The Journal of Risk Finance

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Determinants of narrative risk disclosure in the insurance sector: evidence from German Solvency and Financial Condition Reports

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Received 16 April 2024
Revised 13 December 2024
13 March 2025
14 May 2025
13 August 2025
Accepted 7 October 2025

Abstract

Purpose – This study aims to provide initial evidence on the determinants of insurers' narrative risk disclosure in Solvency and Financial Condition Reports (SFCRs) as a new reporting instrument under Solvency II.

Design/methodology/approach – We investigate the volume of risk disclosure collected from 1,510 solo SFCRs by 302 unique German (non-listed and listed) insurers over the reporting periods 2016–2020. Based on socio-political theories, we hypothesise that risk disclosure volume is positively associated with insurer size and status as a life insurer and negatively associated with the insurer's solvency ratio and legal form as an insurer governed by public law.

Findings – Our results support our hypotheses and suggest that socio-political theories explain the variations in risk disclosure volume in SFCRs. The key results remain unaltered when focusing on the disclosure of insurers' risk profiles and hold for various robustness tests. Additionally, our study provides novel insights into how narrative risk disclosure relates to disclosure regulations and insurers' institutional characteristics.

Social implications – Our findings imply that public (social and political) pressure on insurers drives their narrative risk disclosure to the broad public.

Originality/value – To the best of our knowledge, this study is the first to explore the determinants of risk disclosure in SFCRs. By doing so, it enriches the limited research on risk disclosure in the insurance sector and overcomes the shortcomings of prior studies that focus on grouplevel evidence from the financial reports of listed insurers.

Keywords Content analysis, Solvency II, Insurance, Narrative risk disclosure, SFCR, Socio-political theory

Paper type Research article

1. Introduction

To promote transparency and market discipline, the third pillar of the Solvency II Directive (Solvency II) requires several reports by insurers in the European Union, including the Solvency and Financial Condition Report (SFCR). The SFCR is intended for the public and shall inform about the insurer's business and performance, governance system, risk profile, solvency valuation principles, and capital management (Directive 2009/138/EC, 2025; Sec. 40 (2) Insurance Supervision Act, 2025; Gatzert and Wesker, 2012). With a sceptical eye, supervisors' analyses of SFCRs suggest substantial variations in the volume and level of disclosure detail provided in the reports (BaFin, 2017a); European Insurance and Occupational Pensions Authority (EIOPA), 2017). However, to date, no studies have examined the factors determining risk disclosure in SFCRs as a new reporting instrument. Hence, this study aims to identify these factors by focusing on narrative risk disclosure. Specifically, we investigate the narrative risk disclosure in SFCR Sections C. "Risk profile" and B.3 "Risk management system including the own risk and solvency assessment". Based on prior literature that assumes risk disclosure to cover risks in particular, as well as their

The Journal of Risk Finance
Vol. 27 No. 1, 2026
pp. 85-107
Emerald Publishing Limited
e-ISSN: 2331-2947
p-ISSN: 1526-5943
DOI 10.1108/JRF-04-2024-0106

management (Linsley and Shrives, 2005; Elzahar and Hussainey, 2012; for review: Ibrahim *et al.*, 2022), we assess risk disclosure in two senses. Specifically, we consider, in a broad sense, the total risk disclosure across Sections C. and B.3, and in a narrow sense, the risk profile disclosure in Section C.

Given the vast body of research on risk disclosure and particularly on its determinants that has emerged over the last few decades (for review: Khlif and Hussainey, 2016; Elshandidy *et al.*, 2018), it is surprising that little attention has been paid to the insurance sector. Höring and Gründl (2011) and Malafronte *et al.* (2016) examine the factors associated with risk disclosure by large, listed European insurers but do not consider non-listed insurers. Dobler and Schwartze (2020) include non-listed insurers in their German sample, but their evidence is limited to a single year. All these industry studies address risk disclosure in the financial reports of insurance groups, meaning consolidated financial statements or group management reports, which are primarily designed to inform investors. This focus inevitably leads to small sample sizes and limited evidence at the group level.

Our study overcomes these shortcomings by investigating risk disclosure in the insurers' solo SFCRs. Solo SFCRs are publicly available for a large number of individual insurers, regardless of whether they are listed or the parents of a group. Therefore, using SFCRs allows risk disclosure to be assessed at the individual insurer level for a large sample [1]. A key difference between financial reports and SFCRs is the intended audience. Unlike financial reports, SFCRs are not focused on investors but are designed to inform the broad public [2]. As implied in related contexts, such as environmental or sustainability disclosure that is intended for the broad public (Gray *et al.*, 1995; Aluchna *et al.*, 2023), the economics-based theories used in prior studies on risk disclosure in insurers' financial reports may not be appropriate for explaining risk disclosure in SFCRs. Therefore, we deviate from prior studies and base our study on socio-political theories [3].

Socio-political theories provide a comprehensive perspective on narrative risk disclosure in SFCRs because they explicitly recognise that insurers evolve within a society that encompasses various political, social, and institutional actors. These theories consistently suggest that disclosure is a function of public (social and political) pressure facing a firm (Gray *et al.*, 1995; Patten, 2002; Aluchna *et al.*, 2023). We argue that large insurers, insurers with low solvency ratios (indicating high risk), life insurers, and insurers not governed by public law face high public pressure. Thus, we hypothesise that risk disclosure is positively associated with insurer size and status as a life insurer but negatively associated with the insurer's solvency ratio and legal form as an insurer governed by public law.

Our study investigates narrative risk disclosure in 1,510 annual solo SFCRs of 302 German insurers in the reporting periods 2016–2020. The research period starts in 2016, when annual SFCRs had to be published for the first time, and covers five years, as in Höring and Gründl (2011). Focusing on one country avoids issues of comparability regarding different institutional settings, domestic regulations, and reporting languages that emerge in cross-country studies (Dobler *et al.*, 2011; Gatzert and Heidinger, 2020). Germany provides an interesting setting not only because of its long-standing experience with regulated risk disclosure in (group) management reports (Dobler, 2005) but also because of its large and diverse insurance sector (EIOPA, 2021). The German setting is well-suited to cover a large and broad spectrum of insurers of different lines and various characteristics. Compared with related industry studies, our sample is far larger and includes insurers from all lines. This represents approximately 80% of insurers supervised by the German Federal Financial Supervisory Authority (BaFin) during the study period.

Following prior studies (Linsley and Shrives, 2005; Hasan *et al.*, 2023; for review: Elshandidy *et al.*, 2018; Ibrahim *et al.*, 2022), we measure risk disclosure in terms of volume (i.e. quantity), based on the number of risk-related sentences disclosed in our main analyses. As discussed in Section 3, this measure reflects volume as a key characteristic of narrative risk disclosure in SFCRs, avoids the discretion and subjectivity inherent in more sophisticated measurement approaches, and allows us to investigate a large sample with reasonable effort.

Hence, our results on risk disclosure should be interpreted in terms of "pure" volume and do not necessarily capture risk disclosure in terms of "quality" (Botosan, 2004; Dobler and Schwartze, 2020).

