Essays on Economic Trends, Systemic Shocks and Emerging Risks in the Insurance Industry

Inauguraldissertation

zur

Erlangung des Doktorgrades

der

Wirtschafts- und Sozialwissenschaftlichen Fakultät

der

Universität zu Köln

2025

vorgelegt

von

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Tag der Promotion: 27.02.2026

This thesis consists of the following studies:

Jakubsche, Janosch and Nikolas Diehl (2024): Der deutsche Markt für klassische Lebensversicherungspolicen in der Niedrigzinsphase: Kapitalanlageperformance und laufende Verzinsung

Jakubsche, Janosch (2025): Underwriting profitability of the German P&C insurance industry during COVID-19: An analysis of pandemic impacts

Jakubsche, Janosch, Heinen, Leonard and Anders, Niklas (2025): The Cyber-ILS market two years on: Status quo, learnings, and future developments

Contents

List of Figures

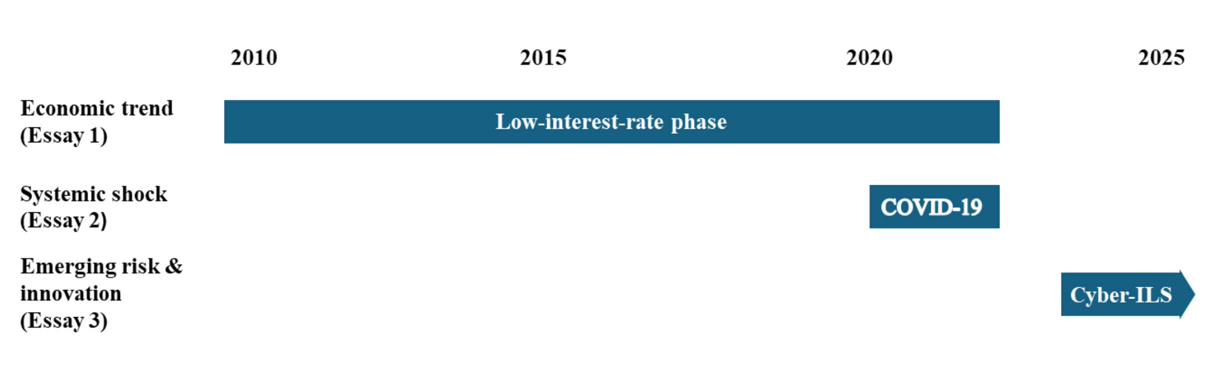
List of Tables

Introduction

The insurance industry is traditionally characterized by stability and long-term orientation. However, over the past decade and a half, the business model of insurance companies has been increasingly influenced by developments that have had a significant and transformative impact on the sector. For example, the low-interest-rate phase posed a particular challenge for life insurance business, especially in connection with products offering interest rate guarantees. During this period, new investments in fixed-income securities generated only limited interest income, while policyholders were entitled to relatively high guaranteed returns over extended periods. With regard to the COVID-19 pandemic, government-imposed lockdowns and mobility restrictions have had a significant impact on the everyday behavior of people and policyholders, which in turn has affected the claims experience of insurance companies. Furthermore, increasing digitalization in recent years has led to a sharp rise in demand for cyber insurance and, in addition to traditional reinsurance solutions, has created a new market for cyber insurance-linked securities (Cyber-ILS).

This thesis explores how structural economic trends, systemic shocks, and the rise of new risks shape the performance and innovation dynamics of the insurance industry. Specifically, this refers to three major external influences between 2010 and 2025, namely the low-interest-rate phase, the COVID-19 pandemic, and the rise of cyber risk along with the associated emergence of the Cyber-ILS market (see Figure 0.1).

Figure 0.1 Phase-based conceptual structure of the thesis



Note: This figure illustrates the three external phases examined in the thesis: the prolonged low-interest-rate environment (2010-2022), the COVID-19 pandemic (2020-2022), and the emergence of cyber risk and the Cyber-ILS market (from 2023 onwards).

