarding the level play a crucial role in mitigating the hidden action problem (Jensen and Meckling, 1976). They ensure that the assurance provider adheres to the standards and rules of the profession, thereby reducing the moral hazard risk (Jensen and Meckling, 1976; Hart and Moore, 1990; Kühle and Quick, 2024).

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<sup>10</sup> However, other standards, such as the global consulting and standards organization AccountAbility (2020), use the terms "high" and "moderate" assurance.

### 1.2.3 Relationship Between the Theories

The theoretical framework of this dissertation is an adaptation and extension of An et al. (2011) and Bhuyan (2018). Following the theories explained above, these are now considered in relation to each other. Figure 1 illustrates the relationship. Agency theory, signalling theory, and legitimacy theory are relevant for any voluntary disclosure of risk-related information, as well as in the context of voluntary assurance. This may relate to the disclosure of risks, risk management practices, or the assurance of risk management system. In addition, the characteristics of the assurance provider using source credibility theory, the theory of profession as well as the assurance level, are essential in explaining the effect of assurance.

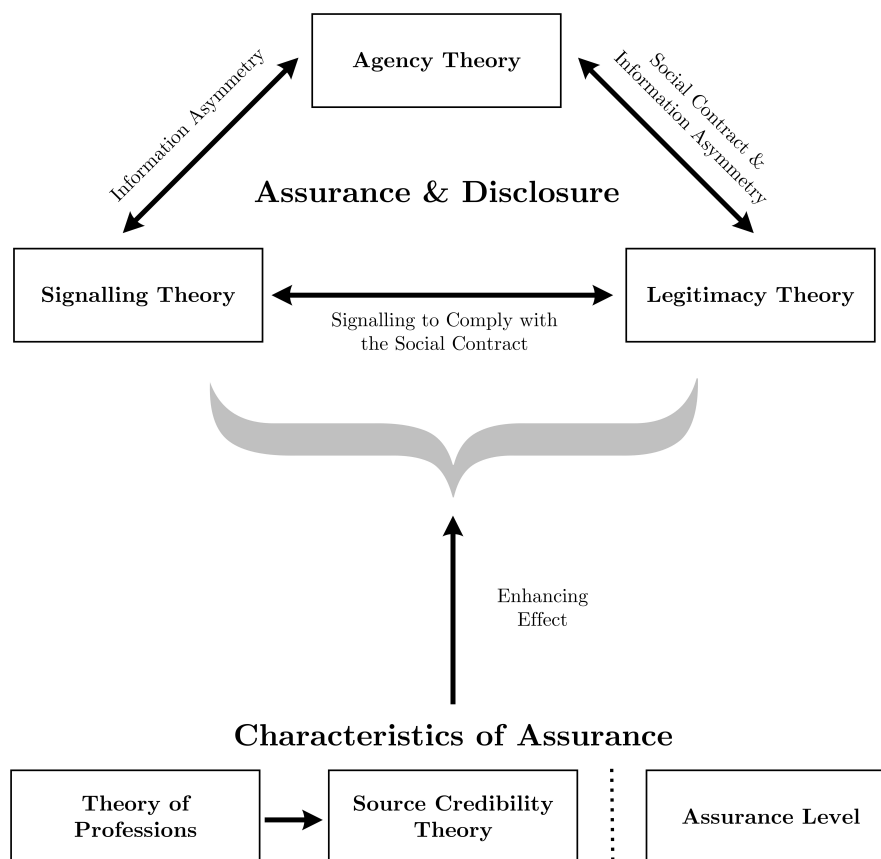


Figure 1: Theoretical Framework, based on An et al. (2011) and Bhuyan (2018)

Agency theory refers to a potential information asymmetry between management and investors, which may lead to agency problems, such as hidden actions. Signalling theory deals with the solution of this information asymmetry and ties in with agency theory. A signal can reduce this information asymmetry, and be provided by the engagement of voluntary assurance. The disclosure of risk-related information is also a signal which helps investors to assess the company's risk exposure. This risk disclosure regularly takes place in corporate reporting, such as annual reports, which has a direct influence on report addressees. Information asymmetry according to agency theory also exists in relation to the legitimacy of the company. A voluntary



assurance of the risk management system can eliminate concerns regarding risk management, and stakeholders can legitimize the system. Furthermore, by voluntarily disclosing risk-related information, the company can legitimize itself to stakeholders and reduce information asymmetries. An implicit social contract between the company and stakeholders characterizes the connection between signalling theory and legitimacy theory. Stakeholders expect the company to manage and disclose risks appropriately, conforming to this implicit social contract. By sending a signal, the company demonstrates that it adheres to the social expectations set out in the implicit social contract. As a result, the company's risk management practices and transparent risk disclosures demonstrate its interest in maintaining the partnership with its stakeholders.

In addition, there are theories regarding the characteristics of assurance. The theory of professions, in combination with source credibility theory, provides insights into why and to what extent assurance providers can influence perceptions and decisions. Whether the assurance provider belongs to a profession might be a relevant factor. Generally, it can be assumed that a profession has high credibility and expertise, which should lead to positive perceptions. The theory of profession, therefore, directly impacts source credibility theory, which argues that a source is considered credible if a high level of expertise, competence, and trustworthiness can be attributed to it. Under the theoretical assumption that these characteristics are attributed to the assurance provider, a positive effect follows using source credibility theory. In addition, the assurance level reflects the extent to which the assurance has been conducted, and indicates adherence to assurance standards. Therefore, these positive effects should enhance the construct, according to agency theory, signalling theory, and legitimacy theory. Consequently, a signal regarding the assurance provider and the assurance level will reduce information asymmetries and legitimacy requirements in the light of stakeholder expectations.

## 1.3 Overview of Dissertation and Synopses

As outlined in the motivation section, my two overarching research questions address what and how companies disclose regarding risks and risk management (RQ 1) and what impact does the risk management system assurance have on various stakeholders (RQ 2). A total of seven research papers, presented in two separate chapters, answer these overarching research questions. Chapter 2 focuses on five research papers that cover the context of risk disclosure. Chapter 3 presents two experiments in the context of risk management system related assurances services. The following seven research questions are not necessarily found in this form in the research papers as research questions or hypotheses. Instead, they summarize the underlying conceptual idea of the individual contributions and relate to the overarching research questions of my dissertation.

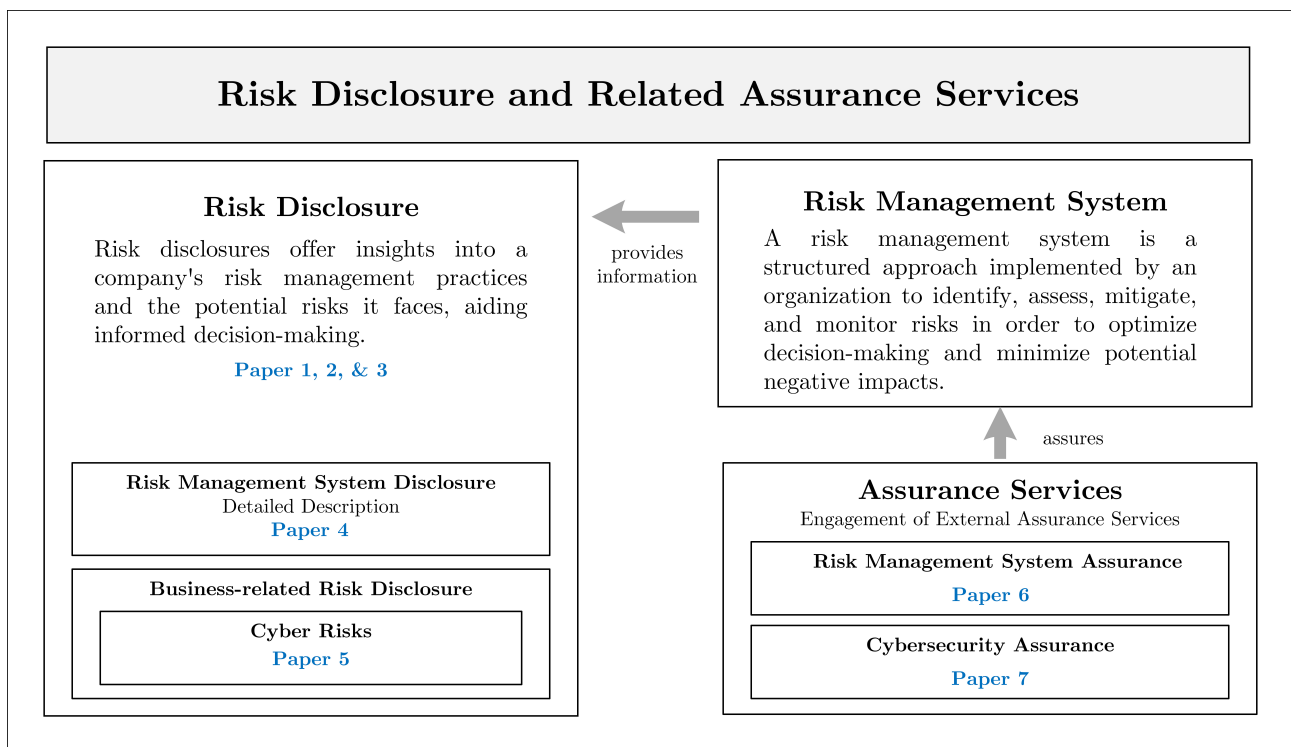


Figure 2: Theme clustering of research papers

Figure 2 clusters the seven research papers into a conceptual framework.<sup>11</sup> A risk management system is a structured approach implemented by an organization in order to identify, assess, mitigate, and monitor risks to optimize decision-making and minimize potential negative impacts. This system provides information for preparing the risk report, which allows insight into an organization's risk management practices and the potential risks to which it is exposed, helping stakeholders (e.g., debt and equity providers) make informed decisions. Papers 1, 2

<sup>11</sup> The papers are presented in this order, so that the reader can move from a more general topic to more specific ones in order to delve deeper into the subject.

and 3 can be seen in the context of general risk disclosure. Paper 1 describes qualitative risk disclosure in the German context, whereas paper 2 focuses on its determinants. Paper 3 focuses on the US capital market and looks at the year-over-year textual dissimilarity of risk disclosure and the determinants that could explain the occurrence of this dissimilarity. Paper 4 is dedicated to one part of the risk disclosure, namely reporting on risk management systems. A significant part of the risk report describes the company-related risks. The risk report regularly includes cyber risks, and therefore, Paper 5 examines the disclosure of cyber risks. A company may voluntarily engage external assurance providers to assure the appropriateness and effectiveness of its management systems. Hence, paper 6 presents research findings in the context of risk management system assurance services, and paper 7 presents a more specific context of cybersecurity assurance.

Table 1 presents a detailed overview of the research papers, including the title, context, research questions, associated data, and method, which is summarized in the following of this section. Research papers 1 to 5 are classified in the broader context of risk disclosure, whereas research papers 6 and 7 are classified in the context of assurance. The studies used multiple research methods.

**Paper 1** The first empirical study (Section 2.1) qualitatively analyzes risk disclosure in the German capital market. The annual reports of a total of 67 companies that were continuously listed in the HDAX were analyzed for the reporting years 2018, 2019, and 2020. Among other things, we manually collected data on disclosure volume, risk categories, and individual risks. The research question of the paper is:

**RQ 1: What risks do German companies disclose?**

The results of the three-year investigation period, influenced by the COVID-19 pandemic, indicate that the number of published individual risks increased significantly from 2018 to 2020. Currency risks and cyber risks (or IT risks) were reported most frequently. The individual risks could be attributed to external origins in particular. The findings are consistent with the theoretical construct of self-serving bias, which assumes that individuals attribute positive developments to themselves, while negative developments are often shifted to the environment.

**Paper 2** Using the same sample as in paper 1, we use regression analyses to investigate which company characteristics influence risk disclosure (Section 2.2). Firstly, the determinants of the disclosure volume were examined, secondly the determinants of the individual risks disclosed, and thirdly the risk management measures. The research question is:

**RQ 2: What are the determinants of risk disclosure in Germany?**

The results regarding the determinants of disclosure volume, reveal a positive impact of company size and beta factor. Regarding the determinants of individual risks and risk management measures, we also find a positive impact of company size, beta factor and furthermore a positive impact of free float and US-listing. The findings are consistent with agency theory, which

explains that larger companies are subject to a higher degree of information asymmetry. More extensive disclosure might therefore reduce agency costs.

**Paper 3** The third research paper (Section 2.3) investigates the textual dissimilarity of risk disclosure in the US and its determinants. For this purpose, a text mining approach was used to retrieve Item 1A risk reports of Form 10-K from the SEC's EDGAR database for all data available in Compustat. The texts of Item 1A were extracted, preprocessed, and finally analyzed for year-over-year textual dissimilarity. The data set comprises the period from 2005 to 2022. The research question of the project is:

**RQ 3: What are the determinants of textual dissimilarity in 10-K risk disclosure?**

The results suggest that the dissimilarity of average company disclosures from year over year is very low, unless serious and unexpected events occur, such as the COVID-19 pandemic. This means that the disclosure of risks from year to year leads to a non-significant gain in information. Multiple determinants impacting textual dissimilarity, in particular risk variables and audit characteristics, were identified.

**Paper 4** The fourth research paper (Section 2.4) uses a qualitative content analysis to assess reporting on risk management systems. The annual reports of HDAX companies for the 2019 financial year and the deviating 2018/2019 fiscal year were examined. The sample was reduced, among other things, by eliminating companies based abroad. The final sample consists of 96 companies. The evaluation focused on the intensity and content of reporting. The research question is:

**RQ 4: How do companies disclose information regarding risk management systems?**

The results of the study indicate heterogeneous reporting. Information on the risk management system was included in all annual reports. Concerning the basic components of the assurance standard IDW AsS 981, the scope of the basic risk management system components averages 6.52 out of 8. The absolute and relative scope, measured by words of reporting, varied considerably. Likewise, only a few companies disclose on risk management frameworks such as ISO 31000. In contrast to the mandatory audit of the risk early-detection system, assurance of the risk management system is voluntary. Although the assurance and associated disclosure can be expected to have a positive impact on stakeholders, only four out of 96 companies report that such an assurance has been conducted. In general, the findings indicate a high quality of reporting. Gaps are not evidence of an insufficient risk management system, as the disclosure may only provide limited insight into the risk management system actually implemented.