The main results of our panel regressions support all of our hypotheses, are consistent for total risk disclosure and risk profile disclosure and hold for an array of robustness tests. We conclude that socio-political theories explain the variations in insurers' risk disclosure in SFCRs. This is an important finding, as it contributes to the understanding of insurers' choice of risk disclosure volume, which we document to relate to public (social and political) pressure. Generally, we show that socio-political theories explain narrative disclosure beyond matters of environmental or sustainability disclosure. Additionally, we provide novel evidence on how risk disclosure relates to disclosure regulations and insurers' institutional characteristics. These findings can be of interest to users and regulators. First, our findings can help users assess why insurers differ in the provided risk disclosure and suggest that public scrutiny and pressure on insurers offer mechanisms for increasing their risk disclosure. Second, our findings inform the regulatory debate on the third pillar of Solvency II and suggest that disclosure regulations can effectively affect actual risk disclosure.

Overall, our study provides initial evidence on the determinants of the narrative risk disclosure volume in SFCRs. It contributes to the limited body of empirical research on the risk disclosure determinants and narrative disclosure in the insurance sector by providing new insights from SFCRs as a new reporting instrument and covering a large sample of individual and non-listed insurers. Our findings enhance the understanding of the fundamental mechanisms that determine corporate narrative risk disclosure, apart from financial reports.

The remainder of this paper is organised as follows. Section 2 provides background for the study and develops our hypotheses. Section 3 explains the research methodology. We then present and discuss our empirical results in Section 4. Finally, Section 5 summarises the conclusions, discusses implications, identifies limitations, and explores avenues for future research.

2. Background and hypotheses development

2.1 Literature review: prior evidence on risk disclosure in the insurance sector

Over the last three decades, a considerable body of empirical research has emerged on risk disclosure in annual corporate financial reports (for review: Khlif and Hussainey, 2016; Elshandidy *et al.*, 2018; Ibrahim *et al.*, 2022). As cross-sector studies typically exclude the insurance sector, evidence on risk disclosure in this sector remains scarce and limited. Following Höring and Gründl (2011), empirical studies on insurers' risk disclosure can be categorised into three strands. The first strand covers descriptive studies on the volume or nature of risk disclosure, which suggest considerable variations in risk disclosure practices even in highly regulated regimes (for Germany: Kraft and Nolte, 2005; for listed European insurers: Völker, 2014; Malafronte *et al.*, 2016, who provide descriptive evidence on limited readability of risk disclosure; for the largest insurers from Asia, Europe, and the U.S.: Klumpes *et al.*, 2014). The second strand covers studies on the consequences of risk disclosure, which suggest that risk disclosure is associated with consequences on capital markets (for European insurers: Malafronte *et al.*, 2018; for Canada and the UK: Kassamany *et al.*, 2023). The third strand covers studies on the determinants of risk disclosure (Höring and Gründl, 2011; Malafronte *et al.*, 2016; Dobler and Schwartze, 2020; Torchani *et al.*, 2024). We focus on the third strand because it is the most relevant to our study.

Höring and Gründl (2011) investigate risk disclosure for a sample of 31 listed European primary insurers between 2005 and 2009. They find that risk disclosure is negatively associated with profitability and positively associated with insurer size, book-to-market ratio, and non-life operations. Furthermore, they reveal significant positive associations between risk disclosure and ownership dispersion as well as cross-listing. For a sample of 47 European insurers in the period 2005–2010, Malafronte *et al.* (2016) find that risk disclosure is only

positively associated with insurer size but unassociated with profitability, book-to-market ratio, or life operations. They further reveal that risk disclosure is positively associated with the insurer's reserves and financial crises. These two studies also indicate that risk disclosure varies with country-level institutional, economic, and cultural characteristics. Both studies refer to risk disclosure in the insurers' entire group annual financial reports and measure risk disclosure using self-constructed disclosure indices. In turn, Dobler and Schwartze (2020) examine risk disclosure in the group management report section of annual reports of 49 (listed and non-listed) German insurers in 2016. They use two variables to measure risk disclosure: the first is based on a disclosure index derived from local accounting regulations, and the second is based on the number of sentences reported as a typical measure of risk disclosure volume. The authors find that both risk disclosure variables are positively associated with insurer size, and disclosure volume is positively associated with insurer profitability. Neither risk disclosure variable is significantly related to the insurers' life operations, solvency ratios, or listing status. Finally, for 13 European listed insurers in the period 2002–2007, Torchani *et al.* (2024) identify insurer size and the adoption of International Financial Reporting Standards as driving the volume of risk disclosure and coverage of risk categories in financial reports. This finding complements the descriptive evidence on the impact of disclosure regulations on risk disclosure.

In summary, existing evidence on the determinants of risk disclosure in the insurance sector is scarce and mixed [4]. Particularly, it is

(1) focused on listed insurers (i.e. not covering the large number of non-listed insurers),

(2) limited to group level disclosure of parent companies (i.e. leading to small sample sizes), and

(3) limited to risk disclosure in financial reports designed for investors as financial experts (as opposed to risk disclosure intended for the broad public).

Hence, we aim to overcome these shortcomings by investigating risk disclosure in solo SFCRs. Solo SFCRs are available to a large number of individual (listed and non-listed, parent and non-parent) insurers and designed to inform the broad public. Although studies have begun using SFCRs [5], to date, there has been no published research on the factors determining narrative disclosure in the SFCR as a new reporting instrument.

2.2 Regulatory background: risk disclosure in the SFCR

The SFCR represents an essential part of the third pillar of Solvency II, promoting transparency and market discipline (Directive 2009/138/EC, 2025, recital (38); Durán Santomil and Otero González, 2020). By its very nature, the SFCR is a narrative report supplemented by Quantitative Reporting Templates (QRTs). Governed by various regulatory provisions at the European and national levels (Schemmel, 2019), the SFCR is intended to be the primary tool for insurers to provide regulatory disclosure to the public. Disclosure in the SFCR covers both qualitative and quantitative information about the insurer's business and performance, governance system, risk profile, solvency valuation principles, and capital management (Directive 2009/138/EC, 2025; Sec. 40 (2) VAG; Gatzert and Heidinger, 2020) [6]. The SFCR shall focus on information that is material in the sense that "omission or misstatement could influence the decision-making or the judgement of the users" (Delegated Regulation 2015/35, 2024) [7]. In the German setting, the information provided in the SFCR shall also be "publicly understandable", meaning understood by users of the report who are unfamiliar with the subject. The level of disclosure detail depends on the nature, scale, and complexity of the insurer's business and the risks faced by the insurer (Sec. 40 (2) VAG; BaFin, 2024, Ch. 5 No. 6.).

Regarding risk disclosure in the SFCR, an insurer must report on its business organisation, assessing its appropriateness for its risk profile, as well as risk exposure, concentration,

mitigation, and sensitivity for each risk category separately (Directive 2009/138/EC, 2025; Sec. 40 (2) No. 3. VAG). Given the binding structure of the SFCR, risk disclosure is located in two sections of the SFCR: B.3 "Risk management system including the own risk and solvency assessment" and C. "Risk Profile" (Delegated Regulation 2015/35, 2024 and Annex XX; BaFin, 2024, Ch. 5 No. 12.). In the German setting, BaFin (2024) clarifies that insurer-specific information is required and that a negative statement is mandatory if the required disclosure item is not applicable.

Section B.3 of the SFCR requires the disclosure of the risk management system, including strategies, processes, reporting procedures, and controls, as well as the process and adoption of the insurer's own risk and solvency assessment (ORSA) (Directive 2009/138/EC, 2025 and 45; Delegated Regulation 2015/35, 2024; BaFin, 2024, Ch. 5 No. 37. and 38.). With respect to the ORSA, the EIOPA requires enhanced disclosure if the calculation of the Solvency Capital Requirement (SCR) is based on a partial or full internal model (EIOPA, 2015, No. 1.16).