Therefore, both the impacts of these events, evaluated through relevant performance indicators, and the underlying drivers of these developments are systematically analyzed using a

combination of quantitative and qualitative research methods. Although this thesis places particular empirical emphasis on the German insurance market, the developments discussed have been fundamentally global in nature and have affected insurance markets worldwide.
The following sections provide overviews of the three essays, each of which focuses on one of the key developments introduced above. These summaries outline the respective research objectives, methods, and main findings of each study. The chapter concludes with a summary of the overall contribution to the academic literature and a discussion of the implications of this thesis.

The first essay was co-authored with Nikolas Diehl, who contributed to the investigation and data curation. I served as the lead author and was responsible for the conceptual development, methodological design, and validation activities. The empirical analysis and writing process were undertaken jointly. The essay investigates the determinants of investment performance and the level of current interest returns on traditional life insurance contracts in the German insurance market during the low-interest-rate phase. Throughout this period, the traditional life insurance business model came under pressure, as the average guaranteed interest rate in insurers' traditional life product portfolios exceeded, for several years, the yields on high-quality bonds relevant for new investments.
While the business models of traditional life insurers are largely homogeneous, dominated by fixed-income investments with investment income serving as the principal source of surplus, and the developments described above have affected all insurers in similar ways, considerable variation in key performance indicators remains. For instance, in 2020, the average investment performance and the annual returns credited to policyholders of the examined life insurers ranged from 1.10% to 7.40% and from 1.25% to 3.30%, respectively.
Against this background, this paper aims to identify and interpret potential systematic factors influencing the investment performance and the level of current interest returns on traditional life insurance policies in Germany over the period from 2011 to 2020, based on an empirical analysis. In addition to the macroeconomic factor of interest rate developments, particular attention is given to factors that lie within the managerial sphere of influence of insurers and are therefore relevant in terms of asset allocation decisions and governance considerations. The empirical analysis applies multiple linear regression models with different model specifications. To the best of our knowledge, the relationships described have not yet been examined empirically in a comprehensive manner. In particular, prior studies addressing potential heterogeneity

factors or the legal form of insurers with regard to the annual returns credited to policyholders remain largely theoretical and descriptive.

The results show that the legal form of insurance companies plays a central role in both investment performance and the annual returns credited to policyholders. Compared with mutual insurers, public-law insurance companies exhibited lower investment performance as well as lower annual returns credited to policyholders during the observation period. The positive correlation between investment performance and current interest returns on traditional life insurance contracts suggests that sustainably competitive profit participation requires solid capital investment performance. One possible explanation for the lower returns credited to policyholders of public-law insurance companies is their lower risk appetite in capital investment compared with mutuals. In addition, hidden reserves and the equity ratio both have a generally positive effect on capital investment performance and current interest returns on traditional life insurance contracts. By contrast, the heterogeneity factors such as *the structure of written life insurance policies*, *the share of single-premium business*, and *product structure* appear to be of lesser importance. Only *the share of single-premium business* shows a weak positive correlation with the collective's current interest returns on traditional life insurance contracts. Consequently, the negative influence of the heterogeneity factors assumed in theory cannot be empirically confirmed in this study. Building on these findings, future research could examine the robustness of the results over a longer observation period that includes the 2022 interest rate reversal and provides additional data points for run-off companies.

The second essay, written as a single-authored paper, investigates how the COVID-19 pandemic affected the underwriting profitability of property and casualty (P&C) insurers in Germany. The focus is less on the direct health-related effects of the pandemic, but rather on the indirect effects, in particular behavioral changes in the daily lives of policyholders triggered either by fear of infection or by government-imposed lockdowns and mobility restrictions.