**Paper 5** As the findings from research paper 1 have already highlighted that IT risks are considered one of the top single risks, the fifth research paper (section 2.5) provides a more in-depth view of reporting these risks. A qualitative content analysis was performed on the risk reports of DAX and MDAX companies for the 2020 annual reports. The final sample consists

of 90 companies and covers all those in the mentioned indices. The investigation focus on the intensity of reporting and the specific content. Thus, the research question is:

**RQ 5: What IT risks do German companies disclose?**

For most companies in the sample, corresponding sections on IT risks can be found in the annual report. However, such a section is labeled with different headings (e.g., cyber risks, IT risks). The intensity of reporting can also be described as heterogeneous. Notably, only 25 of 90 companies adhere to international standards such as ISO 27001. Only 12 companies indicate that they are certified according to an international standard. Insurance against IT risks is also rarely mentioned in the reporting. Data security, system failures, and technical security architectures are frequently reported in the context of IT risks. By contrast, there are barely any mentions of encryption concepts or penetration tests. The results indicate some shortcomings in reporting, although this is not necessarily evidence of insufficient attention being devoted to IT risks.

**Paper 6** Research paper 6 (Section 3.1) uses a 2x2+1 between-subject design to examine the relevance of the risk management system assurance with respect to 145 German bankers. Participants were presented with information about a hypothetical company. We manipulated the effect of the audit provider (audit firm vs. third-party provider) and the assurance level performed (limited assurance vs. reasonable assurance). Furthermore, there was a control group without an assurance of the risk management system. As dependent variables, participants were asked to assess their confidence in the risk management system, the probability of a loan being granted, the probability of an investment recommendation, and the probability of investing themselves. The research question that the study investigates is:

**RQ 6: What is the impact of a risk management system assurance on bankers' decisions?**

The results of the experiment indicate that an assurance of the risk management system increases bankers' reliance on the system and the likelihood of granting a loan. In addition, both investment recommendations and own investments are more likely. These results align with the theoretical construct of legitimacy theory and signalling theory, which assume that companies reduce pressure from society through voluntary measures (in this case, by assuring the risk management system) and reduce information asymmetry through signals to its stakeholders, thereby building trust with them. However, the results show that neither the assurance provider nor the assurance level impacts on the participants' decisions, and that the mere existence of an assurance is perceived as sufficient.

**Paper 7** Paper 7 (Section 3.2) uses a 2x2 between-subject experimental design to investigate the relevance of cybersecurity assurance and cyber risk insurance. The participants were presented with information about a hypothetical company in which we manipulated the assurance of cybersecurity (yes vs. no) and the purchase of cyber risk insurance (yes vs. no). The final

sample consisted of 100 non-professional investors from the UK, who were acquired via the online participant platform Prolific. The dependent variable was the willingness to invest in the hypothetical company. In addition, the importance of the assurance providers (audit firm vs. third-party provider) was examined using a further 2x1 experiment. The research question of the paper is:

**RQ 7: What is the impact of a cybersecurity assurance and insurance against cyber risks on non-professional investors?**

The experimental results reveal that cybersecurity assurance and cyber risk insurance increase participants' willingness to invest. In addition, the results indicate that the presence of at least one measure (assurance or insurance) is perceived more favorably than neither of these measures. These effects are induced by a reduced perception of risk, which increases the willingness to invest. The findings are consistent with the theoretical construct of source credibility theory, which assumes that the quality of the cybersecurity system is perceived to be higher due to external assurance. In addition, the signal to the market participant confirms that the company values the relationship with the stakeholder and increases trust through assurance or insurance. Furthermore, the results of the additional experiment suggested that the choice of assurance provider is irrelevant, and that the mere existence of the assurance service is considered sufficient.

The following sections contain summaries of the research papers. All papers were written with the listed co-authors, with me as the primary author. For this reason, the first-person plural (we, us, our) is used regularly. Some of these research papers have already been published (paper 1, paper 2, paper 4, paper 5, paper 6). Paper 7 is an accepted but not yet published manuscript. However, I decided not to include them in the main text of this dissertation, in order to ensure consistency in terms of formatting and language.<sup>12</sup> The title, abstract, and reference are in the respective subchapters. Paper 3 is a submitted working paper and is currently under review.

This dissertation concludes in Chapter 4 with a summary, overall contribution, limitations, and avenues for future research.

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<sup>12</sup> Papers 1, 2, 4 and 5 were published in German. Therefore, the titles and abstracts were translated for this dissertation to ensure a consistent picture. The bibliographical reference shows the German title.

Table 1: Overview of the research papers

Paper	Title	Context	Research Question	Data/Participants	Methodology
1	Risk Disclosure in HDAX Companies: Qualitative Analysis	Risk Disclosure	What risks do German companies disclose?	HDAX companies (2018-2020)	Qualitative Content Analysis
2	Risk Disclosure in HDAX Companies: Quantitative Analysis	Risk Disclosure	What are the determinants of risk disclosure in Germany?	HDAX companies (2018-2020)	Archival & Qualitative Content Analysis
3	Determinants of Textual Dissimilarity in 10-K Risk Disclosure	Risk Disclosure	What are the determinants of textual dissimilarity in 10-K risk disclosures?	US data (2005-2022)	Archival & Text Mining
4	Reporting on Risk Management Systems	Risk Disclosure	How do companies disclose information regarding Risk Management Systems?	HDAX companies (2019)	Qualitative Content Analysis
5	Disclosure of IT Risks in the Risk and Opportunity Report of DAX and MDAX Companies	Risk Disclosure	What IT risks do German companies disclose?	DAX and MDAX companies (2020)	Qualitative Content Analysis
6	Is Assurance on Risk Management Systems Relevant for Bankers' Decisions?	Assurance Services	What is the impact of a risk management system assurance on bankers' decisions?	145 German bankers	Experiment
7	Assure or Insure Cyber Risk? Non-Professional Investors' Willingness to Invest	Assurance Services	What is the impact of a cybersecurity assurance and insurance against cyber risks on non-professional investors?	100 UK Non-professional investors	Experiment

## 1.4 Further Research Papers

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Additionally to the papers mentioned in the previous section, the following ones were published during my time as a research associate and doctoral candidate. However, these articles are not part of this dissertation:

- Quick, R., Gauch, K., and Niekrawietz, A. (2021). Prognoseberichterstattung am deutschen Kapitalmarkt. *Der Konzern* 19(3), 104-113.
- Quick, R., Pappert, N., and Gauch, K. (2021). Praxis der nichtfinanziellen Berichterstattung zu Sozialbelangen und deren Prüfung im DAX-30. *IRZ – Zeitschrift für Internationale Rechnungslegung* 16(5), 239-243.
- Quick, R., Gauch, K., and Pappert, N. (2021). Nichtfinanzielle Berichterstattung zu den Umweltbelangen in den Geschäftsberichten der DAX-30-Unternehmen. *Betriebs-Berater* 76(15), 875-879.
- Quick, R. and Gauch, K. (2021). Berichterstattung über Risikomanagementsysteme. *Zeitschrift für Risikomanagement* 5(2021), 116-120.
- von Ahsen, A. and Gauch, K. (2022). Opportunities and Challenges of Purpose-Led Companies: An Empirical Study Through Expert Interviews. *Corporate Reputation Review* 25(3), 198-211.
- Quick, R., Gauch, K., and Heinze M. (2023). Qualität der Corporate-Governance-Berichterstattung in Deutschland. *Der Betrieb* 76(16), 913-917.
- Quick, R., Gauch, K., and Messingschlager, S. (2023). Zusammensetzung von Prüfungsausschüssen am deutschen Aktienmarkt. *Die Wirtschaftsprüfung* 76(9), 537-543.
- Quick, R., Gauch, K., and Ballering, R. (2024). Kompetenzprofile von Aufsichtsrats- und Prüfungsausschussmitgliedern. *Zeitschrift für Corporate Governance* 1(24), 24-28.
- Quick, R., Kordisch, J., Gauch, K., and Schulte, P. (2024). Textähnlichkeit der Prognoseberichterstattung. *RWZ - Zeitschrift für Recht & Rechnungswesen* 6(4), 194-198.
- Gauch, K. and Steller, N. (2024). Corporate Purpose in deutschen Unternehmen - Purpose-Statements und erste Ansätze für ein Internes Purpose-Audit. *Theis, J. (Ed.) (2024), Sustainability Reporting: Praxisnahe Informationen und Fallstudien (Online)*.



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# Chapter 2

## Essays on Risk Disclosure

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## 2.1 Risk Disclosure of HDAX Companies: Qualitative Analysis

Abstract (unofficial translation)

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Macroeconomic and industry-specific crises are constantly reigniting the debate on the appropriate disclosure of risks. Furthermore, spectacular corporate collapses have drawn the attention of stakeholders to the importance of risk-related information. This article outlines the results of a qualitative content analysis of the risk reporting of HDAX companies for the reporting years 2018, 2019 and 2020. The focus of the study is on the scope and content of the reporting.

Published in

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**Quick, R., Gauch, K., and Brom, L. (2022).** Risikoberichterstattung am deutschen Kapitalmarkt: Qualitative Analyse der HDAX-Geschäftsberichte der Geschäftsjahre 2018-2020. *Betriebs-Berater*, 77(4), 810-814.

## 2.2 Risk Disclosure of HDAX Companies: Quantitative Analysis

Abstract (unofficial translation)

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The far-reaching and grave COVID-19 pandemic caused existential difficulties for numerous companies due to a decline in demand, supply chain disruptions and production shutdowns. Stakeholders now generally have an increasing need for risk-related information. This article presents the results of a quantitative content analysis of risk reporting by HDAX companies for the 2018, 2019, and 2020 fiscal years. The study focuses on the scope and content as well as the determinants of reporting.

Published in

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**Quick, R., Gauch, K., and Brom, L. (2022).** Risikoberichterstattung der HDAX-Konzerne: Quantitative Analyse der Geschäftsjahre 2018 bis 2020. *IRZ – Zeitschrift für Internationale Rechnungslegung*, 17(4), 175-181.

## 2.3 Determinants of Textual Dissimilarity in 10-K Risk Disclosures

### Abstract

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Companies are exposed to various operational and strategic risks in their day-to-day business environment. Annual reports are the primary publicly available source for assessing a company's risk exposure. Risk disclosures are forward-looking and can potentially reduce the gap between investors' demand and disclosure supply of credible forward-looking information. However, critics regularly argue that risk disclosures are too long, redundant, and use boilerplate language. In this paper, we investigate textual dissimilarities in risk disclosures using a large sample of the US capital market between 2005 and 2022. We shed light on the potential determinants influencing the textual dissimilarities. Our paper contributes by showing the usefulness of qualitative forward-looking disclosures and their limitations, especially their tendency to remain similar unless severe and unexpected events occur, such as the COVID-19 pandemic. The study also identifies potential determinants of 10-K risk disclosures dissimilarity, such as audit characteristics and risk variables, that likely contain the most decision-useful information.

### Conferences and Workshops

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- CAAA Annual Conference, 2024, Halifax, Kanada
- 11<sup>th</sup> International Conference of the Journal of International Accounting Research (JIAR), 2024, Taipei, Taiwan

### Working Paper

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**Gauch, K., Gauch, I., Quick, R., and Friedrich, C. (2024).** Determinants of Textual Dissimilarity in 10-K Risk Disclosures. *Working Paper*.

### 2.3.1 Introduction

Risk disclosures in annual reports are the primary publicly available information used to assess a company's risk exposure. Critics regularly argue that annual reports are untimely and lack informative forward-looking information (Dyer et al., 2017). Risk disclosures are forward-looking and can potentially reduce the gap between investors' demand and disclosure supply of credible forward-looking information. However, this requires them to be reactive to dynamically evolving environments. Empirical evidence shows that 10-K risk disclosures – which have been required by the Securities and Exchange Commission (SEC) in Item 1A since 2005 (SEC, 2005) – are similar over time (Dyer et al., 2017; Cazier et al., 2021). Therefore, this paper examines whether companies change risk disclosures over time and what determinants are responsible for this textual dissimilarity.

Companies are exposed to various operational and strategic risks in their day-to-day business environment. Recent global issues, such as the COVID-19 pandemic (Alles, 2021; Dutta et al., 2023; Roberts et al., 2023), cyberattacks (Chen et al., 2023), climate change (Kim et al., 2023), or geopolitical conflicts, illustrate the increasingly uncertain environment in which companies operate (Caldara and Iacoviello, 2022). The scale and dynamics of those issues underline the relevance and rapidly developing nature of corporate risk exposure. Companies have installed sophisticated enterprise risk management systems to assess the interdependencies between their strategies and these dynamic environments, and to take advantages of opportunities and minimise threats (Beretta and Bozzolan, 2004). Those activities are generally unobservable to investors. Therefore, investors rely on corporate disclosures to evaluate the remaining uncertainties of investing in risk-exposed firms (Linsmeier et al., 2002; Elshandidy and Zeng, 2022).

Previous literature suggests that risk disclosures in Item 1A contain value-relevant information for investors (Kravet and Muslu, 2013; Campbell et al., 2014; Filzen, 2015). However, there are concerns that, over time, risk disclosures' usefulness diminishes because they appear too long, redundant, less readable, generic, and use boilerplate language (Linsley and Shrivess, 2005; Dyer et al., 2017; Beatty et al., 2019). The SEC repeatedly urges companies to avoid generic risk factor disclosures and redundant information because this diminishes the decision-usefulness of this content (SEC, 1998; SEC, 2010; SEC, 2016; Chen et al., 2023). Similar information from previous disclosures reduces their novelty and cannot cover dynamic developments of risk exposure, both contributing to a stale nature of risk disclosure and reduced usefulness (Wang et al., 2023).

Disclosures using generic or standard language are a crucial issue, as they might not contain useful information for the addressees (Hoogervorst, 2013). Furthermore, it is challenging for investors to extract relevant information from redundant texts (Wang et al., 2023). Besides that, it can also have negative effects on the disclosing company, such as a reduced investment willingness (Arikan, 2022).