Section C. of the SFCR focuses on the insurer's risk profile and mandates qualitative and quantitative information on specified risk categories in separate sections: C.1 "Underwriting risk", C.2 "Market risk", C.3 "Credit Risk", C.4 "Liquidity risk", C.5 "Operational risk", and C.6 "Other material risks". These sections are supplemented in Section C.7 for "Any other information" regarding the insurer's risk profile. For each material risk category, an insurer must report risk exposure and changes therein, risk concentration, risk mitigation, and risk sensitivity (Delegated Regulation 2015/35, 2024; BaFin, 2024, Ch. 5 No. 49.).

2.3 Hypotheses development

In contrast to annual financial reports (i.e. financial statements and management reports) that focus on investors, SFCRs are intended for the broad public [8]. As demonstrated by environmental and sustainability disclosure research (Doan and Sassen, 2020; Benameur *et al.*, 2023), socio-political theories are most suited to explaining corporate disclosure to the broad public, particularly when disclosure is discretionary. We acknowledge that risk disclosure in SFCRs is regulated. However, we still assume that narrative risk disclosure is largely under managerial discretion for two main reasons. First, the regulations require judgement and offer room for discretion regarding the volume and level of risk disclosure detail (Sec. 40 (2) VAG). This assessment is consistent with prior assessments of risk disclosure in highly regulated regimes (Hope *et al.*, 2016; Dobler and Schwartze, 2020). Second, the nature of risk disclosure allows for discretion (Jorgensen and Kirschenheiter, 2003; Dobler, 2008). Therefore, we develop our hypotheses based on socio-political theories [9].

Socio-political theories include legitimacy theory (Patten, 1991), stakeholder theory (Roberts, 1992), and political economy theory (Guthrie and Parker, 1990). For the purpose of our study, there is no need to differentiate between them because they all provide consistent explanations for corporate disclosure to the broad public. Socio-political theories posit that corporate disclosure is a function of public (social and political) pressure facing a firm (Gray *et al.*, 1995; Aluchna *et al.*, 2023). In our context, socio-political theories consistently suggest that insurers exposed to high public pressure will provide more comprehensive risk disclosure in their SFCRs. For instance, the insurer's social legitimacy in terms of risk is monitored through public policy processes (Patten, 1991; Moultrie and Thomas, 1997). Therefore, insurers exposed to high public pressure in this regard will have incentives to (actively) participate in the public policy process to change public perceptions regarding their risk profile and risk management. One way of doing so is by providing more risk disclosure (Suchman, 1995; Hassan, 2014). Likewise, insurers who attract particular public scrutiny and pressure are likely to provide more comprehensive risk disclosure to meet or impact stakeholder expectations and avoid political costs (Linsley and Shrives, 2000; Höring and Gründl, 2011). We focus on four proxies for public (social and political) pressures: insurer size, solvency ratio, life insurer status, and legal form as an insurer governed by public law [10].

The insurer size is a typical proxy for public, political, and social attention and pressure. Large insurers are typically mentioned more in the press and under the public eye (Führer and Michel, 2004; Choi *et al.*, 2016). Therefore, socio-political theories suggest that larger insurers provide more comprehensive risk disclosure than smaller ones [11]. Focusing on risk disclosure in annual reports, evidence on risk disclosure in the insurance sector is largely consistent with this size effect (Höring and Gründl, 2011; Malafronte *et al.*, 2016; Dobler and Schwartze, 2020). Although this size effect has not yet been documented for SFCRs, we expect it to hold for risk disclosure in SFCRs. Thus, our first hypothesis is as follows:

H1. Risk disclosure volume is *positively* associated with insurer size.

Specifically, in the insurance sector, an insurer's solvency ratio is an inverse measure of its risk (Gatzert and Heidinger, 2020; Eling *et al.*, 2022). Socio-political theories suggest that higher risk, as measured by a lower solvency ratio, is associated with greater public scrutiny and pressure on an insurer. For instance, insurers shall immediately inform and submit a recovery plan to the supervisory authority if the solvency ratio falls below a certain minimum (Directive 2009/138/EC, 2025; Sec. 134 (1) and (2) VAG). Thus, a low solvency ratio induces more comprehensive risk disclosure. Overall, evidence on the relationship between firm risk and risk disclosure in annual reports is mixed (Dobler *et al.*, 2011; Khlif and Hussainey, 2016). The same applies to the insurance sector (Höring and Gründl, 2011; Malafronte *et al.*, 2016; Dobler and Schwartze, 2020). Dobler and Schwartze (2020) find a negative but insignificant association between risk disclosure in group management reports and the German insurers' solvency ratios. Based on the above discussion, our second hypothesis is as follows:

H2. Risk disclosure volume is *negatively* associated with insurers' solvency ratio.

Life insurers face particularly high public attention and scrutiny (Carson and Hoyt, 1995; Bikker, 2016). Compared with non-life operations, the nature of their business is long-term and more complex. These characteristics and the significance in public retirement provisioning give rise to particular political and social sensitivity towards life insurers (Moultrie and Thomas, 1997; Eling, 2024) and their narrative risk disclosure (Höring and Gründl, 2011). Given the high public pressure on life insurers, socio-political theories suggest that life insurers provide more comprehensive risk disclosure than non-life insurers. There is evidence on high levels of disclosure in the life insurance line, for instance, regarding sustainability reporting (Ullah *et al.*, 2019). However, existing evidence on risk disclosure implies that risk disclosure in annual reports is unrelated (Malafronte *et al.*, 2016; Dobler and Schwartze, 2020) or even negatively related to life operations (Höring and Gründl, 2011). One possible explanation for this finding is that life insurers limit risk disclosure in annual reports to investors because they perceive disclosure as proprietary (Dobler, 2008). Although this countervailing effect may arguably prevail in SFCR risk disclosure, our third hypothesis is as follows:

H3. Risk disclosure volume is *higher* for life insurers than for non-life insurers.

Specific to the German setting, insurers governed by public law claim a significant share of the insurance market (Verband öffentlicher Versicherer, 2024). While operating under conditions equivalent to those of their private law counterparts, insurers governed by public law are owned by public authorities, providing them with financial guarantees from the public sector. For historical reasons, German insurers governed by public law typically operate at a regional level and are oriented towards the common good rather than profit (Sec. 8 (2) VAG; Wende *et al.*, 2008; Paetzmann, 2011). These insurers support the region in which they operate through financial sponsorship, special insurance policies, and social projects. Thus, they are closely related to the regional public (Wissenschaftliche Dienste, 2016). These characteristics suggest that insurers governed by public law face low public pressure regarding their risks. Therefore, socio-political theories suggest that insurers governed by public law provide less comprehensive risk disclosure than their private law counterparts. As no prior study has addressed this association, our last hypothesis is as follows:

H4. Risk disclosure volume is *lower* for insurers with the legal form governed by public law than for those governed by private law.

3. Data and research methodology

3.1 Sample selection

Our initial sample consists of all German insurers supervised by BaFin during the entire research period from 2016 to 2020 (BaFin, 2022). Our research period begins in 2016, when annual SFCRs were published for the first time. It covers five years, as in Höring and Gründl (2011). Based on the BaFin statistics, we identify 379 supervised insurers [12]. We exclude insurers that began their business after 2016 (14), ceased business during our research period (23), or for which the SFCR is not available on the insurer's website for at least one year of our research period (39) [13]. Finally, we exclude one insurer, an accepting insurer of a portfolio transfer, who has no comparable SFCRs.