Although several studies have examined the effects of COVID-19 on the P&C insurance industry, existing research remains limited in scope and geographical coverage. Previous analyses focus on developing markets such as China (Wang et al., 2020), on smaller markets such as Portugal (Costa et al., 2022) and North Macedonia (Stojkoski et al., 2021), or on markets that are both developing and small, such as Ghana (Babuna et al., 2020) and Bangladesh (Haque et al., 2021). Furthermore, none of these contributions investigates the impact of the pandemic on underwriting profitability. This study adresses this gap by analyzing the effect of COVID-19 on the underwriting profitability of the P&C insurance industry in a mature and sizeable market by international standards.

The estimation of the specific COVID-19 effects is conducted using various panel data regressions with individual fixed effects and different variable specifications. The analysis focuses on the year-over-year change in premium volume and on key indicators of underwriting performance, namely the loss ratio, expense ratio, and combined ratio. To provide a more detailed understanding of the effects, the main lines of business are examined separately. The dataset used for the analysis covers 83 P&C insurers operating in the German market between 2004 and 2023, representing approximately 76% of the total German P&C insurance market in 2023. The results show that COVID-19 measurably affected underwriting profitability in the German P&C insurance industry. Whereas premium volumes remained generally stable, underwriting profitability increased, mainly due to fewer motor claims from reduced traffic and accident frequency. Similar effects occurred in household contents and personal accident line, driven by declines in burglaries and trauma-related accidents. In contrast, the legal expenses and liability lines provide only weak evidence of a COVID-19-related impact on losses. Overall, the increase in underwriting profitability resulted primarily from lower losses rather than from reduced expenses. While comparability with prior P&C studies on COVID-19 is limited due to differing research objectives and methodological approaches, notable differences can be observed regarding premium stability. In contrast to the relative stability of the German market, developing and low-penetration insurance markets experienced a considerable drop in premium volumes in 2020.

The third essay was co-authored with Leonard Heinen, who contributed to the methodology, investigation, and data curation, and with Niklas Anders, who contributed to data curation and visualization. I served as the lead author and was responsible for the formal analysis and writing. The conceptual development was carried out collaboratively. The essay explores the increasing securitization of cyber risk through the issuance of Cyber-ILS. This development began with the issuance of the first pure cyber catastrophe (CAT) bond in early 2023 and has since evolved into a new market for Cyber-ILS, reaching a total of 11 issued bonds with a combined volume of over USD 900 million by March 2025.

Given the novelty of the topic, existing research on Cyber-ILS remains limited. Previous publications have mainly focused on theoretical modeling and pricing aspects of Cyber-ILS (Braun et al., 2023; Kolesnikov et al., 2022; Mastroeni et al., 2022; Pal and Nag, 2024; Xu and Zhang, 2021) or have examined the perspectives of investors and vendors (Johansmeyer and Mican, 2022; Johansmeyer, 2024a, 2024b). Cremer et al. (2024) provides one of the first insights into sponsors' perspectives on Cyber-ILS. However, several important aspects remain unexplored, including the detailed structural design of Cyber-ILS products with regard to sponsors' initial market experiences.

To address this research gap, this study offers a comprehensive analysis of the Cyber-ILS market from the sponsors' perspective, encompassing market dynamics and demand drivers, risk assessment and modeling, product development, and the broader economic implications and future trends. These four research dimensions form the analytical framework, derived from insights in the current academic literature on Cyber-ILS and cyber risk, as well as recent developments in industry practice. The research employs a qualitative design based on semi-structured interviews conducted with twelve experts in the field of Cyber-ILS, conceptually guided by the four dimensions of the analytical framework.

Our analysis reveals that the rapid emergence of the Cyber-ILS market is primarily driven by capacity constraints in the reinsurance sector, rising reinsurance costs, advances in cyber risk modeling, and greater investor awareness. Consistent with prior studies, the main challenges in cyber risk assessment and modeling arise from the dynamic characteristics of cyber risk, the limited historical data, and the lack of standardization. Divergent expert opinions mainly concern product structuring: While short maturities are broadly favored, views differ sharply regarding trigger mechanisms and diversification scope. In contrast, there is broad consensus on future developments, with growth expected to be steady but limited and the market's potential viewed as lower than that of Property CAT bonds. In terms of further research, continuous improvements in data availability are expected to enable more comprehensive analyses of the Cyber-ILS market. Future studies could empirically assess to what extent cyber CAT bonds help reduce sponsors' default risk, and how trigger structuring and diversification influence this relationship. It would also be valuable to explore the real impact of future large-scale cyber events on the Cyber-ILS market once such events occur.