Textual similarity refers to the degree of similarity between texts (Jurafsky and Martin, 2023)

and does not require the text to be exactly the same. Textual similarity is distinct from other textual characteristics, such as boilerplate, which refers to standardised generic, repetitive text containing text blocks that are unlikely to be informative (Lang and Stice-Lawrence, 2015). Thus, while boilerplate text can contribute to textual similarity, not all texts with high textual similarity necessarily contain boilerplate text.

Against this background, we measure year-over-year textual dissimilarity of Item 1A in 66,530 10-Ks from 8,966 firms between 2005 and 2022. We use cosine similarity as a textual dissimilarity measure in our main analysis. Our results show that the textual dissimilarity is low over time, suggesting that the information contained in risk disclosures is often stale. This result is surprising given the dynamic nature of firms' environments. Moreover, we regress our textual dissimilarity measure on several potential determinants. We identify several influencing determinants of textual dissimilarity, such as performance measures (e.g., change in assets, current ratio), risk measures (e.g., Z-Score, loss), and audit characteristics (e.g., audit fees, auditor change). Unexpected global events being decisive indicate that Item 1A reacts to rather than anticipates major events. This diminishes the predictive nature/usefulness as forward-looking information of these disclosures.

This paper contributes to the literature examining the quality of risk disclosure by investigating textual dissimilarity and updating the findings to a more recent date. To the best of our knowledge, this is the first systematic analysis of the determinants of risk disclosure textual dissimilarity. Our results suggest that the anticipation of dynamic developments, on average, is at best rare in Item 1As, severely limiting their usefulness. The results will help regulatory authorities when considering revisions of the disclosure guidelines. While it seems that companies are simply using their previous disclosure as a template, requirements may be introduced for companies to explain how risk disclosure has changed from the previous year. Moreover, companies could consider improving the relevance of their year-specific risk disclosure by presenting new information. This might improve the quality of their risk disclosures, and furthermore, contribute to stakeholders' better decision-making. Therefore, investors could use information about textual dissimilarity to judge how idiosyncratic certain risks are, potentially helping to manage systematic and idiosyncratic risks in their investment portfolios. The investigated determinants help risk disclosure addressees to identify the influencing factors for textual dissimilarity. This provides insights into underlying mechanisms, which help to better understand what internal and external forces shape risk communication. Our findings reveal that specific risk variables drive dissimilarity (e.g., loss). Therefore, an indication of textual dissimilarity might also work as a risk proxy for investors.

The remainder of this paper is organised as follows. Section 2 presents details of the regulatory setting, prior research, and research questions. Section 3 explains the research design. Section 4 illustrates the study's main findings including robustness checks. Finally, Section 5 concludes.

## 2.3.2 Regulatory Setting, Prior Research, and Research Questions

### 2.3.2.1 Regulatory Setting

Under the Securities Exchange Act of 1934, the disclosure of Form 10-K annual reports has evolved into a pivotal requirement for listed companies in the US. These annual reports serve as the primary information source for stakeholders, such as investors, creditors, or regulators. Their reliance on the narrative disclosures to comprehend and interpret the financial and non-financial data provided in 10-K filings underscores the crucial role these reports play in the financial ecosystem (Nadeem, 2022).

Since 2005, US companies have been required to disclose their risk in the section Item 1A: Risk Factors in the Form 10-K (SEC, 2005) (Item 503(c), relocated in 2019 to Item 105 of Regulation S-K).<sup>13</sup> The Securities and Exchange Commission (SEC) introduced this requirement as part of the implementation of the Sarbanes-Oxley Act of 2002. Under Item 1A, companies are required to provide a comprehensive discussion of the most material risks that could impact their business (e.g., market risks, operational risks, legal risks, and financial risks). The primary purpose of Item 1A is to enable investors to gain a more comprehensive understanding of the potential risks associated with an investment in the company. The disclosure should use plain language and avoid unnecessary repetition, and should focus on the risks and not how the company addresses them (SEC, 2021).

Critics complain about 10-Ks' increasing length and boilerplate language (Bushman et al., 2017). Furthermore, the SEC expressed concern that the use of boilerplate language in 10-K's has been increasing over time, which interferes with usefulness and informativeness (SEC, 2010; SEC, 2016). In 2019, the SEC adopted amendments intended to modernise and simplify the disclosure requirements of Regulation S-K (Richman et al., 2019; SEC, 2019). With this regulation, the risk disclosures were modified from a mere listing to a more informative presentation of company-specific risks. However, the regulation appears to have limited impact on how firms design their Item 1A-disclosure thus far (SEC, 2016; SEC, 2019; Alles, 2021).

In addition to Form 10-K annual reports, the SEC regulations also apply to quarterly reports 10-Q, although the disclosure requirements vary. Annual reports offer a comprehensive overview of all risk factors affecting the company, whereas quarterly reports are limited to updates. Companies should disclose any material changes from the risk factors previously disclosed in Item 1A of the 10-K filing, including any newly identified ones (Filzen, 2015; SEC, 2024).

Moreover, the Form 8-K, a requirement by the SEC, plays a crucial role in the context of risk disclosure. The SEC mandates companies to disclose extraordinary and significant events

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<sup>13</sup> Initially, the disclosure of risk factors was only mandatory in the prospectus for initial public offering (SEC, 2005).

affecting business operations within four business days of a triggering event (SEC, 2004).<sup>14</sup> The Form 8-K serves the vital purpose of promptly informing investors of potentially significant events, such as bankruptcy proceedings or business interruptions. This form of communication, designed to keep investors informed between regular filings of, for example, quarterly and annual reports, underscores the value of timely and transparent communication in the financial landscape (Carter and Soo, 1999; Gostlow, 2020).

### 2.3.2.2 Prior Research

Risk disclosure has long been a frequently studied subject in accounting research.<sup>15</sup> Numerous studies confirm the usefulness of risk reporting for addressees (Kravet and Muslu, 2013; Miihkinen, 2013; Campbell et al., 2014). The usefulness depends on various factors, such as quantity and quality (Ott, 2020), readability (Huang et al., 2023), or tone (Elshandidy and Zeng, 2022).

Using Finnish data, a study by Miihkinen (2013) shows that high-quality risk disclosure, measured by quantity and analyst coverage of risk information as a proxy for disclosure quality, reduces information asymmetry in the capital market and that investors include disclosed risks in their decision-making process. Using a sample of UK firms, Ibrahim and Aboud (2023) find a positive relationship between risk disclosure quantity, measured by a number of risk-related sentences in the annual report, and firm value, which provides evidence regarding the economic usefulness of risk disclosure. For the banking industry in Bangladesh, Nahar et al. (2016) show that the cost of capital is negatively and performance is positively associated with risk disclosure. A scoring model based on the requirements of IFRS measured the extent and quality of risk disclosure. They argue that risk disclosure lowers the cost of capital by providing investors with better information and confidence in the company. Using US data, Hope et al. (2016) demonstrate that a more specific disclosure of risk factors, measured by the number of specific words in Item 1A, leads to analysts being more able to assess fundamental risks. According to Nelson and Pritchard (2016), US companies with higher litigation risk disclose more risk factors and update them yearly. Again, using US data and a topic modelling approach, Histen (2022) demonstrates that firm performance, measured by year-over-year returns on equity and assets, is positively correlated with topics of risk disclosure. The author argues that risk disclosures contain information about firm performance as they signal management actions. The results indicate that these risk disclosures are not only informative for investors but also enhance the firm's preparedness and effectiveness in risk management. An example provided in the paper is the improved response to data breaches by firms that disclosed cybersecurity risks compared to those that did not, indicating better risk management. Investigating 10-K filings, Kravet and Muslu (2013) find that annual increases in risk disclosure volume are associated with increased stock return volatility as well as trading volume around and after the release of the reports. However, the findings are less pronounced for firm-level disclosures that differ from

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<sup>14</sup> Analogously, Form 6-K is mandatory for non-US companies.

<sup>15</sup> Isiaka (2021) provides a systematic literature review on risk reporting.



those of other companies in the same industry and year. These findings provide credence to the arguments that risk disclosures at the firm level are more inclined to be generic or boilerplate.

Despite the studies confirming the usefulness of risk disclosure, there are also concerns about its quality. Multiple studies have raised these concerns, highlighting the need for improvement in this area. Issues such as excessive length, redundancy, lack of readability, and the use of generic and boilerplate language have been identified (Linsley and Shrivess, 2005; Dyer et al., 2017; Beatty et al., 2019).

For UK companies, Elshandidy and Zeng (2022) demonstrate that aggregated risk information does not add value for investors because it does not impact share prices, since managers may provide it as a boilerplate. In contrast, investors are likely to react more strongly to a negative than a positive tone, as the former has a higher information content than the latter. Likewise, for American companies, Yen et al. (2016) observe that companies in concentrated industries disclose large amounts of risk information that are very similar to their competitors, which reduces the informativeness of their disclosure. Similarly, for the US, Bao and Datta (2014) conclude that about two-thirds of the risk types in the Form 10-K are not informative and have no significant impact on investors' risk perception measured by stock return volatility. An earlier study by Linsley and Shrivess (2006) found that UK companies predominantly disclose general risk management policies, implying that stakeholders are unable to properly assess a company's risk profile. Using international participants, the experimental results by Arıkan (2022) reveal that less specific language in risk disclosures causes non-professional investors to invest less, but only when they have prior information about the disclosed risks. Nevertheless, Abraham and Shrivess (2014) claim that unspecific or boilerplate language might not always be useless, as long as management regularly reflects it (e.g., regular meetings discussing the risk situation). However, such information must also be made accessible to the addressees. A US study by Cazier et al. (2021) investigates boilerplate language measured by commonly used word phrases in Item 1A. They propose an explanation for the persistence of boilerplate disclosures in Item 1A and provide evidence indicating that lengthier and more boilerplate disclosures are less likely to be found inadequate under judicial and regulatory scrutiny.

Outside of academia, regulators also noticed this weakness. The SEC has repeatedly expressed concerns about the vagueness of risk information, stating that it diminishes the decision-usefulness of such information. The SEC has urged companies to avoid generic risk factor disclosures, highlighting the regulatory perspective on risk disclosure (SEC, 2010; SEC, 2016; Chen et al., 2023).

### 2.3.2.3 Research Questions

Considering the high relevance of risk disclosure for stakeholders, it is a promising area of research, as several studies have already demonstrated (see previous section). The findings showed that risk disclosure is helpful to investors (Kravet and Muslu, 2013; Campbell et al., 2014) but also demonstrated textual similarities or boilerplate practice (Dyer et al., 2017; Cazier et al., 2021), which might reduce informativeness (Bao and Datta, 2014; Yen et al., 2016). We first examine whether textual dissimilarity occurs while investigating year-over-year disclosures. Based on this, our first research question arises:

Research Question 1. *To what extent does textual dissimilarity in 10-K risk disclosures develop over time?*

Considering this, we further investigate which company-related and audit-related determinants explain textual dissimilarities in risk disclosures. Thus, our second research question is formulated as follows:

Research Question 2. *What underlying determinants contribute to the textual dissimilarity in 10-K risk disclosures?*

### 2.3.3 Research Design

#### 2.3.3.1 Methodology & Dependent Variable

##### Methodology: TF-IDF & Cosine Similarity

We calculate similarity based on vectorised Item 1As, i.e., the documents are represented as vectors of tokens<sup>16</sup> and their respective frequency in the documents. The average length of the tokenised Item 1A is 8,944 tokens, which is more than the allowed context window of large language models (Vaswani et al., 2017; Peng et al., 2023) that we could have used for the vector embeddings calculation. Therefore, we used the traditional yet well-proven and efficient method of Term Frequency-Inverse Document Frequency (*tf-idf*) (Jurafsky and Martin, 2023). *Tf-idf* is a statistical measure widely employed in natural language processing and information retrieval to evaluate the significance of terms within a document corpus (Jurafsky and Martin, 2023). While term frequency measures how often a word appears in a document divided by the total words in the document (Luhn, 1957), inverse document frequency measures a term’s importance (Sparck, 1972).

$$tf_{t,d} = count(t, d), \quad (1)$$

which is the frequency of the word  $t$  in the document  $d$ .

$$idf_t = \log\left(\frac{n}{df_t}\right) + 1, \quad (2)$$

where  $n$  is the total number of documents in the document set (i.e., one set represents all Item 1As of one company) and  $df_t$  is the document frequency of  $t$ ; the document frequency is the number of documents in the document set that contain the term  $t$ . Adding “1” to the *idf* in the equation above means that terms with zero *idf*, i.e., terms that occur in all documents in a training set, will not be entirely ignored. *Tf-idf* is thus the product of those two measures:

$$w_{t,d} = tf_{t,d} \cdot idf_t. \quad (3)$$

This weighting scheme  $w_{t,d}$  serves as a powerful tool in information retrieval and text mining, effectively discriminating between common terms and those with distinctive topical significance. Therefore, for each Item 1A we received one vector  $\vec{V}(d)$ , which consists of  $w_{t,d}$  representing each token  $t$  of the document  $d$ . The calculation was accomplished using scripting in Python

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<sup>16</sup> A token refers to a single unit of a text. Tokens can be words, sub-words, or characters. Tokenization is the process of segmenting text into these tokens as seen in Jurafsky and Martin (2023).

with help of the scikit-learn package (Pedregosa et al., 2011). The parameters included a usage of a standard stopwords list for English as well as n-gram range of 1 to 3 (Manning and Schütze, 1999). Jurafsky and Martin (2023) defines an n-gram as a sequence of  $n$  words.<sup>17</sup>

One of the most popular metrics to assess the similarity of documents as vectors in a high-dimensional space is cosine similarity. Cosine similarity is regularly used in accounting research to measure textual similarity (Brown and Tucker, 2011; Loughran and Mc Donald, 2016; Johnston and Zhang, 2021; Bai et al., 2022; Qiu et al., 2023; Bochkay et al., 2023).<sup>18</sup> For two documents  $d_1$  and  $d_2$  the cosine similarity of their vector representations  $\vec{V}(d_1)$  and  $\vec{V}(d_2)$  is computed as

$$sim(d_1, d_2) = \frac{\vec{V}(d_1) \cdot \vec{V}(d_2)}{\left| \vec{V}(d_1) \right| \left| \vec{V}(d_2) \right|}, \quad (4)$$

where the numerator represents product of the vectors  $\vec{V}(d_1)$  and  $\vec{V}(d_2)$ , while the denominator is the product of their Euclidean lengths (Manning and Schütze, 1999). Cosine similarity ranges from 0 (indicating orthogonality and dissimilarity) to 1 (indicating perfect similarity). The efficiency and simplicity of cosine similarity make it a prevalent choice for comparing the content of documents and, consequently, a valuable tool in diverse applications within the realm of natural language processing and information retrieval. The calculation was done with the help of the implemented cosine similarity function of the scikit-learn package (Pedregosa et al., 2011).