Our final sample comprises 302 German insurers: 78 life insurers, 162 property and casualty insurers, 39 health insurers, and 23 reinsurers. We collect each insurer's solo SFCRs from the insurer's website for the years 2016–2020, resulting in 1,510 SFCRs and balanced panel data [14]. Thus, our study covers the vast majority of insurers under the BaFin supervision. Compared with prior risk disclosure studies in this sector, our sample includes far more insurers and covers health insurers and reinsurers.

3.2 Measurement of risk disclosure

Risk disclosure research measures risk disclosure based on disclosure indices (labelled as disclosure "quality") or disclosure volume (labelled as disclosure "quantity") (Elshandidy *et al.*, 2018; Ibrahim *et al.*, 2022). Related research in the insurance sector uses both measurement approaches. Our study investigates narrative risk disclosure in terms of volume (i.e. quantity). This choice is justified for several reasons. First, the volume reflects a key characteristic of narrative risk disclosure in SFCRs, which are intended to inform the broad public, including users who are unfamiliar with the topic (BaFin, 2017a, 2024, Ch. 5 No. 6.). Second, using a consistent disclosure index can lead to comparability issues across insurance lines, given differences in regulations. By focusing on the risk disclosure volume, we avoid the subjectivity inherent in the construction of a disclosure index and related coding. Finally, as a matter of fact, using a sophisticated disclosure index, such as the one used by Höring and Gründl (2011), for the large sample of this study would be too time-consuming. However, we acknowledge that risk disclosure volume does not necessarily reflect risk disclosure in terms of "quality" (Botosan, 2004).

Risk-related sentences (or their natural logarithms) are the most widely used tool in empirical research to measure narrative risk disclosure volume (Dobler *et al.*, 2011; Elzahar and Hussainey, 2012; for review: Elshandidy *et al.*, 2018; Ibrahim *et al.*, 2022). Research based on risk-related sentences includes early and seminal works (e.g. Linsley and Shrives, 2005; Abraham and Cox, 2007) as well as recent studies (e.g. Hasan *et al.*, 2023; Khan *et al.*, 2023). In particular, Dobler and Schwartze (2020) and Kassamany *et al.* (2023) are examples of studies in the insurance sector. Consistent with this literature, we measure risk disclosure volume in terms of the number of risk-related sentences.

Using automated text analysis, we count the number of complete sentences in Sections B.3 "Risk management system including the own risk and solvency assessment" and C. "Risk Profile" of each insurer's solo SFCR. We then calculate three risk disclosure variables [15]: risk management disclosure (*RDISCL_RM*), representing the number of sentences in SFCR Section B.3; risk profile disclosure (*RDISCL_RP*), representing the number of sentences in SFCR Section C.; and total risk disclosure (*RDISCL_TOT*), which is the sum of *RDISCL_RM* and *RDISCL_RP*. Based on prior literature that assumes risk disclosure to cover risks in particular, as well as their management (Linsley and Shrives, 2005; Elzahar and Hussainey, 2012; for

review: Ibrahim *et al.*, 2022), risk disclosure can be investigated in a broad and a narrow sense. The broad sense is represented by total risk disclosure, and the narrow sense is represented by risk profile disclosure [16].

Our approach to measuring risk disclosure volume has the advantage of avoiding discretionary choices and the issues of adopting a more sophisticated text-modelling approach to SFCRs as a new reporting instrument in a specialised industry sector (for discussion: Fritzsch *et al.*, 2021; Bochkay *et al.*, 2023). A major concern relates to the potential bias due to different sentence lengths. While we rely on sentences rather than words in our main analysis because a word cannot be interpreted without the context of a sentence, our key findings are robust if the natural logarithm of the number of words is used instead.

3.3 Independent variables and empirical model

To test our hypotheses, we regress our dependent risk disclosure variables (*RDISCL_TOT* and *RDISCL_RP)* on our four measurement variables (insurer size, solvency ratio, status as a life insurer, and legal form as an insurer governed by public law) and a set of control variables. Specifically, we estimate the panel data regression model as follows:

$$RDISCL = \beta_0 + \beta_1 SIZE + \beta_2 SOLV + \beta_3 LIFE + \beta_4 PLAW + \beta_5 PROF + \beta_6 BLIN + \beta_7 BTM + \beta_8 DER + \beta_9 MODL + \beta_{10} GRP + \beta_{11} LIST + u, \quad (1)$$

where *RDISCL* is one of our two dependent risk disclosure variables, and insurer and year subscripts are suppressed. All variables are defined in Table 1.

Regarding our measurement variables, we capture insurer size (*SIZE*) as the natural logarithm of total assets and the solvency ratio (*SOLV*) as the total eligible own funds to meet the SCR divided by SCR in general (Gatzert and Heidinger, 2020). *LIFE* is a binary variable that equals 1 if the insurer is a life insurer, in accordance with the BaFin classification and 0 otherwise (Gavira-Durón *et al.*, 2022). *PLAW* is a binary variable that equals 1 if the insurer or an entity affiliated with it is governed by public law and 0 otherwise [17]. A significantly positive coefficient β_1 (β_3) would support our hypothesis H1 (H3), whereas a significantly negative coefficient β_2 (β_4) would support H2 (H4).

Consistent with Höring and Gründl (2011) and Malafronte *et al.* (2016), our model controls for the insurer's profitability (*PROF*) and book-to-market ratio (*BTM*), both of which are expected to be positively related to risk disclosure. We also control for the number of reported lines of business (*BLIN*) and expect a positive association between risk disclosure and this control variable. Further, we include four binary control variables. Based on the SFCR disclosure regulations, we expect a positive association between risk disclosure and the insurer's use of derivatives (*DER*) and a (partial) internal model to calculate the SCR (*MODL*). Regarding the insurer's institutional characteristics, we control for the insurer's affiliation to a group (*GRP*) and listing status (*LIST*). Consistent with socio-political theories, we expect a positive coefficient β_{11} on *LIST*.

Statistical tests are conducted to verify the linear regression assumptions and determine the most appropriate model for our study (Henningsen and Henningsen, 2019; Baltagi, 2021). We identify that random effects models, which control for time-specific differences, are the most appropriate in our case. We use robust time-clustered estimators to correct for heteroscedasticity and cross-sectional correlations.

4. Results and discussion

4.1 Descriptive statistics

We identify 428,185 risk disclosure sentences in our sample. Table 2 lists the descriptive statistics for our risk disclosure variables. On average, the sample insurers report almost 284 risk disclosure sentences (*RDISCL_TOT*) in their SFCRs, with 197 in their risk profiles