Taken together, the three essays demonstrate the key success factors for the insurance industry under structural pressure, how it preserves stability amid external shocks, and how innovation emerges in response to new and evolving risks. Essay 1 and Essay 2 contribute to insurance research by examining the effects of major economic trends and crises between 2010 and 2025 on the German insurance industry, namely the prolonged low-interest-rate environment and the COVID-19 pandemic. Both developments are of particular relevance due to their potentially structural impact, either through persistently low yields on reinvested and newly invested fixed-income assets or through the effects of the pandemic on the loss experience of insurers. To the best of our knowledge, Essay 1 is the first empirical study to examine internal and external drivers of investment performance and current interest returns on traditional life insurance policies in Germany during the low-interest-rate phase, thereby contributing to the asset allocation and insurance governance literature. Essay 2 in turn provides the first empirical evidence on the underwriting profitability of the German P&C insurance industry during the COVID-19 pandemic and advances the literature on the crisis resilience of insurance companies.

In addition to the key findings, several implications can be derived from these two essays. The results of Essay 1 indicate that maintaining a sustainably competitive profit participation for policyholders depends on solid investment performance. Especially during prolonged low-interest-rate periods, the inherent risk-return trade-off implies that excessive risk aversion in investment decisions may ultimately disadvantage policyholders. Consequently, buyers of traditional life insurance products should pay particular attention to insurers' investment performance, while heterogeneity factors appear to play only a minor role in determining the level of profit participation. The findings of Essay 2 demonstrate the structural resilience of the German P&C insurance industry during the COVID-19 pandemic. This resilience is particularly relevant for policyholders, investors, managers, and regulators when considering the implications of potential future pandemics. Overall, the evidence suggests that large, mature P&C insurance markets with high insurance penetration and density, combined with appropriate lockdown policies and government support measures, may be able to withstand future pandemic shocks relatively well.

Essay 3 enriches research on innovation and alternative risk transfer, particularly in the still emerging Cyber-ILS space, by providing a detailed examination of the sponsors' perspective, a dimension that has received little attention so far. The paper focuses on the sponsors' experiences and lessons learned well after the market launch, particularly concerning product design considerations and prospects for future market development. Beyond its academic contribution, this study provides several practical implications. The findings highlight the need for standardized definitions to clarify both event criteria and the scope of covered risks. In cyber risk modeling, practitioners should reassess the realism and influence of extreme doomsday assumptions. Finally, practical efforts should address the divergent views on diversification and trigger design in Cyber-ILS products.

The following chapters present the full versions of the three essays, each focusing on one of the key developments discussed in this thesis. While two of the essays are written in English, one essay (Essay 1) is written in German, reflecting the national context of the topic addressed.

1. Essay 1: Der deutsche Markt für klassische Lebensversicherungspolicen in der Niedrigzinsphase: Kapitalanlageperformance und laufende Verzinsung

Zusammenfassung

Diese Arbeit untersucht mögliche Einflussfaktoren auf die Kapitalanlageperformance und die Höhe der laufenden Verzinsung klassischer Lebensversicherungspolicen auf dem deutschen Lebensversicherungsmarkt während der Niedrigzinsphase. Es zeigt sich, dass sowohl bei der Kapitalanlageperformance als auch der laufenden Verzinsung die Rechtsform eines Versicherungsunternehmens von wesentlicher Bedeutung ist. Zudem deutet der positive Zusammenhang zwischen laufender Durchschnittsverzinsung und laufender Verzinsung darauf hin, dass eine nachhaltig konkurrenzfähige Überschussbeteiligung eine robuste Kapitalanlageperformance voraussetzt. Im Gegensatz dazu scheinen die Heterogenisierungsfaktoren (Bestandsstruktur, Einmalbeitragsgeschäft und Produktstruktur) für die Höhe der laufenden Verzinsung eher eine untergeordnete Rolle einzunehmen.