### **Dependent Variable: Textual Dissimilarity**

As the focus of this paper is the textual dissimilarity of risk disclosure, we calculate textual dissimilarity as one minus the value for similarity (given by formular (5)) as follows:

$$dissim(d_1, d_2) = 1 - sim(d_1, d_2). \quad (5)$$

We measure the textual dissimilarity within the firms' disclosures over time. More in detail, the dependent variable,  $YoY$  (year-over-year), compares the textual dissimilarity of Item 1A with the previous year. This model allows us to gain insight into how companies change their disclosure from one fiscal year to another. The textual dissimilarity can range from 0 (= no dissimilarity at all) to 1 (= 100 percent dissimilarity).

As features for the *tf-idf* vectorisation, we use a combination of 1-grams, 2-grams, and 3-grams. While 1-grams can indicate whether the same words are in both texts, 2-grams and 3-grams

<sup>17</sup> An n-gram can be explained more in detail using an example: A single word is a 1-gram, while a 2-gram consists of two words, e.g. "risk disclosure", and so on.

<sup>18</sup> An overview of studies that used cosine similarity is provided by Guo (2022).

also give a hint as to whether the words appear in the same context and order, and, therefore, alleviate meaning variation and ambiguity (Guo, 2022). A bag-of-n-grams (2-grams or 3-grams) representation is more powerful because it reveals better results for dissimilarity measures as it is more informative than their individual components (Manning and Schütze, 1999; Goldberg, 2017).<sup>19</sup>

### 2.3.3.2 Sample and Data Section

Table 2, Panel A illustrates the initial data selection process whereas Table 2, Panel B demonstrates the final data selection process. Our sample consists of firms (i.e., tickers) available in the Compustat database, and results in an initial number of 20,367 firms. We used an automated script in Python to collect data from the Electronic Data Gathering, Analysis, and Retrieval (EDGAR) database, which is publicly available for investors to download or search for 10-K annual filing reports.<sup>20</sup> Our time period spanned from 1<sup>st</sup> December 2005 to 31<sup>st</sup> December 2023.<sup>21</sup> We selected 1<sup>st</sup> December 2005 as the first year because it marked the initial requirement by the SEC for firms to disclose their risk factors in Item 1A (SEC, 2005). After downloading and preprocessing the 10-K forms, we extracted Item 1A utilising a semi-automated approach by using regular expressions. We gathered 89,260 URLs from 10,853 firms (Table 2, Panel A). After that, we checked our data for plausibility and conducted multiple data preparation measures,<sup>22</sup> which resulted in our dataset compromising 66,530 firm-year observations across 8,966 firms. We use these datasets for our descriptive analysis. Furthermore, we obtained the financial statements and audit data from Compustat and Audit Analytics to investigate the determinants of textual dissimilarity. Because not all relevant variables were available, we had to exclude some firm-year observations shown in Table 2, Panel B. We also excluded firms from the banking, insurance, and financial service industries, which were indicated using SIC codes (SIC codes 6000-6999). This resulted in a final sample of 2,952 firms and 29,070 firm-year observations.<sup>23</sup>

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<sup>19</sup> Using 3-grams and higher might lead to sparsity issues (Manning and Schütze, 1999; Goldberg, 2017). To prevent this problem, the combination of 3-grams with 2-grams and 1-grams is proposed by Manning and Schütze (1999).

<sup>20</sup> A detailed description of the data collection process can be found in Appendix A.

<sup>21</sup> The data collection process took place in February and March 2024.

<sup>22</sup> In the first step, we identified regular expressions, used to extract Item 1A of the gathered 10-K Forms. We used a sample of the S&P500 to verify our regular expressions. To achieve high data quality, we removed all data where the extraction did not succeed or where Item 1A was not available (e.g., small firms are not obligated to report risk factors under SEC regulation). Furthermore, we applied plausibility checks (e.g., words-ratios, length) and manually checked a relevant number of texts to verify our extraction method.

<sup>23</sup> The appendix contains detailed information on the industry composition (see Appendix B) and year composition (see Appendix C) of the initial and final data set.

Table 2: Sample selection process

<b>Panel A: Initial Data Selection Process</b>		
	Number of Firms	Number of Firm-Years
Available firms (tickers) at Compustat (fiscal year > 2004)	20,367	—
All data available from EDGAR between 2005 and 2022	10,853	89,260
<b>Panel B: Final Data Selection Process</b>		
All data available after data preparation measures* <i>less</i>	8,966	66,530
Observations with missing values for variables	-5,880	-36,346
Firms from banking, insurance, and financial service (SIC codes 1-digit “6”)	-164	-1,114
	<b>∑ 2,952</b>	<b>∑ 29,070</b>

*Notes:* This table summarises the data selection process. Panel A gives information regarding the initial data selection process. We gathered the tickers available in the Compustat dataset and retrieved them via a Python script from EDGAR. Panel B shows the data selection process for the year-over-year model after data preparation measures. We use the full dataset marked with a \* for the descriptive analysis and the final dataset shown for the regression models.

### 2.3.3.3 Potential Determinants

Our OLS regression model includes a comprehensive set of financial accounting and auditing variables as potential determinants of textual dissimilarity.<sup>24</sup> Our approach is mainly explorative and descriptive, including a large set of variables that could plausibly affect the longitudinal dissimilarity of risk disclosures. Equation (6) presents the resulting model:

$$\begin{aligned}
\text{Dissimilarity}_{i,t} = & \beta_0 + \beta_1 \text{SIZE}_{i,t} + \beta_2 \Delta \text{ASSETS}_{i,t} + \beta_3 \text{ROA}_{i,t} + \beta_4 \text{CFO}_{i,t} + \beta_5 \text{CR}_{i,t} \\
& + \beta_6 \text{FCA}_{i,t} + \beta_7 \text{R\&D}_{i,t} + \beta_8 \text{INT}_{i,t} + \beta_9 \text{LEV}_{i,t} + \beta_{10} \text{ZSCORE}_{i,t} \\
& + \beta_{11} \text{LOSS}_{i,t} + \beta_{12} \text{SOX404}_{i,t} + \beta_{13} \text{AUDITFEES}_{i,t} + \beta_{14} \text{NAS}_{i,t} \\
& + \beta_{15} \text{AUDITORCHANGE}_{i,t} + \beta_{16} \text{BIG4}_{i,t} + \beta_{17} \text{INDSPEC}_{i,t} \\
& + \beta_{18} \text{LENGTH}_{i,t} + \beta_{19} \text{FYCY}_{i,t} + \beta_k \text{YEAR\_FIXED\_EFFECTS}_{i,t} \\
& + \beta_j \text{IND\_FIXED\_EFFECTS}_{i,t} + \epsilon_{i,t}.
\end{aligned} \tag{6}$$

We use the natural logarithm of total assets to measure the *SIZE* of the company. Larger companies are confronted with more and more diverse risks which pushes them to update their risk disclosure. Furthermore, they may have a well-established risk management system, which results in higher quality reporting following regular changes in disclosure. Therefore, we assume a positive direction of textual dissimilarity.

<sup>24</sup> A definition of the variables can be found in Appendix D.

We use the change in total assets ( $\Delta ASSETS$ ) to control for growth and return on assets ( $ROA$ ) to check for profitability. We expect that dissimilarity is higher for growing companies because they have an incentive to adjust their risk disclosure due to the higher risks they take. In terms of profitability, we expect a negative relationship because one may assume that more profitable companies do not see the necessity to adjust their disclosure.

Two variables represent liquidity measures:  $CFO$ , Cash flow from operations scaled by total assets; and  $CR$  the ratio of current assets and current liabilities. We assume that disclosure dissimilarity is lower for companies with higher liquidity, as they see no reasons to adjust their risk disclosure due to their stable conditions.

The amount of foreign current assets ( $FCA$ ) in the balance sheet scaled by total assets examines the company's complexity. More complex companies may change their disclosures more regularly as they are exposed to higher risk due to their foreign operations.

We include several risk variables in our model to control for risk factors.  $R\&D$  measures the research and development expense scaled by total assets.  $R\&D$  activities are subject to a certain level of risk, which is why more frequent adjustments to disclosure may be necessary. Also, we assume a positive sign for the intangible assets ( $INT$ ), scaled by total assets, as those assets face a higher risk. Similarly, higher leverage ( $LEV$ ) should lead to more dissimilar disclosure, as companies with a higher level of debt could be exposed to a higher risk of financial troubles, such as insolvency. Altman's (1968)  $ZSCORE$  measures the insolvency risk of the company. The higher this score, the healthier the company; thus, it is likely to report less dissimilarly.  $LOSS$  is a dummy variable that indicates whether net income is less than zero. Companies with a loss should adjust their disclosure.

$SOX404$  is a dummy variable coded as 1 if the internal controls were found to be ineffective; otherwise, 0. The variable was given by Audit Analytics. We assume that if an internal control system is considered ineffective, the company would be less likely to adjust its risk disclosure because the internal controls are not functioning adequately.

We also expect that audit variables might be influencing determinants.  $AUDITFEES$  reflects the natural logarithm of audit fees. As higher audit fees usually indicate higher audit quality, we expect companies to adjust their disclosure through higher quality reporting, indicating a positive correlation with dissimilarity.  $NAS$  is the ratio of non-audit services fees to audit fees. We expect a higher demand for non-audit services fees will indicate smaller auditor independence, which in turn might lead to less dissimilar disclosure.  $AUDITORCHANGE$  is a dummy variable that indicates a change of the auditor in the given fiscal year — a new auditor might result in changing the disclosure. Also,  $BIG4$  is a dummy variable coded 1 for Big4 audit firms, resulting in higher dissimilar disclosure due to higher expected audit quality.  $INDSPEC$  is a dummy variable coded as 1 if the auditor is an industry specialist, which measures whether an auditor has 30 percent of the market share measured by absolute audit fees. We expect

a higher dissimilarity due to market knowledge regarding risk, which might lead to regular disclosure adjustments.

*LENGTH* is the natural logarithm of the number of words in Item 1A. We controlled for the length of the risk disclosure, as Brown & Tucker (2011) state that the longer texts are, the more likely it is that word combinations occur more frequently, and thus, the documents do not differ from each other.

We also controlled whether a financial year that differs from the calendar year *FYCY* has an impact on the similarity (indicated by 1 = fiscal year equals calendar year, otherwise 0).

Finally, we controlled for industry-fixed effects using the 2-digit SIC codes as well as for year-fixed effects. We define all variables in Appendix A. Furthermore, all continuous variables were winsorised at 1 and 99 percent.



## 2.3.4 Results

### 2.3.4.1 Descriptive and Visual Results

Table 3 presents descriptive statistics for all variables used in our empirical model.<sup>25</sup> It shows the descriptive statistics for continuous (Panel A) and dummy variables (Panel B) for our dependent variable  $YoY$ . The mean value for  $YoY$  is 0.158, which indicates that the Item 1As are usually quite similar (Table 3, Panel A). The values range from 0.000 to 0.994, demonstrating that some disclosures do not change. These results indicate that companies do not constantly adjust their disclosure and even maintain their disclosure. Considering the 25 percent quantile information regarding  $YoY$ , it is even more obvious that these companies only adjust their disclosure very little. The other values do not show any unique characteristics.

Table 3: Descriptive statistics

<b>Panel A:</b> Descriptive statistics for continuous variables								
Variables	N	Mean	SD	Min	0.25	Median	0.75	Max
$YoY$	29,070	0.158	0.139	0.000	0.070	0.199	0.198	0.994
$SIZE$	29,070	6.165	2.684	-1.671	4.492	6.436	8.042	11.491
$\Delta ASSETS$	29,070	0.190	0.654	-0.610	-0.038	0.050	0.183	4.541
$ROA$	29,070	-0.236	1.002	-7.631	-0.110	0.027	0.073	0.341
$CFO$	29,070	-0.063	0.466	-2.946	-0.025	0.070	0.123	0.354
$CR$	29,070	2.973	3.318	0.048	1.232	1.967	3.290	21.443
$FCA$	29,070	0.000	0.002	-0.011	0.000	0.000	0.000	0.008
$R\&D$	29,070	0.087	0.201	0.000	0.000	0.006	0.074	1.271
$INT$	29,070	0.192	0.215	0.000	0.005	0.107	0.324	0.799
$LEV$	29,070	0.568	3.384	-17.953	0.002	0.301	0.880	19.888
$ZSCORE$	29,070	-0.332	26.845	-203.334	1.077	2.880	5.066	52.485
$AUDITFEES$	29,070	-0.093	1.549	-4.423	-1.081	0.072	0.979	3.168
$NAS$	29,070	0.188	0.248	0.000	0.018	0.102	0.258	1.394
$LENGTH$	29,070	8.827	0.740	4.762	8.369	8.875	9.327	10.910

<b>Panel B:</b> Descriptive Statistics for dummy variables			
Variables	N	=0	=1
$LOSS$	29,070	17,679	11,391
$SOX404$	29,070	25,842	3,228
$AUDITORCHANGE$	29,070	26,902	2,168
$BIG4$	29,070	9,776	19,294
$INDSPEC$	29,070	21,377	7,693
$FYCY$	29,070	20,714	8,356

*Notes:* This table shows the descriptive statistics. Panel A shows the descriptive statistics for continuous variables. N = number of observations; SD = standard deviation; Min = Minimum; 25% = 25% quantile; 75% = 75% quantile; Max = Maximum. Panel B shows the description statistics for dummy variables coded with 0 = no and 1 = yes.