Table 1. Description of variables and data sources

Variable	Variable description and data sources
Risk disclosure variables	
RDISCL_TOT	Insurer's total risk disclosure: number of complete sentences in Sections B.3 "Risk management system including the own risk and solvency assessment" and C. "Risk Profile" (Source(s): SFCR Sections B.3 and C.)
RDISCL_RP	Insurer's risk profile disclosure: number of complete sentences in Section "C. Risk Profile" (Source(s): SFCR Section C.)
RDISCL_RM	Insurer's risk management disclosure: number of complete sentences in Section B.3 "Risk management system including the own risk and solvency assessment" (Source(s): SFCR Section B.3)
Measurement variables	
SIZE	Insurer's size: natural logarithm of "Total assets" valued in accordance with Solvency II (in € thousand) (Source(s): QRT S.02.01.02)
SOLV	Insurer's solvency ratio: "Total eligible own funds to meet the SCR" divided by "SCR" (Source (s): QRT S.23.01.01)
LIFE	Life insurer status: binary variable that equals 1 if the insurer is a life insurer in accordance with the BaFin classification and 0 otherwise (Source(s): BaFin, 2021a)
PLAW	Insurer's legal form: binary variable that equals 1 if the insurer or an entity affiliated with it is governed by public law and 0 otherwise (Source(s): BaFin, 2021a and SFCR Section A.1)
Control variables	
PROF	Insurer's (pseudo) profitability: "Total Net Premiums written" minus "Total Net Claims incurred" and "Total Expenses" for each insurance line divided by „Total assets" (Source(s): QRT S.05.01.02 and S.02.01.02)
BTM	Insurer's (pseudo) book-to-market ratio of equity: "Book value of equity" divided by "Excess of assets over liabilities" (Source(s): Insurer's balance sheet in the annual report and QRT S.02.01.02)
BLIN	Insurer's business lines: number of reported lines of business as defined in Annex I of the Delegated Regulation 2015/35 (Source(s): QRT S.05.01.02)
DER	Insurer's use of derivatives: binary variable that equals 1 if the insurer reports "Derivatives" in their balance sheet valued in accordance with Solvency II and 0 otherwise (Source(s): QRT S.02.01.02)
MODL	Insurer's SCR model: binary variable that equals 1 if the insurer uses a partial or full internal model to calculate the SCR and 0 otherwise (Source(s): QRT S.25.01., S.25.02., or S.25.03)
GRP	Insurer's group membership: binary variable that equals 1 if the insurer is part of an insurance group and 0 otherwise (Source(s): SFCR Section A.1)
LIST	Insurer's listing status: binary variable that equals 1 if the insurer is listed on a stock exchange and 0 otherwise (Source(s): Refinitiv Eikon)

Note(s): If the Minimum Capital Requirement (MCR) of an insurer is higher than its SCR, we calculate *SOLV* as the MCR ratio ("Total eligible own funds to meet the MCR" divided by "MCR") for this insurer and year, as non-compliance of the MCR would have substantial supervisory implications and presents a higher risk exposure. In addition, this leads to a non-comparable excessive solvency ratio, which makes the MCR ratio more meaningful overall for these cases ($N = 57$)

Source(s): Authors' own work

(*RDISCL_RP*) and 86 in their risk management systems (*RDISCL_RM*). In terms of volume, insurers emphasise risk profile disclosure over risk management disclosure in their SFCRs. This finding seems consistent with SFCR disclosure regulations and coincides with evidence on risk disclosure in group management reports of German insurers (Dobler and Schwartze, 2020).

The mean values of all our risk disclosure variables increased with each advancing year. During our sample period, the mean total risk disclosure grew by 36% from 233 sentences in 2016 to 317 sentences in 2020. The relative increase was greater for risk profile disclosure (45%) than for risk management disclosure (19%). The year-to-year mean and median

Table 2. Descriptive statistics for risk disclosure variables over time

Variable	Year	N	Mean	Std. dev	Median	Min	Max
RDISCL_TOT	2016–2020	1,510	283.566	113.663	273.500	24	756
	2016	302	232.695	101.817	220	24	580
	2017	302	270.073	105.288	253	78	629
	2018	302	293.185	108.593	285	79	635
	2019	302	305.331	112.846	289.500	83	662
	2020	302	316.546	119.791	301	97	756
RDISCL_RP	2016–2020	1,510	197.446	84.942	189	16	495
	2016	302	155.407	73.036	150	16	388
	2017	302	185.252	77.572	177.500	27	442
	2018	302	205.811	81.957	195.500	29	472
	2019	302	215.990	84.557	206.500	33	472
	2020	302	224.772	88.694	212.500	34	495
RDISCL_RM	2016–2020	1,510	86.120	43.636	78	5	367
	2016	302	77.288	45.136	68.500	5	367
	2017	302	84.821	40.934	76	12	267
	2018	302	87.374	40.765	82	12	267
	2019	302	89.341	43.300	83	18	298
	2020	302	91.775	46.608	85	18	303

Note(s): The variables are defined in Table 1
Source(s): Authors' own work

comparisons indicate that the largest increase in all our risk disclosure variables occurred between 2016 and 2017. This finding is likely related to adoption effects in the first period of SFCR publication. The standard deviations and spans between the minimum and maximum values indicate large dispersion in our risk disclosure variables.

Regarding the risk profile disclosure in Section C., all sample SFCRs contain disclosures in each of Sections C.1 to C.6 [18]. On average, over the sample period, Sections C.2 "Market risk" (53 sentences), C.1 "Underwriting risk" (42 sentences), and C.5 "Operational risk" (26 sentences) are the longest. This finding indicates that insurers focus their risk profile disclosure on these risk categories vis-à-vis credit, liquidity, and other risks. In 83 SFCRs, we observe that Section C.6 "Other material risks" consists of a single sentence, typically a negative statement. These observations decreased from 29 in 2016 to nine in 2020. The latter finding seems to be at least partly related to regularly revised supervisory notes (BaFin, 2015, 2024).

Table 3 reports the mean values of our risk disclosure variables, grouped by insurance lines. We observe that, on average, life insurers provide the most total risk disclosure and risk profile

Table 3. Mean values of risk disclosure variables per insurance line

Variable	Life insurance line (N = 390)	Property and casualty insurance line (N = 810)	Health insurance line (N = 195)	Reinsurance line (N = 115)
RDISCL_TOT	309.749	267.557	287.108	301.530
RDISCL_RP	216.372	185.567	206.964	200.800
RDISCL_RM	93.377	81.990	80.144	100.730

Note(s): The variables are defined in Table 1
Source(s): Authors' own work

disclosure but are outweighed by reinsurers in terms of risk management disclosure. Moreover, life insurers have the largest mean size and a high mean solvency ratio that is only exceeded by health insurers [19].

Table 4 summarises the descriptive statistics for the measurement and control variables. Our sample covers a broad range of insurer sizes (*SIZE*) that vary between € 3.3 million and € 335.8 billion in total assets (under Solvency II). The solvency ratio (*SOLV*) equals 338% on average. According to the BaFin classification, approximately a quarter of our sample insurers are life insurers (*LIFE*), and approximately 15% are classified as insurers governed by public law (*PLAW*). Regarding the control variables, notably, a (partial) internal model for calculating the SCR is used in only 12% of our observations, which is comparable to the figures determined by BaFin (2017b, 2021). The sample insurers are mostly affiliated with a group (*GRP*) but are rarely listed (*LIST*), thereby reflecting some further institutional characteristics of the German insurance sector.

Table 5 displays the Pearson's correlations between the variables used in our regression models. Our dependent risk disclosure variables (*RDISCL_TOT* and *RDISCL_RP*) are positively correlated with *SIZE* and *LIFE* but negatively correlated with *PLAW* (all correlations are significant at the 1% level). However, only *RDISCL_RP* is significantly correlated with *SOLV*. In our study, the variance inflation factors are all below three, indicating the absence of severe multicollinearity.