Abstract

This paper examines potential determinants of investment performance and the level of current interest returns on traditional life insurance policies in the German life insurance market during the low-interest-rate phase. The investment performance and the current interest returns on traditional life insurance policies are significantly influenced by the legal form of the insurance company. Additionally, the positive correlation between the investment performance and the current interest returns on traditional life insurance policies suggests that a sustainable competitive surplus participation requires a robust investment performance. In contrast, the heterogeneity factors (the structure of written life insurance policies, the share of single-premium business and product structure) play a rather subordinate role in determining the level of current interest returns on traditional life insurance policies.

Keywords: Lebensversicherung, klassische Lebensversicherung, Überschussbeteiligung, laufende Verzinsung, Kapitalanlageperformance, Niedrigzinsphase

1.1 Einleitung

Nach aktuellen Angaben des Gesamtverbands der Deutschen Versicherungswirtschaft (GDV) existierten im Jahr 2022 über 81.8 Millionen Lebensversicherungsverträge in Deutschland, wovon knapp die Hälfte der Verträge (39.2 Millionen) den klassische Lebensversicherungspolicen zugeordnet werden können (GDV, 2023).[1] Im Zuge der bis Mitte 2022 anhaltenden Niedrigzinsphase ist insbesondere das Geschäftsmodell der klassischen Lebensversicherung unter Druck geraten. Bis Ende 2022 lag die durchschnittliche Garantieverzinsung in den Beständen der Versicherer über mehrere Jahre hinweg über den für die Neuanlage relevanten Renditen von Anleihen höchster Bonität. Der Gesetzgeber reagierte hierauf frühzeitig mit zusätzlichen regulatorische Anforderungen und führte 2011 die Zinszusatzreserve (ZZR) ein, um die Erfüllbarkeit der von den Lebensversicherern zugesagten Garantieleistungen zu gewährleisten (Assekurata Assekuranz Rating-Agentur GmbH, 2023b; Bierth et al., 2018). Zudem waren auf Seiten der Lebensversicherer bis zuletzt rückläufige Überschussbeteiligungen sowie reduzierte Garantien für neue Versicherungsprodukte zu beobachten. Einige Versicherer gingen noch einen Schritt weiter und entschieden sich für den sog. Run-off, was eine Einstellung des Neugeschäfts und Abwicklung der Altbestände bedeutet (Jost et al., 2020). Darüber hinaus waren die Lebensversicherer während der Niedrigzinsphase auch von zusätzlichen Herausforderungen wie der Erhöhung der regulatorischen Anforderungen durch die Einführung von Solvency II im Jahr 2016, der voranschreitenden Digitalisierung sowie der Veränderung der Kundenbedürfnisse betroffen (Bierth et al., 2018).

Obwohl sich das Geschäftsmodell der klassischen Lebensversicherung unter den Versicherern nur marginal unterscheidet (rentenlastige Kapitalanlage, Kapitalerträge als wichtigste Überschussquelle) und die genannten Entwicklungen alle Lebensversicherer mehr oder weniger gleichermaßen betreffen, ist eine hohe Varianz bei wichtigen Erfolgsgrößen zu beobachten.[2] So variiert zum Beispiel im Jahr 2020 die laufende Durchschnittsverzinsung und laufenden Verzinsung der untersuchten Lebensversicherer zwischen 1.10% und 7.40% bzw. 1.25% und 3.30%.

Vor diesem Hintergrund setzt sich diese Arbeit zum Ziel mögliche systematische Einflussfaktoren auf die Kapitalanlageperformance und die Höhe der laufenden Verzinsung klassischer

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[1] Unter klassischen Lebensversicherungspolicen sind hierbei und im weiteren Verlauf der Arbeit Policen mit Überschussbeteiligung, d. h. kapitalbildende Lebensversicherungen und private Rentenversicherungen mit Überschussbeteiligung zu verstehen.