<sup>25</sup> We winsorise all continuous variables at 1% and 99%.

For our graphical analysis, we used the largest possible data set, which consists of 8,966 firms and 66,530 observations (see Table 2, Panel B).<sup>26</sup> The graphical representation of the dissimilarities is shown in Figure 3 and Figure 4.<sup>27</sup> The graph in Figure 3 visualises the mean and median values as well as the 25 percent and 75 percent quantiles for the *YoY* dissimilarity. All three lines indicate a similar graphical trend, indicating a decreasing dissimilarity. As can be seen from the chart, the mean dissimilarities are between around 10 and 20 percent, which demonstrates a reasonably similar disclosure over time as only a small part of the disclosure is adjusted. In particular, from 2009 onwards, the trend indicates that dissimilarity is declining and reached its lowest value in terms of average dissimilarity before COVID-19 in the 2018 financial year. However, a significant increase in dissimilarity can be seen for the fiscal years 2008 and 2020. In 2008, the global financial crisis and, in 2020, the COVID-19 pandemic impacted the corporate environment heavily. Nevertheless, the trend toward dissimilar disclosure as in the previous year continues after these events. Considering the quantile information, the results clearly show that 25 percent of disclosures only adjust their disclosure a small amount.

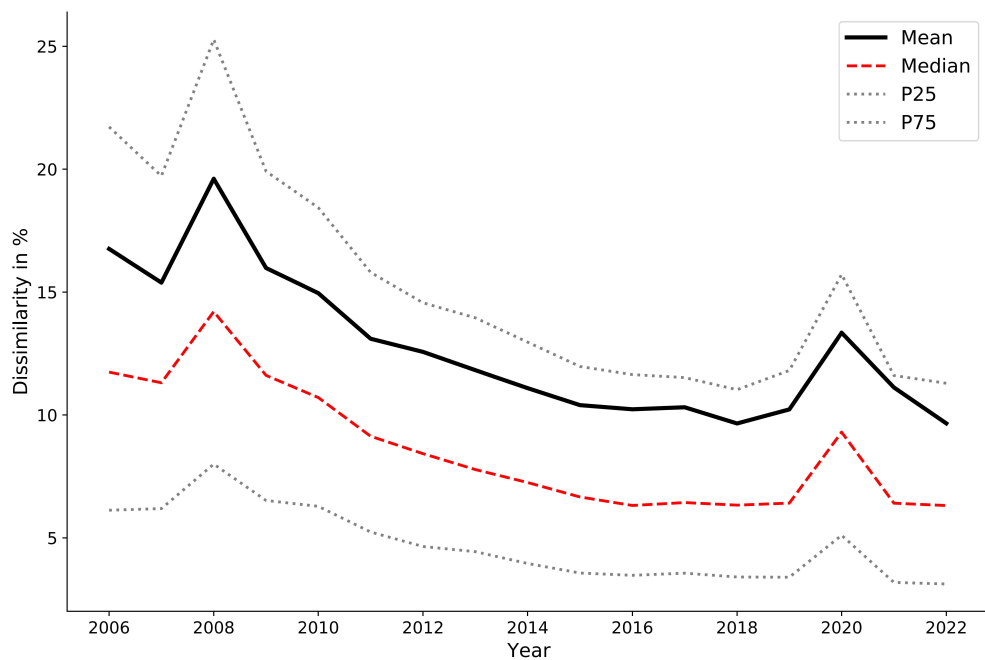


Figure 3: Mean, median, and quartiles for *YoY*

*Notes:* This figure visualises the graphical trend of the year-of-year dissimilarity in percent from 2006 to 2022. The black solid line shows the mean values, the red dashed line shows the median, and the dotted lines show the 25% and 75% quantiles, respectively. The underlying dataset is the initial dataset.

<sup>26</sup> This dataset also includes the Finance, Insurance, and Real Estate industry (SIC 6000-6999).

<sup>27</sup> The graphical representation regarding our final dataset used in the regression to investigate the determinants of textual dissimilarities can be found in Appendix E and Appendix F.

Additionally, we examined the textual dissimilarity from year to year, itemised by the individual industries of our industry composition. The results are illustrated in Figure 4. As we can see, the graphical trend is similar to the averages in Figure 3. All industries experienced a significant increase in fiscal years 2008 and 2020. For the Finance, Insurance, and Real Estate industry (SIC codes 6000-6999), an especially significant increase occurred in 2008 when the financial crisis hit the financial markets. To summarise, the results for the individual industries are quite comparable.

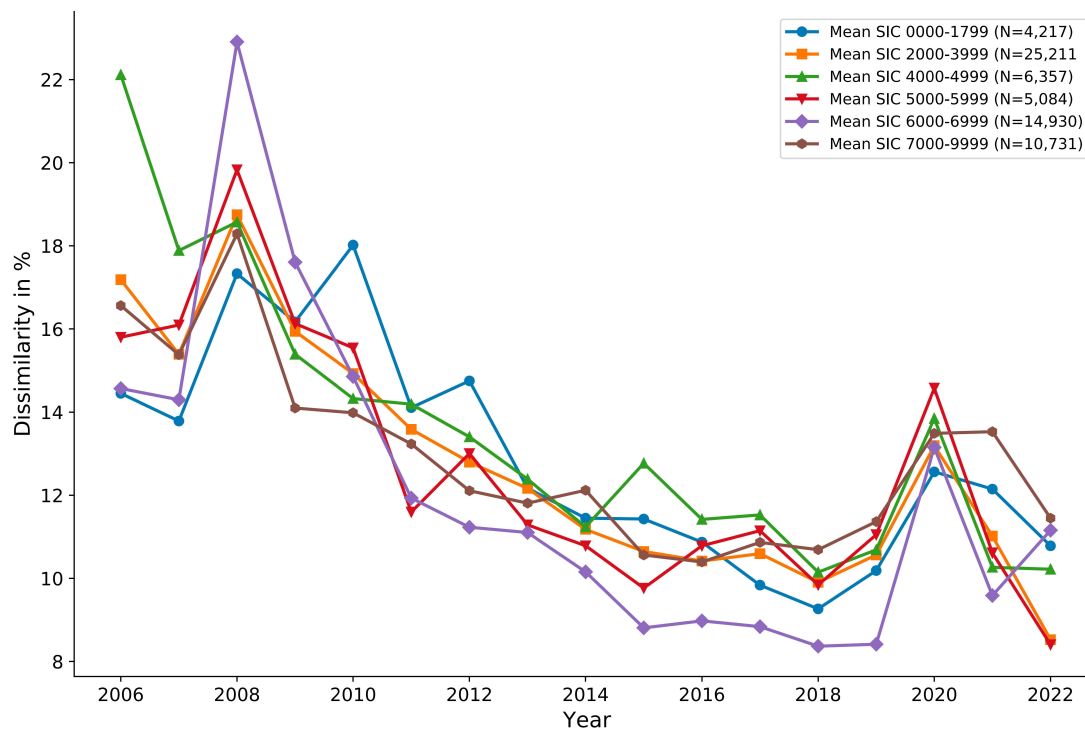


Figure 4: Mean for YoY for the given industries

*Notes:* This figure visualises the graphical trend of the mean value for the year-of-year dissimilarity in percent from 2006 to 2022 for the given industries. The SIC codes clustered the industries.

### 2.3.4.2 Determinants of Textual Dissimilarity

The second research question of this paper is to identify the determinants that can explain the textual dissimilarity of Item 1A risk disclosure. Therefore, we run OLS regressions using our dissimilarity measure with robust standard errors clustered by company name. Table 4 shows our OLS regression results.

We find multiple significant determinants that might explain the year-over-year textual dissimilarity.  $\Delta ASSETS$  has, as expected, a positive significant impact on dissimilarity. One possible explanation could be that growing firms take on higher risks, e.g., due to a change in

the business environment or new business activities, which is why firms adjust their disclosure. We also find a significant influence of *ROA*, showing that more profitable companies disclose more similarly as they see no necessity to change their disclosure.

*CFO* and *CR* have a negative significant relationship to dissimilarity. As financial performance increases, the company finds itself in a stronger position due to high liquidity and perceives no necessity to modify its risk disclosure.

We include several risk variables in our model: In contrast to our expectations, *R&D* has a negative relationship to dissimilarity. This could be explained by the fact that, although *R&D* is associated with a higher risk, companies tend to report in a more standardised manner to avoid providing too many details for competitive reasons. In contrast to our expectations, we find that *ZSCORE* has a positive influence on dissimilarity. Companies with a *LOSS* disclose less similarly, as expected. The dummy *SOX404* measured whether internal controls were found to be ineffective (=1). We expected that ineffective internal controls would lead to less dissimilar disclosure. However, in contrast to our expectations, we find a positive relationship. This might be explained by understanding that after the internal control was assessed to be ineffective, the company has an incentive to change the disclosure more regularly in order to signal internal control. Overall, there are opposing results regarding the risk variables in terms of the direction of the impact. One explanation might be that companies try to hide higher risks as they fear negative capital market reactions, and thus they use standardised and more similar disclosures in some cases.

Considering audit characteristics, we find multiple significant associations. Higher *AUDITFEES* result in a higher textual dissimilarity. A higher audit effort, measured by *AUDITFEES*, might explain why companies should adjust their risk disclosure. In contrast to our expectations, we find a positive significant relationship regarding *NAS*. Furthermore, we find that after an *AUDITORCHANGE* the risk factors are more dissimilar, which can be explained through new processes and perspectives that influence the way in which risks are identified, assessed, and communicated. In contrast to our expectations, we find a significant negative relationship regarding *BIG4* auditors. One possible explanation could be that the Big 4 audit firms know the best practices for disclosure and companies are willing to adapt them, resulting in more similar disclosure. We also controlled for the *LENGTH* and find, as expected, a negative relationship. Finally, we controlled fiscal years that differ from calendar years *FYCY* and find a negative relationship.<sup>28</sup> All other variables do not reveal any influence on our dependent variable *YoY*.

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<sup>28</sup> The findings remain unchanged if we conduct the regression exclusively using financial years aligned with the calendar year.

Table 4: OLS regression results for textual dissimilarity

Variables	Expected sign	Measure 1 DV = $YoY*100$ (1-, 2- & 3-gram) Coefficient (t-value)
<i>Intercept</i>		46.667*** (24.727)
<i>SIZE</i>	+	0.076 (0.611)
$\Delta$ <i>ASSETS</i>	+	2.623*** (12.931)
<i>ROA</i>	-	-0.987*** (-3.367)
<i>CFO</i>	-	-2.148*** (-4.049)
<i>CR</i>	-	-0.160*** (-4.394)
<i>FCA</i>	+	-49.842 (-1.282)
<i>R&amp;D</i>	+	-4.846*** (-5.344)
<i>INT</i>	+	0.839 (1.444)
<i>LEV</i>	+	0.018 (0.848)
<i>ZSCORE</i>	-	0.028*** (3.796)
<i>LOSS</i>	+	2.636*** (10.928)
<i>SOX404</i>	-	2.118*** (5.588)
<i>AUDITFEES</i>	+	0.966*** (5.256)
<i>NAS</i>	-	2.533*** (5.878)
<i>AUDITORCHANGE</i>	+	1.980*** (5.067)
<i>BIG4</i>	+	-0.544* (-1.766)
<i>INDSPEC</i>	+	0.015 (0.060)
<i>LENGTH</i>	-	-4.138*** (-18.957)
<i>FYCY</i>	?	-0.579*** (-2.209)
Firm Fixed Effects		No
Ind. Fixed Effects		Yes
Year fixed effects		Yes
N		29,070
Adjusted $R^2$		0.132

Notes: This table reveals the regression results for our main analysis using Measure 1 (1-, 2-, & 3-grams) for our dependent variable. \*, \*\*, \*\*\* indicate significance levels at 10, 5, and 1 % (two-tailed).

### 2.3.4.3 Alternative Dissimilarity Metrics (Robustness Checks)

In this section, we perform several robustness tests to ensure that the predefined parameters or dissimilarity measures do not drive our results.

#### Robustness Check: Different n-grams

As a reminder, in our main analysis (Table 4), we used a combination of 1-grams, 2-grams, and 3-grams as defined features for vectorizing our texts. Then, we calculated the dissimilarity using cosine similarity. However, different n-grams can lead to different results. We investigated year-over-year dissimilarity again and further conducted regression analysis to ensure that these parameters were not driving our results.

Table 5 shows the descriptive statistics for different n-grams. For comparison reasons, we also insert our main analysis, Measure 1. Measure 2 provides the results for a combination of 1-grams and 2-grams, whereas Measure 3 shows a combination of 1-grams, 2-grams, 3-grams, and 4-grams. The descriptive values indicate results similar to our main results. Considering the graphical representation, shown in Figure 5, all three lines indicate a similar graphical trend. Therefore, we can conclude robust results from a visual perspective.

Considering our determinants, the regression results in Table 6 provide strong support for our results from the main analysis. Only in Measure 2 is the variable *INT* significant. However, this does not detract from the overall robustness of our results, which are well-supported by the regression analysis.

Table 5: Descriptive statistics for different n-gram measures

Descriptive statistics for different n-gram measures								
Measure	N	Mean	SD	Min	0.25	Median	0.75	Max
Measure 1: 1-, 2- & 3-gram	29,070	0.158	0.139	0.000	0.070	0.199	0.198	0.994
Measure 2: 1- & 2-gram	29,070	0.122	0.129	0.000	0.047	0.084	0.149	0.991
Measure 3: 1-, 2-, 3- & 4-gram	29,070	0.186	0.145	0.000	0.090	0.149	0.237	0.995

*Notes:* This table shows the descriptive statistics for all different n-gram measures. N = number of observations; SD = standard deviation; Min = Minimum; 25% = 25% quantile; 75% = 75% quantile; Max = Maximum.