4.2 Panel regression results

Table 6 reports the results of our panel regressions. The third column presents the results using total risk disclosure (*RDISCL_TOT*) as the dependent variable. We find positive coefficients for insurer size (*SIZE*) and status as a life insurer (*LIFE*) and negative coefficients for the insurer's solvency ratio (*SOLV*) and legal form as an insurer governed by public law (*PLAW*), all at the 1% significance level. We find consistent results while focusing on risk profile disclosure (*RDISCL_RP*) as reported in the last column of Table 6. Marginal effects analysis regarding *SIZE* suggests that a 10% increase in total assets increases *RDISCL_TOT* (*RDISCL_RP*) by approximately 1.0 (1.1) sentences. Regarding *SOLV*, a 10% point increase in the solvency ratio reduces risk disclosure by 0.6 (0.3) sentences. As compared to their counterparts, life insurers disclose 13.7 (6.5) more sentences, whereas insurers governed by public law disclose 50.0 (52.6) fewer sentences. The four measurement variables are incrementally informative for both dependent risk disclosure variables. The findings fully

Table 4. Descriptive statistics for measurement and control variables

Variable	Mean	Std. dev	Median	Min	Max
Measurement variables					
SIZE	13.818	2.272	13.803	8.093	19.632
SOLV	3.379	1.831	2.830	1.015	14.898
LIFE	0.258	0.438	0	0	1
PLAW	0.149	0.356	0	0	1
Control variables					
PROF	0.021	0.061	0.013	−0.266	1.038
BTM	0.394	0.237	0.346	0.035	1.477
BLIN	5.303	4.283	3	1	19
DER	0.297	0.457	0	0	1
MODL	0.120	0.325	0	0	1
GRP	0.844	0.363	1	0	1
LIST	0.017	0.128	0	0	1

Note(s): The variables are defined in Table 1. (N = 1,510)

Source(s): Authors' own work

Table 5. Pearson correlations

Variable	SOLV	LIFE	PLAW	PROF	BTM	BLIN	DER	MODL	GRP	LIST	RDISCL_TOT	RDISCL_RP
SIZE	0.362***	0.410***	0.032	−0.231***	−0.629***	0.255***	0.530***	0.339***	0.486***	0.156***	0.344***	0.369***
SOLV	–	0.306***	0.024	0.047*	−0.358***	−0.258***	0.229***	−0.008	0.197***	−0.020	0.025	0.054**
LIFE	–	–	−0.056**	−0.056**	−0.429***	−0.298***	0.242***	0.029	0.212***	−0.077***	0.136***	0.132***
PLAW	–	–	–	−0.070***	−0.006	0.116***	−0.053**	−0.143***	0.154***	−0.054**	−0.152***	−0.197***
PROF	–	–	–	–	0.047*	−0.114***	−0.013	0.008	−0.139***	−0.014	−0.015	−0.009
BTM	–	–	–	–	–	−0.051**	−0.423***	−0.213***	−0.392***	0.044*	−0.214***	−0.203***
BLIN	–	–	–	–	–	–	0.129***	0.239***	0.188***	0.296***	0.181***	0.190***
DER	–	–	–	–	–	–	–	0.295***	0.259***	0.131***	0.246***	0.225***
MODL	–	–	–	–	–	–	–	–	0.158***	0.192***	0.261***	0.207***
GRP	–	–	–	–	–	–	–	–	–	−0.016	0.243***	0.241***
LIST	–	–	–	–	–	–	–	–	–	–	0.156***	0.158***

Note(s): The variables are defined in Table 1. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. (N = 1,510)
Source(s): Authors' own work

Table 6. Panel regression results

Variable	Expectation	RDISCL_TOT	RDISCL_RP
SIZE	+	10.607***	11.641***
		(0.792)	(0.454)
SOLV	–	−5.577***	−2.840***
		(0.746)	(0.623)
LIFE	+	13.705***	6.452***
		(1.316)	(1.021)
PLAW	–	−49.964***	−52.628***
		(8.998)	(5.347)
PROF	+	107.424***	111.776***
		(34.954)	(24.683)
BTM	+	9.639*	21.955***
		(5.390)	(1.880)
BLIN	+	1.547***	1.635***
		(0.230)	(0.170)
DER	+	17.145***	5.869
		(6.276)	(5.191)
MODL	+	33.657***	4.347
		(5.762)	(5.891)
GRP	+	44.838***	32.367***
		(2.184)	(3.510)
LIST	+	65.891***	45.001***
		(10.782)	(9.845)
Constant		97.417***	2.369
		(20.737)	(11.635)
Adjusted R^2		0.202***	0.228***

Note(s): The variables are defined in Table 1. Robust time-clustered standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. ($N = 1{,}510$)

Source(s): Authors' own work

support our hypotheses H1 through H4 and imply that socio-political theories explain the variations in risk disclosure in SFCRs.

Regarding our control variables, *RDISCL_TOT* and *RDISCL_RP* are significantly positively associated with insurer profitability (*PROF*) and the book-to-market ratio (*BTM*). These results add to the mixed results of prior research on how risk disclosure relates to insurer profitability and the book-to-market ratio.

Both of our dependent variables are significantly positively associated with the number of business lines an insurer operates (*BLIN*). These results suggest that insurers with more business lines disclose more because they have more to report on their risks across business lines to satisfy the SFCR disclosure regulations. We observe positive coefficients for the use of derivatives (*DER*) and a (partial) internal model for calculating the SCR (*MODL*), which are significant only when using *RDISCL_TOT* as the dependent risk variable. These results suggest that *DER* and *MODL* drive risk management disclosure rather than risk profile disclosure. As insurers are required to provide risk-related information on the use of derivatives and a (partial) internal model within the risk management system, these findings are also consistent with SFCR disclosure regulations. Again, these results reaffirm the impact of disclosure regulations on risk disclosure practices. We observe positive and significant coefficients for an insurer's affiliation with a group (*GRP*) invariably. This result suggests that group-wide reporting guidelines have an incremental effect on an individual insurer's risk disclosure in its solo SFCR.

Finally, across our dependent risk disclosure variables, listed insurers (*LIST*) consistently provide more comprehensive risk disclosure than other insurers. Although only a few SFCRs

in our sample are from listed insurers, these results align with socio-political theories that consider higher public and political pressures on listed insurers.

4.3 Additional analyses and robustness tests

We conduct additional analyses to check the robustness of our main regression results. First, we use alternative dependent variables by setting our main dependent risk disclosure variables to their natural logarithms, and we use the natural logarithm of the number of words in risk-related sentences. In both cases, our main results hold.

Second, we use alternative measurement variables. We (1) calculate insurer size (*SIZE*) based on financial book values instead of solvency-based values, (2) replace the solvency ratio (*SOLV*) with a binary variable that equals 1 if the insurer's solvency ratio is above the annual median per insurance line, (3) replace *LIFE* with a binary variable that equals 1 if the insurer's total net premiums written in the business line life (re-)insurance obligations is higher than these in non-life insurance and reinsurance obligations according to the QRT S.05.01.02, and (4) replace *PLAW* with a binary variable that equals 1 if the insurer itself is an insurer governed by public law. In all four cases, our main results remain qualitatively unaltered.

Third, we include (1) additional control variables for reinsurers and/or health insurers, and (2) a binary control variable for insurers with significant foreign businesses according to their QRT S.05.02.01. Our main results remain robust to each of these specifications [20].

Fourth, we modify our sample. To mitigate concerns that our results could be biased by the adoption effects in 2016 and the pandemic in 2020, we estimate our model without observations from either year (N = 1,208) and both years (N = 906). Nevertheless, these modifications do not change our main results. Additionally, our results are virtually unaffected when the sample is restricted to non-listed insurers (N = 1,485).