[2] Statistiken des GDV beziffern den Anteil von Renten an den gesamten Kapitalanlagen deutscher Lebensversicherer für das Jahr 2020 auf über 82% (GDV, 2021c). Bei über 88% der untersuchten Unternehmen in dieser Arbeit beträgt, nach den Angaben gemäß §15 Mindestzuführungsverordnung, der Anteil der Kapitalerträge an den Gesamterträgen des jeweiligen Versicherers im Geschäftsjahr 2020 über 50%. Über alle untersuchten Unternehmen hinweg beträgt, nach den Angaben gemäß § 15 Mindestzuführungsverordnung, der Anteil der Kapitalerträge an den gesamten Erträgen im Zeitraum von 2014 bis 2020 im Mittel (gewichtetes Mittel) über 83%.

Lebensversicherungspolicen in Deutschland im Zeitraum von 2011 bis 2020 innerhalb einer empirischen Analyse zu identifizieren und zu interpretieren. Hierzu zählen neben dem Makrofaktor der Zinsentwicklung insbesondere solche Faktoren, die prinzipiell im Einflussbereich des Managements des Versicherungskollektivs liegen. Im Kern der empirischen Analyse stehen dabei multiple lineare Regressionsmodelle unterschiedlicher Modellspezifikationen.
Die Arbeit gliedert sich wie folgt: In Kapitel 1.2 wird kurz das Grundprinzip der klassischen Lebensversicherung erläutert. Im Anschluss werden in Kapital 1.3 die theoretischen Einflussfaktoren auf die Kapitalanlageperformance und die laufende Verzinsung ausführlich beschrieben. In Kapitel 1.4 werden die Datenbasis und die verwendeten Regressionsmodelle vorgestellt. Kapitel 1.5 umfasst die Analyse und die Interpretation der Ergebnisse. Kapitel 1.6 fasst abschließend die Erkenntnisse dieser Arbeit zusammen.

1.2 Grundprinzip der klassischen Lebensversicherung

Die klassische Lebensversicherung ist ein Produkt der privaten Altersvorsorge, bei der im Rahmen eines kollektiven Spar- und Investmentprozesses eine jährliche Mindestrendite (Rechnungszins oder Garantiezins) gutgeschrieben wird. Diese ist für die gesamte Vertragslaufzeit gültig, unterscheidet sich jedoch, abhängig vom Verlauf der Kapitalmarkzinsen, für unterschiedliche Tarifgenerationen. Der kollektive Charakter dieses Produkts besteht darin, dass die Versicherungsbeiträge (Prämien) aller Versicherungsnehmer (VN) gemeinsam (langfristig) angelegt werden und hierbei grundsätzlich nicht nach verschiedenen Tarifgenerationen unterschieden wird (Albrecht & Weinmann, 2015a). Gemäß des Gleichbehandlungsgrundsatzes sollte eine einheitliche Gesamtverzinsung für alle VNs eines Kollektivs über alle Tarifgenerationen hinweg angestrebt werden (Bundesanstalt für Finanzdienstleistungsaufsicht, 2004; Deutsche Aktuarvereinigung e.V., 2017b). Die konkrete Beteiligung der VNs erfolgt, dadurch, dass anfangs die vertragsindividuellen Garantiezinsen mittels der durch den Investmentprozess generierten Kapitalerträge beglichen werden. Die daraufhin verbleibenden Kapitalerträge münden weitgehend als Zinsgewinn bzw. Überzins im sog. Rohüberschuss, der die Grundlage der Überschussbeteiligung der VNs bildet (Albrecht & Weinmann, 2015a; Kleinlein, 2015). Zu den weiteren Quellen des Rohüberschusses zählen das Risikoergebnis und das Kostenergebnis. Beide Größen entstehen vorwiegend aufgrund der vorsichtigen Kalkulation der Prämien (Berücksichtigung von Sicherheitspuffern) und werden anhand des Abgleichs zwischen den rechnungsmäßigen Annahmen und den tatsächlich erzielten Werten bestimmt. Die VNs partizipieren auf Einzelvertragsebene an dem Rohüberschuss in Form einer (jährlichen) laufenden