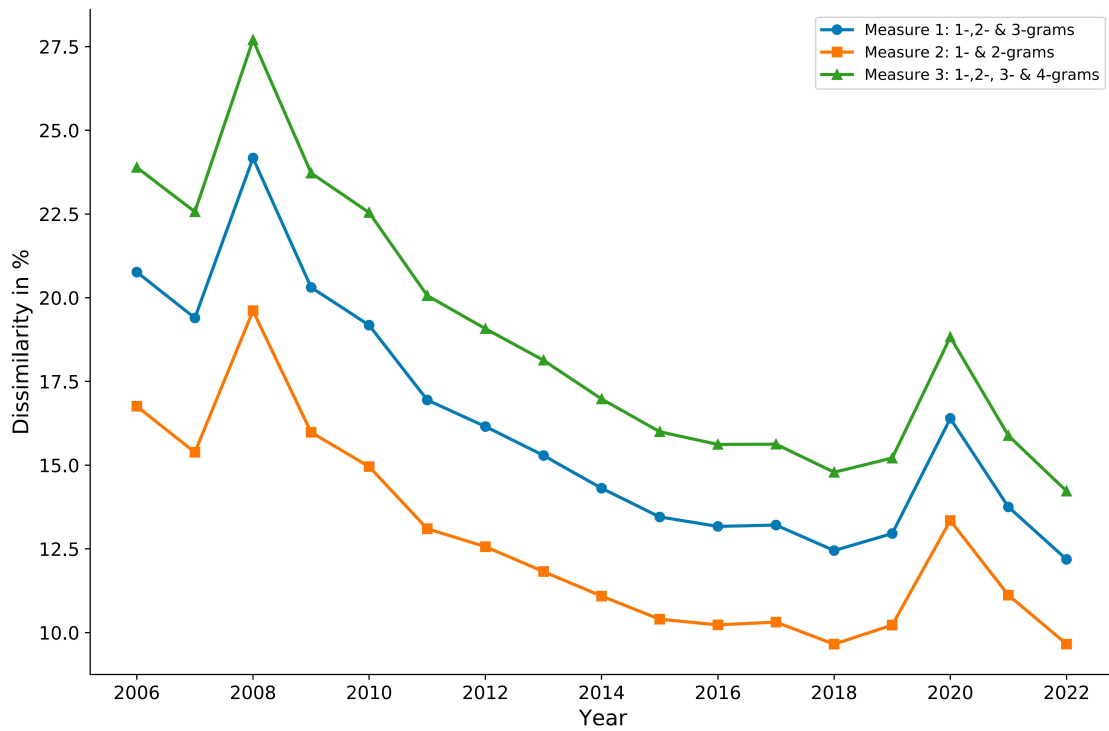


Figure 5: Mean for  $YoY$  for different n-gram measures

*Notes:* This figure visualises the graphical trend of the year-of-year dissimilarity in percent from 2006 to 2022 for three different n-gram measures. Measure 1 uses 1-, 2- & 3-grams, Measure 2 uses 1- & 2-grams. Measure 3 uses 1-, 2-, 3- & 4-grams.

Table 6: OLS regression results for textual dissimilarity

Variables	Expected sign	Measure 2 DV = YoY*100 (1- & 2-gram) Coefficient (t-value)	Measure 3 DV = YoY*100 (1-, 2-, 3-, & 4-gram) Coefficient (t-value)
<i>Intercept</i>		39.573*** (22.993)	51.428*** (25.676)
<i>SIZE</i>	+	0.042 (0.372)	0.111 (0.845)
$\Delta$ <i>ASSETS</i>	+	2.505*** (12.662)	2.691*** (13.078)
<i>ROA</i>	-	-1.046*** (-3.689)	-0.936*** (-3.129)
<i>CFO</i>	-	-1.985*** (-3.909)	-2.233*** (-4.088)
<i>CR</i>	-	-0.138*** (-4.051)	-0.175*** (-4.600)
<i>FCA</i>	+	-34.326 (-0.947)	-62.150 (-1.527)
<i>R&amp;D</i>	+	-4.664*** (-5.471)	-4.892*** (-5.179)
<i>INT</i>	+	0.987* (1.877)	0.694 (1.120)
<i>LEV</i>	+	0.017 (0.882)	0.017 (0.784)
<i>ZSCORE</i>	-	0.029*** (4.097)	0.028*** (3.631)
<i>LOSS</i>	+	2.416*** (10.921)	2.727*** (10.702)
<i>SOX404</i>	-	2.061*** (5.797)	2.107*** (5.345)
<i>AUDITFEES</i>	+	0.753*** (4.425)	1.105*** (5.728)
<i>NAS</i>	-	2.262*** (5.694)	2.690*** (5.926)
<i>AUDITORCHANGE</i>	+	1.834*** (4.911)	2.072*** (5.157)
<i>BIG4</i>	+	-0.491* (1.785)	-0.564*** (-1.706)
<i>INDSPEC</i>	+	0.032 (0.148)	-0.010 (-0.039)
<i>LENGTH</i>	-	-3.645*** (-18.225)	-4.420*** (-19.146)
<i>FYCY</i>	?	-0.547*** (-2.339)	-0.574*** (-2.004)
Firm Fixed Effects		No	No
Ind. Fixed Effects		Yes	Yes
Year fixed effects		Yes	Yes
N		29,070	29,070
Adjusted $R^2$		0.117	0.141

Notes: This table reveals the regression results for different n-grams for our dependent variable. Measure 2 (1-, 2- & 3-grams) and Measure 3 (1-, 2-, 3- & 4-grams). \*, \*\*, \*\*\* indicate significance levels at 10, 5, and 1 % (two-tailed).



## Robustness Check: Different Measures for Dissimilarity

Furthermore, we are using different measures for dissimilarity to prove the robustness of our findings.<sup>29</sup> Therefore, we repeat our regressions with measures already used in accounting literature (Bochkay et al., 2023), such as Levenshtein distance (El-Haj et al., 2020; Carlé et al., 2023), Jaccard distance (Johnston and Zhang, 2021; Deneuve et al., 2024), and Euclidian distance (Fontes et al., 2005). Furthermore, we use the large language model “text-embedding-ada-002”, provided by OpenAI (2024) in combination with cosine similarity. Before we dive into the details of our results, we would like to explain and acknowledge the newly introduced measures shortly.

The Levenshtein distance describes the minimum number of transformations of single characters (i.e., letters) that must be edited to change one word into another word (Levenshtein, 1966; Wang and Dong, 2020; Carlé et al., 2023; Bochkay et al., 2023). Following that, more edits are needed, as the texts are dissimilar. However, this measure only considers character-level edits, which means it cannot effectively handle cases where entire words are inserted or deleted, which is often more relevant in longer texts (Navarro, 2001). Furthermore, the context is not considered using Levenshtein distance.

The Jaccard distance (Jaccard, 1901) refers to the number of common words in two texts scaled by all words. Consequently, more common words indicate higher similarity (Huang, 2008; Bochkay et al., 2023; Deneuve et al., 2024). Following that, the Jaccard distance describes one minus the similarity, i.e., the dissimilarity. However, every word in the collection of texts (i.e., all risk disclosures) is given equal importance, which may not be appropriate in many contexts where certain words should have more influence on the similarity score. Furthermore, the Jaccard distance does not consider the context of the texts.

The Euclidian distance also uses the introduced *tf-idf* vectorisation of our risk disclosures. Instead of using the cosine of the angle between the two vectors (cosine similarity), the Euclidian distance measures simply the straight distance between the two vectors. The longer the distance, the more dissimilar the texts are (Huang, 2008). However, text vectors might have different magnitudes based on the length of the texts or the frequency of the terms. Therefore, longer texts result in a larger vector magnitude, which can disturb the similarity measure. This is solved by using cosine similarity, which measures the angle of two vectors, focusing on the direction instead of the magnitude (Huang, 2008).

Our final measure uses cosine similarity again with the basis of the vectorisation using the large language model “text-embedding-ada-002” provided by OpenAI (2024). After that, we used one minus cosine similarity to measure textual dissimilarity. Large language models surpass *tf-idf* due to their ability to understand context and semantics in natural language, enabling

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<sup>29</sup> A comparison of different textual similarity measures are presented by Huang (2008) and Wang and Dong (2020).

more accurate and nuanced text processing. Large language models are pre-trained on vast text corpora, capturing deep linguistic patterns beyond the scope of traditional *tf-idf* methods (Devlin et al., 2019). However, while a large language model might reveal the best outcomes, the results are limited by the maximum allowance of a certain number of tokens, e.g., OpenAI (2024) only can handle input from 8,191 tokens. Therefore, only a beginning part of our risk disclosures is observed within this method. Another issue with large language models is that average cosine similarity between two random texts is much higher than zero (the range only spans from 0.6 to 1) (Liang et al., 2021; Rudman and Eickhoff, 2024).

Bochkay et al. (2023) claim that there is a disadvantage of using *tf-idf* as a vectorisation method because if two sentences use synonyms, the sentences will be ranked less similar, although both deliver the same message. However, a distinction might be important. Even if the texts are semantically similar, the different words will make information processing more complex (Daske et al., 2023). This would even suggest that at least for certain aspects, vectorisation with *tf-idf* is more suitable than such with a large language model.

Table 7 shows the descriptive statistics for the above-mentioned measures. For comparison reasons, we also insert our main analysis, Measure 1. The mean values for all measures range from 0.024 to 0.369. The smallest mean value can be found for Measure 7 (0.024), and the highest mean value for Measure 5 (0.369). Overall, the mean values indicate that companies do not adjust their disclosure constantly and even maintain it. This is further highlighted by the 75 percent quantile information, which shows that a large number of observations do not change their disclosure much, regardless of measures. Regarding the graphical representation shown in Figure 6, Measure 5 and Measure 6 indicate a similar graphical trend as our main analysis. In contrast, the graphical trend of Measure 4 and Measure 7 appears to be very flat and indicates almost no textual dissimilarity. Nevertheless, increasing dissimilarity exists for the financial crisis and the COVID-19 pandemic.

Using the introduced measures, we run the same regression analysis to investigate determinants of textual dissimilarity. The results are shown in Table 8. The descriptive statistics corresponding with the measures can be found in Table 7. Regarding Measure 4, we find similar results as in our main regression. However, we are losing significance for the variables *ROA* and *BIG4*. Considering Measure 5, we can confirm our results, except *BIG4* and *LENGTH*. In addition to our main measure, Measure 6 further finds negative significant results for *FCA*. Finally, we only lose significance for *FYCY* for our Measure 7. However, this regression also reveals a negative significant value for *SIZE* and a positive significant value for *INDSPEC* and *INT*.

To sum up, overall, our results are more or less robust, compared to our findings regarding our main analysis which used the *tf-idf* vectorisation and cosine similarity as our measure.

Table 7: Descriptive statistics for different dissimilarity measures

Descriptive statistics for different dissimilarity measures								
Measures	N	Mean	SD	Min	0.25	Median	0.75	Max
Measure 1: 1-,2- & 3-gram	29,070	0.158	0.139	0.000	0.070	0.199	0.198	0.994
Measure 4: Levenshtein	29,070	0.026	0.037	0.000	0.007	0.015	0.032	0.985
Measure 5: Jaccard	29,070	0.167	0.127	0.000	0.094	0.139	0.201	0.994
Measure 6: Euclidian	29,070	0.369	0.150	0.000	0.265	0.346	0.446	1.000
Measure 7: OpenAI	29,070	0.024	0.028	0.000	0.007	0.015	0.031	0.236

Notes: This table shows the descriptive statistics for different dissimilarity measures. N = number of observations; SD = standard deviation; Min = Minimum; 25% = 25 quantile; 75% = 75% quantile; Max = Maximum.

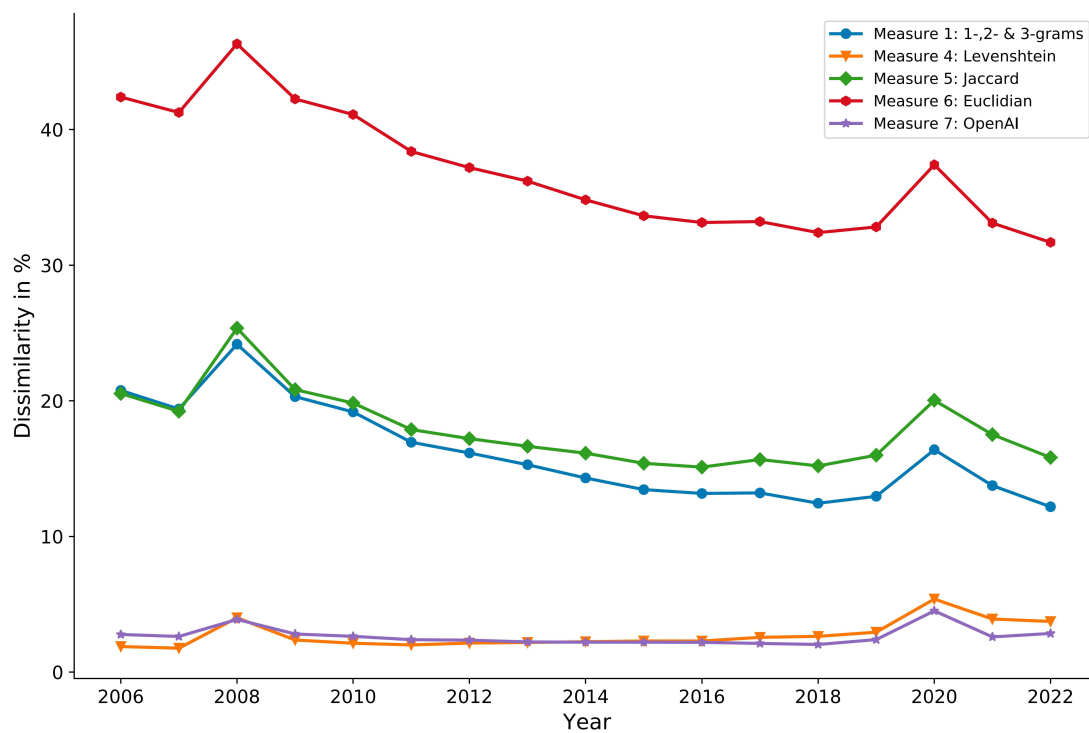


Figure 6: Mean for YoY for different measures

Notes: This figure visualises the graphical trend of the mean values for the year-of-year dissimilarity in percent from 2006 to 2022 for five different measures. Measure 1 uses 1-, 2- & 3-grams, Measure 4 uses Levenshtein distance, Measure 5 uses Jaccard distance, Measure 6 uses Euclidian distance, and Measure 7 uses the LLM by OpenAI.