Finally, we use additional types of empirical models. We (1) perform ordinary least squares (OLS) regressions (with control variables for years) and (2) use a fixed effect model. We employ several strategies to address potential endogeneity concerns. We (3) estimate our random effects panel regressions with measurement and control variables lagged by one year (N = 1,208 for reporting periods 2017–2020), (4) adopt one-step system generalized method of moments (GMM) models using our main model with insurer and time fixed effects, and (5) use a two-stage least squares (2SLS) estimation to control for reverse causality and omitted variables resulting from the possibility that insurer size or solvency ratio affects other insurer characteristics besides risk disclosure (Ntim *et al.*, 2013; Khan *et al.*, 2023). In all cases, our main results remain qualitatively unaltered, with only one noteworthy change. In cases (4) and (5), all coefficients for *LIFE* are positive but slightly below the 10% significance level. In summary, our main results hold, at least qualitatively, for a series of robustness tests.

5. Conclusions

Our study provides initial evidence on the determinants of German insurers' narrative risk disclosure in SFCRs, which are designed to inform the broad public. Focusing on insurers' solo SFCRs as a new reporting instrument allows us to address the shortcomings of prior research, which typically investigates listed insurers, group level financial reports designed for investors, and small sample sizes. Since the intended audience of SFCRs is the broad public, we base our hypotheses on socio-political theories that consider disclosure as a function of public (social and political) pressure on an insurer. We hypothesise and find that the risk disclosure volume in SCFRs is positively associated with insurers' size and status as a life insurer and negatively associated with insurers' solvency ratio (as a measure of risk) and legal form as an insurer governed by public law. Our results indicate that larger insurers, life insurers, insurers with lower solvency ratios, and insurers not governed by public law provide more comprehensive risk disclosure in SFCRs. The results are consistent with the total risk disclosure and risk profile disclosure and hold for various robustness tests.

Therefore, we conclude that socio-political theories explain the variations in insurers' risk disclosure in SFCRs, which is further supported by our results of more risk disclosure by listed firms. While we acknowledge the indirect nature of our proxies for public pressure, this is an important finding. First, it reveals that socio-political theories hold in explaining narrative disclosure beyond environmental or sustainability disclosure. Second, it shows that risk disclosure in SFCRs relates to public pressure on insurers (as depicted by the proxies used in our study). A potential concern is the extent to which public (social and political) pressure can matter, given the doubts about whether the SFCR is actually widely used by the public beyond professional experts (European Insurance CFO Forum, 2024; GDV, 2024). Our study does not assess how widespread and by whom SFCRs are accessed, read, or understood. However, our evidence is consistent with insurers considering the broad public as the audience for risk disclosure in SFCRs, along with the related social and political pressure, when determining the volume of risk disclosure in SFCRs. The finding suggests that, despite a potential disconnect between the actual and the intended audience of SFCRs, insurers do not substantially deviate from the regulation that accentuates the broad public as the intended audience of the SFCR. This is arguably related to enforcement by supervisory authorities (EIOPA, 2017; BaFin, 2024).

For a large sample of primarily non-listed insurers, we not only document large variations in risk disclosure volume in SFCRs that supervisors observe with a sceptical eye (BaFin, 2017a; EIOPA, 2017) but are also the first to highlight the factors that determine these variations. Our key results indicate that higher public pressure induces insurers to provide more comprehensive narrative risk disclosure in the SFCR. These findings enrich the understanding of how insurers exercise discretion in narrative risk disclosure in highly regulated regimes. On the one hand, they suggest that insurers can take action to reduce social and political pressure to limit their public risk disclosure. In light of our empirical results, such actions may include insurers' business strategies to strengthen their solvency or limit operations that attract public scrutiny, as well as increased social engagement (as assumed for insurers governed by public law). On the other hand, our findings suggest that public scrutiny and pressure on insurers offer mechanisms to increase their disclosure, which can enhance insurers' transparency and improve policyholder protection.

Additionally, our results contribute to the risk disclosure research by providing novel evidence on how insurers' institutional characteristics and risk disclosure regulations relate to risk disclosure. These findings not only help users assess why insurers differ in the risk disclosure provided but also inform the regulatory debate on SFCRs as a key element of the third pillar of Solvency II (EIOPA, 2020). Our evidence on increased total risk disclosure volume when using financial derivatives or a (partial) internal model to calculate the SCR is consistent with SFCR disclosure regulations. As are several of our descriptive findings, such as more risk profile than risk management disclosure and increasing risk disclosure volume over time. Furthermore, all sample SFCRs include risk disclosure in each of the Sections C.1 to C.6, meaning they cover each of the prescribed risk categories. This finding contrasts with existing evidence from insurers' financial reports that indicates limited coverage of risk categories (Dobler and Schwartze, 2020; Torchani *et al.*, 2024). Thus, our findings suggest that regulations can effectively affect risk disclosure. This implies that more detailed regulatory provisions can enhance narrative risk disclosure in the SFCR. Although we do not assess the detailed content of risk disclosure, our results, for instance, suggest more specific regulatory provisions on Section C.6 "Other material risks" to overcome the lower risk disclosure volume in this section.

The full coverage of risk categories and, on average, the considerable risk disclosure volume revealed in our study can be seen as fundamental elements for risk disclosure in the SFCR to facilitate risk transparency. We acknowledge that our measure of the risk disclosure volume can be biased by paraphrases that convey little or no new information. However, even such disclosure can still assist in the understanding of users who are unfamiliar with the topic. The extent to which these users read and understand the SFCR is crucial to whether risk

disclosure directly promotes risk transparency beyond a professional audience. These concerns stimulate the European regulatory debate on shifting the intended audience of the SFCR primarily to professional users (European Commission, 2021). Such a shift is likely to imply not only a reduced volume, but also a more technical and complex nature of narrative risk disclosure (as present in financial reports). Risk disclosure in the SFCR would then require more financial literacy to be understood, rather than playing any potential role in mediating financial literacy to the broad public.

Our study has several limitations, which in turn suggest promising avenues for future research. First and most notably, we measure risk disclosure in terms of "pure" volume (i.e. quantity). Although our measure is common in the empirical risk disclosure literature, it allows us to cover a large and broad sample of insurers and avoid subjectivity, it is subject to limitations. Despite reflecting one key characteristic of narrative risk disclosure, it does not necessarily capture disclosure in terms of "quality" (Botosan, 2004). It does not allow a detailed assessment of compliance with disclosure regulations, nor the content or semantic properties of risk disclosure. Recent risk disclosure studies have adopted machine learning and natural language processing approaches (Düsterhöft *et al.*, 2023; Xia *et al.*, 2024) that offer opportunities to explore the textual characteristics with large samples (Fritzsch *et al.*, 2021; Bochkay *et al.*, 2023). Future research could adopt these approaches to investigate risk disclosure in SFCRs. Evidence on topical content and semantic text similarity would be warranted to complement our findings on the variations in risk disclosure in SFCRs across insurers and over time. Moreover, evidence on textual complexity and readability can inform the regulatory debate about the extent to which disclosure is comprehensible to the broad public and "publicly understandable" (Malafronte *et al.*, 2016; Ferri *et al.*, 2023).