Überschussbeteiligung und einem Schlussüberschuss am Vertragsende.[3] Um allzu große Schwankungen bei der Überschussbeteiligung zu vermeiden, wird der gesamte Rohüberschuss der VNs zunächst in der sog. Rückstellung für Beitragsrückerstattung (RfB) geparkt und erst nach einer gewissen Zeitspanne den einzelnen Verträgen zugeteilt (Zimmermann et al., 2006). Dieses Verfahren bewirkt eine zeitliche Glättung der Überschussbeteiligung auf individueller Ebene und führt in Verbindung mit dem kollektiven Investmentprozess zu einer intergenerationalen Risikoteilung (Albrecht & Weinmann, 2015a). Schlussendlich ist dieser Mechanismus als ein spezielles Charakteristikum der klassischen Lebensversicherung anzusehen, welcher nicht mit einer individuellen Kapitalanlage über Banken oder Investmentfonds in dieser Weise duplizierbar ist (Schradin, 2005).

1.3 Theoretische Einflussfaktoren

Im Folgenden werden alle (Proxy-)Variablen und Kennzahlen vorgestellt, die in den Regressionsanalysen Anwendung finden und bei der ein theoretisch begründeter Einfluss auf die Kapitalanlageperformance und laufende Verzinsung vermutet wird.[4] Aufgrund der rentenlastigen Anlageportfolien deutscher Lebensversicherungsunternehmen (VU) stellt die Entwicklung des Zinsniveaus den wesentlichen Makrofaktor der Untersuchung dar.[5] Im Hinblick auf die Mikrofaktoren werden unterschiedliche (Bilanz)-Kennzahlen betrachtet, die grundsätzlich im Einflussbereich des Managements eines Versicherungskollektivs liegen. Hierbei nehmen die drei ‚Heterogenisierungsfaktoren‘ (Umfang der individuellen Zinsgarantien, Anteil Einmalbeitragsgeschäft, Anteil fondsgebundene Lebensversicherung) eine besondere Rolle ein, da diese potenzielle Heterogenisierungstendenzen innerhalb des (Anlage)-Kollektivs abbilden und somit in gewisser Hinsicht konträr zum Kollektivprinzip stehen.[6]

[3] VNs können auch mittels einer Direktgutschrift an dem Rohüberschuss beteiligt werden. Die Direktgutschrift hat jedoch in der klassischen Lebensversicherung im Zuge der Niedrigzinsphase an Bedeutung verloren (Schwenke & Taube, 2016, S. 142; Wagner, 2017, S. 933).

[4] Auf die konkrete Berechnungsweise gebräuchlicher Kennzahlen innerhalb der Versicherungswirtschaft wird hierbei nicht weiter eingegangen, es sei denn, dass diese wichtig im Hinblick auf das Ziel dieser Arbeit ist bzw. um auf etwaige Schwächen und mögliche Fehlinterpretationen ausgewählter Kennzahlen hinzuweisen. Für eine umfassende Sammlung gebräuchlicher Kennzahlen ist auf Wagner (2017) zu verweisen.

[5] VU, als Abkürzung für Versicherungsunternehmen, steht im weiteren Verlauf der Arbeit ausschließlich für Lebensversicherungsunternehmen.

[6] Unter Heterogenisierungsfaktoren fallen Variablen, die innerhalb der klassischen Lebensversicherung bestimmte Produktcharakteristika abbilden, welche zu einer potenziellen Ungleichbehandlung bzw. Bevorteilung einzelner Vertragskohorten innerhalb der Kollektivanlage führen können oder das Prinzip der kollektiven Kapitalanlage eher in den Hintergrund rücken lassen.