Table 8: OLS regression results for textual dissimilarity

Variables	Expected sign	Measure 4 Levenshtein Coefficient (t-value)	Measure 5 Jaccard Coefficient (t-value)	Measure 6 Euclidian Coefficient (t-value)	Measure 7 OpenAI Coefficient (t-value)
<i>Intercept</i>		-13.873*** (-29.359)	14.076*** (7.989)	73.055*** (33.009)	-0.880*** (-2.654)
<i>SIZE</i>	+	0.021 (0.758)	0.137 (1.175)	0.119 (0.835)	-0.087*** (-3.686)
$\Delta$ <i>ASSETS</i>	+	0.417*** (9.247)	2.636*** (14.035)	2.565*** (13.345)	0.360*** (10.161)
<i>ROA</i>	-	-0.063 (-1.540)	-1.138*** (-3.982)	-0.544* (-1.860)	-0.170*** (-3.390)
<i>CFO</i>	-	-0.172* (-1.874)	-2.186*** (-4.308)	-2.592*** (-4.553)	-0.218*** (-2.295)
<i>CR</i>	-	-0.014*** (-1.766)	-0.148*** (-4.344)	-0.200*** (-4.740)	-0.035*** (-5.083)
<i>FCA</i>	+	1.632 (0.143)	-47.212 (-1.243)	-76.341* (-1.855)	-4.906 (-0.548)
<i>R&amp;D</i>	+	-0.414*** (-2.435)	-5.020*** (-5.795)	-5.021*** (-4.867)	-0.682*** (-4.168)
<i>INT</i>	+	-0.032 (-0.217)	0.439 (0.804)	0.992 (1.436)	0.543*** (4.466)
<i>LEV</i>	+	-0.007 (-0.994)	0.005 (0.292)	0.023 (0.984)	0.007 (1.348)
<i>ZSCORE</i>	-	0.003*** (3.018)	0.036*** (4.993)	0.025*** (3.073)	0.007*** (5.535)
<i>LOSS</i>	+	0.523*** (8.371)	2.367*** (10.440)	2.915*** (10.792)	0.471*** (9.526)
<i>SOX404</i>	-	0.271*** (3.256)	2.467*** (6.848)	1.744*** (4.241)	0.370*** (5.222)
<i>AUDITFEES</i>	+	0.207*** (4.859)	0.718*** (4.203)	1.421*** (6.897)	0.186*** (5.246)
<i>NAS</i>	+	0.564*** (4.930)	2.365*** (6.010)	2.999*** (6.162)	0.461*** (5.682)
<i>AUDITORCHANGE</i>	+	0.256*** (2.887)	1.924*** (5.181)	2.032*** (5.155)	0.342*** (4.731)
<i>BIG4</i>	+	0.094 (1.204)	-0.350 (-1.238)	-0.844** (-2.244)	-0.159*** (-2.636)
<i>INDSPEC</i>	+	-0.036 (-0.528)	0.115 (0.512)	-0.068 (-0.235)	0.108** (2.219)
<i>LENGTH</i>	-	1.912*** (33.419)	-0.113 (-0.556)	-4.976*** (-19.777)	0.392*** (10.150)
<i>FYCY</i>	?	-0.139** (-2.527)	-0.679*** (-2.789)	-0.631* (-1.981)	-0.031 (-0.634)
Firm Fixed Effects		No	No	No	No
Ind. Fixed Effects		Yes	Yes	Yes	Yes
Year fixed effects		Yes	Yes	Yes	Yes
N		29,070	29,070	29,070	29,070
Adjusted $R^2$		0.223	0.083	0.157	0.102

Notes: This table reveals the regression results for different dissimilarity measures as our dependent variable. Measure 4 (Levenshtein), Measure 5 (Jaccard), Measure 6 (Euclidian), and Measure 7 (OpenAI). \*, \*\*, \*\*\* indicate significance levels at 10, 5, and 1 % (two-tailed).

### 2.3.5 Conclusion

This paper investigated the determinants of textual dissimilarities in 10-K risk disclosure using a sample of 29,070 observations between 2005 and 2022 of the US capital market. We stated two research questions in the beginning: To answer the first research question, to what extent the textual dissimilarity changes over time, our results show that textual dissimilarity is low over time, indicating that risk disclosure quality decreases over time and might not result in a significant information gain. The decrease of longitudinal textual dissimilarity of the average firm occurs unless severe and unexpected events happen, such as the financial crisis or the COVID-19 pandemic. Regarding the second research question, which asked about the determinants of textual dissimilarity, we were able to identify several influencing factors. The results suggest that performance measures (e.g., change in assets, current ratio), risk measures (e.g., Z-Score, loss), and audit characteristics (e.g., audit fees, auditor change) influence textual dissimilarity.

We contribute to the risk disclosure literature, focusing on the overall usefulness of risk disclosures. Since risk information focuses predominantly on the future, reacting to and anticipating dynamic developments is crucial. Risk disclosure is intended to inform addressees about the company's risk exposure and thus reduce information asymmetries between the company and stakeholders. Very similar risk reports are unlikely to contain new information, which is why the function of reducing information asymmetry is less likely to be fulfilled, and the usefulness for decision-making may, therefore, be limited. To the best of our knowledge, this is the first systematic analysis of the determinants of textual dissimilarity of risk disclosures.

The findings help regulatory authorities revise their disclosure guidelines. While it seems that companies just use their previous disclosure as a template, regulators might introduce rules requiring companies to declare how their risk disclosure has changed from the previous year. In addition, companies may consider improving the uniqueness of their year-specific risk disclosure. This might improve the quality of their risk disclosures and, furthermore, might contribute to stakeholders' better decision-making. Therefore, investors could use information about textual dissimilarity to judge how idiosyncratic certain risks are, potentially helping to manage systematic and idiosyncratic risks in their investment portfolios. The revealed determinants help risk disclosure addressees to identify the influencing factors for textual dissimilarity. Identifying the determinants reveals underlying factors and provides insights into underlying mechanisms which help to better understand what internal and external forces shape the way risks are communicated. Our findings reveal that specific risk variables drive dissimilarity (e.g., loss). Therefore, an indication of textual dissimilarity might also work as a risk proxy for investors. This information might help to assess the risk situation of the company, which is needed to make well-founded investment decisions.

Our findings are subject to several limitations, most of which point to the need for further research. We only examined the US setting. Regression results for individual industry or

other countries could also provide useful information. In the US, risk disclosure is mandatory. Thus, looking at the extent to which textual similarities exist in jurisdictions with a voluntary risk disclosure setting would be worthwhile. Although we have a large sample, expanding the data analysis may yield further insights. In addition, there may be other unknown factors influencing the textual similarities. Another promising avenue for future research is to examine whether textual dissimilarities have an impact on the capital market, such as stock return or trading volume.<sup>30</sup> Furthermore, a deeper dive into subsamples (e.g., only firms with a loss or firms with a high-risk profile) could also yield interesting insights. In addition to that, the risk disclosure could be compared with companies from the same industry. To gain a deeper understanding, interview studies with the communication department of companies or auditors could yield additional insights into textual similarities and reasons for its existence. Finally, we are limited to our natural language processing approaches (e.g., vectorisation method and similarity methods). Using new large language models in the future might improve the coverage of the semantics of the texts, opening exciting possibilities for future research in this field.

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<sup>30</sup> However, Cohen et al. (2020) demonstrate that prices are “lazy” to minimal changes in corporate disclosures, meaning that investors are inattentive to the additional information they receive.

## 2.3.6 Appendix

### Appendix A

Our sample consists of firms (i.e., tickers) available in the Compustat database. The initial number of firms was 20,367. We used an automated script in Python to collect data from the EDGAR database, which is publicly available for investors to download or search for annual filing reports. We submitted an HTTPS request using the following query parameters to specify some details:

1. CIK number (CIK): a unique numerical identifier assigned by the EDGAR system.
2. Report type (type): type of financial report that is to be queried, e.g., 10-K.
3. Start date (start): the starting point for data collection.
4. The number of reports (count): this quantity describes the number of filings from the starting date.
5. Ownership (owner): The SEC requires filings from individuals who own significant amounts of the company's stock. Setting the owner parameter to exclude, EDGAR does not provide reports related to its director or officer ownership.

This returned a collection of URLs pointing to the according 10-K documents. Further, we automatically collected the HTML documents and parsed them, extracting only the text data needed for our analysis. For the purposes of this paper, we collected 10-K forms filed in the time period from 1<sup>st</sup> December 2005 to 31<sup>st</sup> December 2023. We selected 1<sup>st</sup> December 2005 as the base year because it marked the initial requirement by the SEC for firms to disclose their risk factors in Item 1A (SEC, 2005). The 10-K forms were preprocessed by lowercasing the content. As the main research object is the risk factors disclosure, the next step was to extract Item 1A from the collected forms. For that, we used a semi-automated approach by using regular expressions to extract the required passages from the whole 10-K form, first, and then checked the plausibility of the extraction quality with different methods. If needed, the passages were corrected or extracted manually. The collected Item 1A texts are the data for vectorisation and textual dissimilarity calculation.

## Appendix B

Table 9: Industry composition

<b>Panel A: Industry Composition of the Initial Dataset</b>			
Industry	SIC Codes	Initial Dataset	
		Firms	Firm Year
Agriculture, Forestry and Mining & Construction	0100-1799	613	4,217
Manufacturing	2000-3999	3,473	25,211
Transportation, Communication, Electric, Gas and Sanitary services	4000-4999	718	6,357
Wholesale Trade & Retail Trade	5000-5999	647	5,084
Finance, Insurance and Real Estate	6000-6799	1,810	14,930
Services, Public Administration & not classifiable	7000-9999	1,705	10,731
		$\Sigma$ 8,966	$\Sigma$ 66,530
<b>Panel B: Industry Composition of the Final Datasets</b>			
Industry	SIC Codes	Initial Dataset	
		Firms	Firm Year
Agriculture, Forestry and Mining & Construction	0100-1799	214	1,989
Manufacturing	2000-3999	1,591	15,857
Transportation, Communication, Electric, Gas and Sanitary services	4000-4999	227	2,582
Wholesale Trade & Retail Trade	5000-5999	275	2,976
Finance, Insurance and Real Estate	6000-6799	0	0
Services, Public Administration & not classifiable	7000-9999	645	5,666
		$\Sigma$ 2,952	$\Sigma$ 29,070

*Notes:* This table summarises the industry composition. Panel A delineates the industries for the initial dataset, whereas Panel B delineates the industries for the final dataset. The initial dataset is used for the descriptive analysis, whereas the final dataset is used for the regression model. The sum indicates the total amount of the column.



## Appendix C

Table 10: Year composition

Year Composition of the Initial and Final Dataset		
Year	Initial Dataset	Final Dataset
	Firm Year	Firm Year
2006	3,614	832
2007	3,892	1,086
2008	4,150	1,282
2009	4,313	1,422
2010	4,268	1,483
2011	4,217	1,540
2012	4,225	1,599
2013	4,225	1,713
2014	4,212	1,830
2015	4,205	1,944
2016	4,122	2,048
2017	4,037	2,172
2018	3,959	2,282
2019	3,987	2,387
2020	4,050	2,505
2021	4,153	2,586
2022	901	359
	$\Sigma$ 66,530	$\Sigma$ 29,070

*Notes:* This table delineates the data per year for the initial and final datasets. The initial dataset is used for the descriptive analysis, whereas the final dataset is used for the regression model. The sum indicates the total amount of the column.

## Appendix D

Table 11: Variable description

Variables	Definitons
<i>YoY</i>	Year-over-year dissimilarity
<i>SIZE</i>	Natural logarithm of total assets
$\Delta ASSETS$	Change in total assets, scaled by total assets
<i>ROA</i>	Return on assets
<i>CFO</i>	Cash flow from operations, scaled by total assets
<i>CR</i>	Ratio of current assets and current liabilities
<i>FCA</i>	Foreign currency adjustment, scaled by total assets
<i>R&amp;D</i>	Research and development expenses, scaled by total assets
<i>INT</i>	Intangibles, scaled by total assets
<i>LEV</i>	Leverage, measured total debt, divided by total assets
<i>ZSCORE</i>	Altman's (1968) Z-score
<i>LOSS</i>	Dummy variable, coded as 1 if net income is less than 0, otherwise 0
<i>SOX404</i>	Dummy variable, coded as 0 if the internal controls were found to be effective, otherwise 1
<i>AUDITFEES</i>	Natural logarithm of audit fees
<i>NAS</i>	Sum of non-audit fees, divided by audit fees
<i>AUDITORCHANGE</i>	Dummy variable, coded as 1 if there was an auditor change in the fiscal year
<i>BIG4</i>	Dummy variable, coded as 1 if the auditor belongs to the Big4, otherwise 0
<i>INDSPEC</i>	Dummy variable, coded as 1 if the auditor is an industry specialist, which was measured whether an auditor has 30% of the market share measured by absolute audit fees
<i>LENGTH</i>	Natural logarithm of length measured by words of Item 1A
<i>FYCY</i>	Dummy variable, coded as 0 if fiscal year = calendar year, otherwise 0

*Notes:* This table summarises the variable description.