Second, we focus on Germany as a single country with a large and diverse insurance market. Substantial variations in the overall length of SFCRs have been documented for other European countries (for Ireland and the UK: Lane Clark & Peacock, 2018; for France: Grant Thornton, 2021). We assume that socio-political theories generally hold in explaining variations in risk disclosure in SFCRs beyond the German setting. Nevertheless, our detailed findings are not necessarily generalisable across Europe. This is not only because country-level institutional, economic, and cultural factors affect insurers' risk disclosure (Höring and Gründl, 2011; Malafronte *et al.*, 2016). Domestic insurance market characteristics are also likely to play an important role. For instance, Malafronte *et al.* (2016) find that risk disclosure is positively associated with country-level insurance consumption in terms of insurance density (Kohl and Römer, 2024). As insurance density is likely to relate to public pressure on insurers, socio-political theories would suggest that risk disclosure is positively associated with country-level insurance density. In 2020, Germany ranked average in terms of life insurance density and well above average in terms of non-life insurance density compared to other European countries (Insurance Europe, 2022). Against this background, our detailed findings may not hold for European countries with particularly low insurance density. Thus, comparative evidence from other European countries would be of interest. While risk disclosure in SFCRs is largely based on European regulations, the Solvency II 2020 review aims to further harmonise related domestic regulations and to mandate or allow SFCRs in English across European countries. This could mitigate biases in comparative research on narrative disclosure in SFCRs arising from different domestic regulations or languages in future reporting periods (Dobler *et al.*, 2011; EIOPA, 2019, Ch. 4.5.5. and Ch. 4.5.7.), thereby offering promising settings for cross-country research in Europe.

Finally, our study does not assess the consequences and impact of SFCR risk disclosure on the insurers' business activities and the stakeholders' decision-making. However, research on the consequences and impact of SFCR risk disclosure is required to complement our understanding of the informativeness and usefulness of risk disclosure. Since the SFCR is not focused on investors, future research should go beyond impacts on capital markets (Gatzert and Heidinger, 2020) and examine impacts on insurers' operations and performance or on policyholders and their decision-making behaviour.

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Notes

1. Additionally, the standardised location of risk disclosure in specific sections helps to detect risk disclosure comprehensively in solo SFCRs. This is an advantage over studying financial reports of individual insurers, where risk disclosure can be missing or dispersed across the reports. For instance, financial reporting regulation in Germany offers options to present risk disclosure for the firm and the group jointly in the group financial report and to locate part of risk disclosure in the notes to financial statements or the management report.

2. It should be noted that the SFCR and financial report are not the only instruments insurers use to communicate about risk. Beyond non-public reports filed to supervisory bodies, such as Regulatory Supervisory Reporting (RSR) under Solvency II, insurers may use a variety of additional channels for public risk disclosure, including their environmental and sustainability reports (Aburto Barrera and Wagner, 2023) and websites (Hemrit and Ben Arab, 2011).

3. Socio-political theories include legitimacy theory, stakeholder theory, and political economy theory. We do not differentiate between them in our study because they suggest the same predictions concerning the relationship between narrative risk disclosure and our proxies for public pressure on insurers.

4. This assessment holds for disclosure on specific risk categories. Notably, investigating operational risk disclosure from various sources for a sample of 14 Tunisian insurers in the period 2000–2009, Hemrit and Ben Arab (2011) document insurer size, leverage, and the weight of technical provisions to drive insurers' operational risk disclosure.

5. Studies based on SFCRs include Gatzert and Heidinger (2020), Mukhtarov *et al*. (2022), and Müller (2024). Notably, Gatzert and Heidinger (2020) provide initial evidence on market reactions to SFCRs and conclude that "SFCR key figures matter more than textual features" (p. 407). Their study, however, refers to the entire SFCR and does not focus on the SFCR sections on risk disclosure.

6. In general, insurers are required to publish SFCRs at both the solo and the group level.

7. With the supervisory authorities' permission, insurers may omit some information from their disclosure if competitors would gain a significant and undue advantage or if confidential obligations to policyholders or secrecy in other counterparty relations would be breached (Directive 2009/138/EC, Art. 53; Sec. 41 VAG).

8. While the regulation accentuates the broad public as the intended audience of the SFCR, it remains uncertain whether the reports are actually widely used by the public. Insurance professionals have recently questioned public interest in SFCRs (European Insurance CFO Forum, 2024). They particularly refer to a note of the Gesamtverband der Deutschen Versicherungswirtschaft (GDV, 2024). This note states low download rates for SFCRs for the reporting period 2022 (i.e. after our research period), from German insurers' websites. However, it does not provide any information regarding the sample size or the methodology employed for data collection. Notably, the enforcement of SFCR disclosure regulations by supervisory authorities suggests that insurers are obliged to consider the broad public as the intended audience of SFCRs.

9. While supporting H1, economics-based theories would suggest the opposite sign of the association stated in H2 (Jorgensen and Kirschenheiter, 2003; Dobler, 2008). In our view, it would be very hard to derive hypotheses on how insurers' risk disclosure is associated with the status as a life insurer (H3) or insurer governed by public law (H4) grounded only on economics-based theories and without referring to socio-political ones when the broad public is the intended audience.

10. Our regression models also control for an insurer's listing status. Socio-political theories suggest a positive association between risk disclosure and listing status. However, we refrain from postulating a separate hypothesis since the number of listed insurers in our sample is rather low. Other proxies for public pressures used in disclosure research are based on unfavourable media coverage. We do not include such proxies because our initial screening indicates that media coverage is limited to a few and mainly large German insurers. Essentially, our study is reliant on indirect proxies for the measurement of public pressure.
11. Although size has been used extensively in accounting research as a proxy for public pressures, it may also represent other characteristics of insurers. Larger insurers may operate in more business lines and, therefore, provide more comprehensive risk disclosure. To mitigate this concern, we control for the number of business lines (in our main model) and foreign business (in our robustness checks).
12. Pension funds and funeral expenses funds are not included, as they are not required for disclosing an SFCR (Sec. 234 (1), 237 (1), and 219 (1) VAG).
13. One reason for non-disclosure may be the exemption for small insurers (Sec. 211 and 212 (2) VAG).
14. For all insurers in the sample, the SFCRs are available in German, and the SFCR reporting period aligns with the calendar year.
15. By counting complete sentences, we exclude headings, tables with quantitative data, and figures. Thus, our risk disclosure variables focus on the volume of narrative risk disclosure.
16. We do not use *RDISCL_RM* as a dependent risk disclosure variable because it is particularly likely to be affected by group-wide reporting guidelines, which can lead to standardised risk management disclosure for different insurers within the same insurance group. Our initial screening of SFCRs, provides some indication of limited variations in *RDISCL_RM* across insurers within the same group. Notably, in one group with nine sample insurers of different sizes and a non-listed parent, we observe that the per-year values of *RDISCL_RM* of eight insurers are within a range of only five sentences or less (with the per-year mean above 110 sentences). In contrast, the per-year values of *RDISCL_RP* of these same eight insurers show a range of at least 93 sentences (with the per-year mean above 260 sentences). We acknowledge that text standardisation within a group can affect the variations in the volume of risk disclosure, and we control for insurers' affiliation to a group in our regressions. Regression results using *RDISCL_RM* as the dependent variable would support H2 and H3.
17. As a part of our robustness test, we redefine *PLAW* to take the value 1 if the insurer itself is governed by public law and 0 otherwise. Our main results are robust to this redefinition.
18. Thirty-two sample SFCRs provide no disclosure in Section C.7 "Any other information". Over the entire sample period, this section is the shortest with six risk disclosure sentences on average.
19. To mitigate concerns that public pressure and other unidentified factors may vary by insurance lines beyond life insurance, we further control for the status as a reinsurer and/or health insurer in Section 4.3. Our main results are robust to these additional controls.
20. In case (1), the coefficients for the binary variable for reinsurers (health insurers) are negative (positive) and significant.

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