## Appendix E

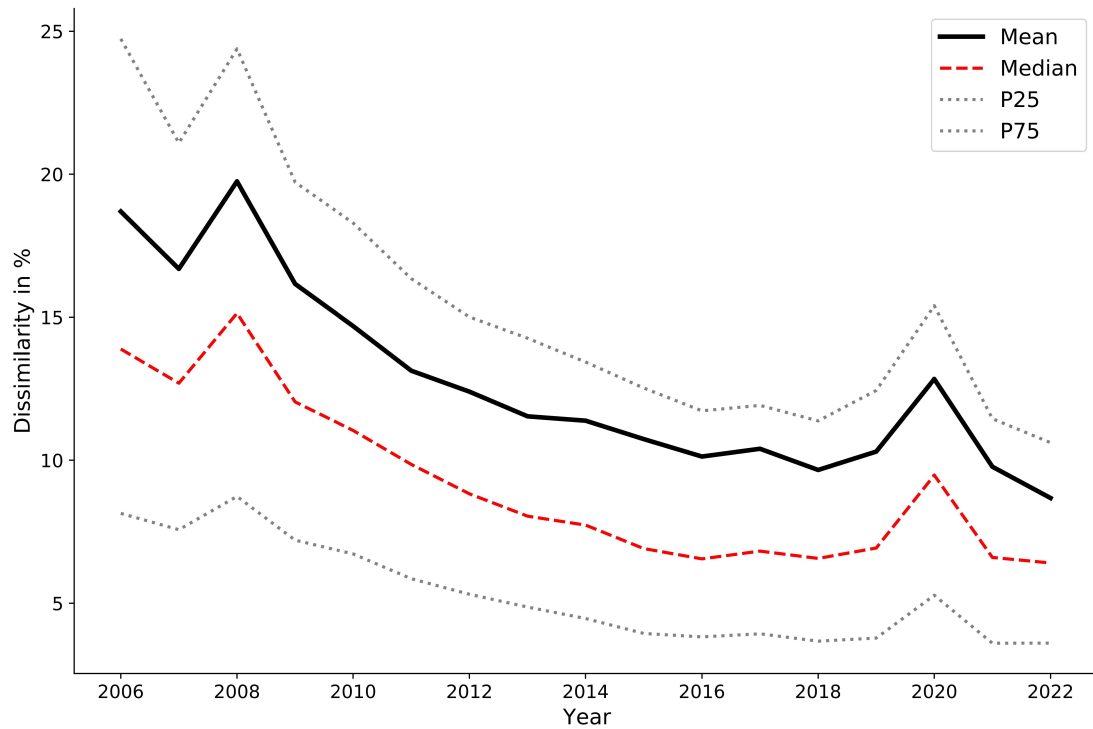


Figure 7: Mean, median, and quartiles for *YoY* of the final dataset used for the regressions

*Notes:* This figure visualises the graphical trend of the year-of-year dissimilarity in percent from 2006 to 2022. The black solid line shows the mean values, the red dashed line is the median, and the dotted line shows the 25% and 75% quantiles, respectively. The underlying dataset is the final one and is also used in our regression analysis.

Appendix F



Figure 8: Mean for  $YoY$  for the given industries of the final dataset used for the regressions

*Notes:* This figure visualises the graphical trend of the mean value for the year-of-year dissimilarity in percent from 2006 to 2022 for the given industries. The SIC codes clustered the industries.

## 2.4 How Do Companies Report about their Risk Management Systems?

Abstract (unofficial translation)

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Risk management became part of the legal and regulatory requirements in Germany with the introduction of the Law on Control and Transparency in Business in 1998. The reporting on risk management systems in annual reports is highly relevant for stakeholders. Given this context and background, the following article conducts a qualitative analysis of the reporting found in the annual reports of HDAX companies, assessing both the intensity and content of this reporting. The results can support companies and their stakeholders in identifying best practices for reporting on risk management systems.

Published in

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**Quick, R. and Gauch, K. (2021).** Wie berichten Unternehmen über ihre Risikomanagementsysteme? Eine Inhaltsanalyse zu den Geschäftsberichten der HDAX-Unternehmen. *Die Wirtschaftsprüfung* 74(18), 1121-1126.

## 2.5 Disclosure of IT Risks in DAX and MDAX Companies

Abstract (unofficial translation)

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The relevance of IT risks for companies has risen sharply in recent years due to increasing digitalization. Negative headlines, such as about cyber attacks, regularly appear in the media. A structured approach to IT risks is therefore essential, and, reporting on such risks in annual reports is highly relevant for stakeholders. This article presents the results of a qualitative content analysis of the reporting on IT risks by DAX and MDAX companies. The focus is on the content and scope of the reporting. The findings can help companies to identify best practices for reporting on IT risks.

Published in

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**Quick, R. and Gauch, K. (2022).** Darstellung der IT-Risiken im Risiko-und-Chancenbericht der DAX- und MDAX-Unternehmen. *Der Betrieb*, 75(8), 414-417.

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## **Chapter 3**

### Essays on Risk Management System Related Assurance Services

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### 3.1 Is Assurance on Risk Management Systems Relevant for Bankers' Decisions?

#### Abstract

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Risk management systems (RMS) are an essential element of corporate governance and support companies in managing the omnipresent internal and external risks. Assurance on such systems can support such efforts and add further benefits. This study investigates the impact of RMS assurance on the perceptions and decisions of German bankers, and analyzes whether the assurance provider and the assurance level are relevant to them. We conducted an experiment with 145 bankers, using ANOVA to analyze their reliance on the hypothetical company's RMS and their decisions regarding lending, recommending investments, and investing in stocks. A 2x2+1 between-subjects design was chosen, and we manipulated the assurance provider (audit firm vs. third-party provider) and the assurance level (limited vs. reasonable), and added a control condition with no assurance. Our results indicate that RMS assurance positively influences banker perceptions and decisions, whereas the assurance provider and assurance level has no statistically significant impact on them.

#### Conferences and Workshops

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- XVII Congreso Internacional de Costos, 2021, Sevilla, Spain
- 11<sup>th</sup> EARNet Symposium, PhD Workshop, 2021, online

#### Published in

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**Quick, R. and Gauch, K. (2021).** Is assurance on risk management systems relevant for bankers' decisions? *Advances in Accounting*, 55.



## 3.2 Assure or Insure Cyber Risk? Non-Professional Investors' Willingness to Invest

### Abstract

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Organizations face severe cyber risks, which may lead companies to contract related insurance or to demand cybersecurity assurance services to signal risk management. This paper experimentally investigates how cybersecurity assurance and insurance against cyber risks impact non-professional investors. We conducted an experiment with a 2x2 between-subject design with 100 UK non-professional investors and manipulated the assurance provision and insurance purchase to analyze their impact on willingness to invest. Our results suggest that cybersecurity assurance and cyber risk insurance positively affect willingness to invest. The results confirm the usefulness of measures to handle cyber risks and are of interest to managers, auditors, regulators, and academics.

### Conferences and Workshops

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- 4<sup>th</sup> Workshop on Governance and Management of Digitalization, 2022, Strasbourg, France
- 4<sup>th</sup> Workshop on Corporate Governance, 2022, Strasbourg, France
- 33<sup>rd</sup> Audit & Assurance Conference, 2023, Edinburgh, Scotland
- 45<sup>th</sup> EAA Annual Congress, 2023, Helsinki, Finland
- 12<sup>th</sup> EARNet Symposium, 2023, Thessaloniki, Greece

### Working Paper

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**Gauch, K. and Quick, R. (2024).** Assure or Insure Cyber Risk? Non-Professional Investors' Willingness to Invest. *Accounting Perspectives*, (forthcoming).

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# Chapter 4

## Overall Conclusion

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## 4.1 Contribution

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This dissertation examines risk disclosure and assurance of risk management systems through seven empirical research contributions. This section highlights the overall contributions of this dissertation. For a detailed discussion the readers should refer to the individual research paper.

Overall, the results have implications for various different stakeholder groups: academia, regulators, audit firms, third-party assurance providers, companies, and other stakeholders such as equity and debt investors. First, this dissertation contributes to the accounting and auditing literature on risk disclosure and the assurance of risk management systems. The content analysis studies provide an up-to-date insight into risk disclosures, and thus directly reflect current developments in risk disclosure. Such studies are carried out regularly and periodically by various researchers and can provide insights into implementing legal requirements. The study on textual dissimilarity in the US context is, as far as currently known, the first systematic analysis of the determinants of textual dissimilarity in risk disclosures. Both experimental studies are also the first to examine the assurance of risk management systems. Moreover, the second experiment is the first to analyze cybersecurity assurance in combination with cyber insurance. In this context, the research papers offer a unique contribution by adding relevant topics to the literature.

For the legislator, the results indicate how further statutory regulation can be designed effectively. In particular, the results of the content analyses in this dissertation reflect the current implementation status of the statutory requirements, which can signal the regulator regarding the extent to which the statutory regulation has been implemented and what further regulation could look like. For example, heterogeneous disclosure could be standardized more intensively through more substantial requirements, so as to achieve greater comparability. In addition, updated accounting standards could help improve the information provided to recipients. For instance, very few companies report on the assurance of risk management systems. It is often unclear whether an assurance has not been conducted at all or whether it has simply not been disclosed in the other cases. Regarding new and emerging risks, such as cyber risk, the picture is similar regarding the disclosure of applied and certified standards.

The results of the two experimental studies also indicate potential new regulatory adjustments. From a regulatory perspective, the positive effect of voluntary assurance of the risk management system or cybersecurity could lead to the regulators to consider legal obligation. On the one hand, this could allow these positive effects to unfold. On the other hand, following the obligation to introduce a risk management system by the FISG, a new legal obligation regarding an assurance could ensure appropriateness and effectiveness. In addition, the results also reveal the positive effects of the purchase of cyber insurance on equity providers. A legal obligation could also be contemplated, as insurance could minimize any negative effects, mainly due to the high-risk exposure.

Assurance providers can learn from our findings that the shareholders of potential clients have a positive perception of their risk management and cybersecurity assurance services, which could lead the providers to consider expanding their offer. However, audit firms can also learn from our findings that their assurance services are not automatically perceived as better than those of other assurance providers. Finally, the lack of impact of the specific assurance level highlights an expectation gap. Standard setters, audit firms, and their clients should ensure that users of assurance reports really understand the different assurance levels. This is essential in order to ensure that the scope of the assurance is understood. In addition, heterogeneous risk disclosure offers audit firms the opportunity to offer consulting services in this context.

Companies can learn from our content analysis studies what constitutes the best practice of risk disclosure in Germany currently, and can consequently derive any need for action to improve their company's reporting quality. In addition, companies could consider engaging voluntary assurance, which may increase the attractiveness of the company for equity investors and the chances of obtaining financing. However, managers must individually weigh up the costs and benefits of such assurance.

Other stakeholders, such as equity or debt investors, would also benefit from the findings of best practices. They can more accurately assess the quality of reporting and, if necessary, make well-grounded and prudent investment decisions.

## 4.2 Limitations and Directions for Future Research

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This dissertation has some limitations, which could provide avenues for future research. Each of the individual research papers provides a detailed description.

Regarding the geographical context of the studies, six of the seven studies were conducted in the German context, and the remaining one in the US context. Hence, this might limit the generalizability of our results. Concerning the methodology, several limitations inevitably arise. On the one hand, qualitative content analyses cannot be carried out without subjective influences, which limits reproducibility. Nonetheless, care was taken to ensure the highest data quality when conducting the studies, and the researchers used several quality indicators. With regard to the study on text dissimilarity, the models used constitute a limitation. Despite using different models, the text mining market is developing extremely rapidly, so that future models will achieve more accurate results. Experiments are also generally vulnerable to limitations. On the one hand, the experimental results are limited by the specific experimental case descriptions. They were restricted to German companies in a favorable financial situation. Therefore, the results may turn out differently in a different setting. The assurance providers used are also not free of limitations, such that using other assurance providers could give rise to different perceptions. It is noteworthy that the costs of the assurance and cyber insurance were not considered in our experimental design. Participants were not given any information about the potential costs of these elements. However, as we were keen to provide an accurate representation of reality, we did not include this, as it is not information that is usually disclosed in corporate communication. Finally, although we believe that our participants yielded high data quality due to various quality checks, we cannot exclude the possibility that other participants would have decided differently at a different time.

Apart from these limitations and the resulting implications for future research projects, this dissertation opens up numerous additional avenues for future research. Concerning risk disclosure, it is necessary to analyze risk disclosure in order to monitor developments regularly over time. This is particularly necessary after regulatory adjustments so as to review them and identify any further need for action. It would furthermore be interesting to shed light on the reporting process. For example, interview studies with report preparers and corresponding consulting firms could shed light on why some information is disclosed voluntarily, while other aspects are given little attention. Additionally, analyzing which elements are relevant for report addressees would be useful. Due to the increasing risk exposure to cyberattacks, analyzing the disclosure of cyber risks is a promising avenue. New disclosure guidelines were recently introduced in the US, which provide potential for innovative research.

Furthermore, the investigation of other consequences of voluntary assurance services is relevant. For example, the impact of assurance of risk management systems on the company's reputation or financial performance could be a promising avenue for future research. In addition, new

projects could analyze the most influential factors affecting the quality of risk management system assurance. The increasing relevance of cybersecurity in fact opens up a wide range of research opportunities. For instance, the cyber assurance market and the impact of assurance could be examined in more detail. Another area of interest could be to examine the impact of specific assurance provider characteristics on willingness to invest, e.g., tenure, Big 4 vs. non-Big 4, or industry specialization. As already indicated in the limitations, the costs of assurance are usually not taken into account in studies. This is why the cost side could also be included in the analysis, so as to obtain a more comprehensive picture of the cost-benefit ratio in the future.

Apart from the above considerations, new and upcoming regulatory changes, such as the recent FISG in Germany or the disclosure obligation regarding cybersecurity in the US, will create plenty of potential for future research projects. Last but not least, the topics surrounding risk management will remain a fruitful field for compelling and insightful research in the future, due to the increasing complexity of business activities, digitalization, and rising stakeholder needs.

# Declaration of Authorship

The dissertation is provided by me with a list of all sources used. I declare that I have written the thesis on my own – apart from the help explicitly mentioned in it. The thesis has not been published anywhere else nor presented to any other examination board.

Die Dissertation ist von mir mit einem Verzeichnis aller benutzten Quellen versehen. Ich erkläre, dass ich die Arbeit – abgesehen von den in ihr ausdrücklich genannten Hilfen – selbstständig verfasst habe. Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt noch veröffentlicht.

Darmstadt, 2024

Kevin Gauch

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