1.3.1 Erklärte Variablen:

Die Kapitalanlageperformance wird durch die Nettoverzinsung und die laufende Durchschnittsverzinsung approximiert.[7] Die Performance wird hier anhand bilanzieller Größen und nicht etwa durch die jährliche Rendite von Marktwerten alternativer Kennzahlen beurteilt (Billmeyer, 2022a). Anders als bei der laufenden Durchschnittsverzinsung sind bei der Nettoverzinsung sowohl außerordentliche Erträge (u.a. Zuschreibungen oder Gewinne aus dem Abgang von Kapitalanlagen) als auch außerordentliche Aufwendungen (u.a. außerordentliche Abschreibungen und Verluste aus dem Abgang von Kapitalanlagen) in die Berechnung mit einzubeziehen (Wagner, 2017, S. 612). In der jüngeren Vergangenheit ist die Nettoverzinsung vor allem aufgrund der Finanzierung der ZZR im Vergleich zur laufenden Durchschnittsverzinsung die volatilere Größe. Zudem kann die Höhe der Nettoverzinsung durch die Realisierung stiller Reserven in dem jeweiligen Geschäftsjahr gezielt beeinflusst werden, was bei der Interpretation zu berücksichtigen ist (Billmeyer, 2022a). Bei Betrachtung der laufenden Durchschnittsverzinsung gilt indes zu beachten, dass außerordentliche Erträge in Spezialfonds, die wiederum an die VUs ausgeschüttet werden, ebenfalls in die Berechnung dieser Kennzahl miteinfließen (Wolfsdorf, 2021), weshalb eine mehrjährige Betrachtung beider Kennzahlen sinnvoll erscheint.

Die Höhe der jährlichen (laufenden) Rendite einer klassischen Lebens- bzw. Rentenversicherung wird anhand der von den VUs jährlich verbindlich deklarierten laufenden Verzinsung an die VNs bewertet. Diese ergibt sich als Summe aus der laufenden Überschussbeteiligung und dem vertragsindividuellen Garantiezins. Verträge mit einem höheren Garantiezins steuern folglich im geringeren Umfang zum laufenden Überschuss für das Kollektiv bei als Verträge mit einem niedrigerem Garantiezins (Deutsche Aktuarvereinigung e.V., 2017a). Sofern auf Einzelvertragsebene der vereinbarte Garantiezins die deklarierte laufende Verzinsung überschreitet, vereinnahmt der VN keine laufende Überschussbeteiligung, sondern lediglich den Garantiezins (Deutsche Aktuarvereinigung e.V., 2017b; Policen Direkt Versicherungsvermittlung GmbH, 2023). Darüber hinaus erhalten VNs einen sog. Schlussüberschuss, der zusammen mit der laufenden Verzinsung als Gesamtverzinsung bezeichnet wird. Die Zuteilung des Schlussüberschusses erfolgt einmalig am Vertragsende (Kündigung, Tod oder Ablauf) und ist bis zur Beendigung des Vertrags nicht als garantierte Leistung zu sehen (Bundesanstalt für Finanzdienstleistungsaufsicht, 2012). Dementsprechend könnten z. B. außergewöhnlich negative Entwicklungen am Kapitalmarkt oder bei der Sterblichkeit dazu führen, dass der

[7] Die Nettoverzinsung und die laufende Durchschnittsverzinsung werden sowohl als erklärte Variablen in den Regressionen zur Kapitalanlageperformance als auch zusätzlich als erklärende Variablen in der Regression zur Höhe der Überschussbeteiligung verwendet.

Schlussüberschuss geringer ausfällt als erwartet oder gänzlich entfällt (Deutsche Aktuarvereinigung e.V., 2017a). Aufgrund der fehlenden Prognosefähigkeit über die Höhe des vertragsindividuellen Schlussüberschusses, wird die Gesamtverzinsung in den Regressionsanalysen nicht berücksichtigt, der Schlussüberschuss jedoch später in einer gesonderten Analyse im Abschnitt RFB Analyse noch genauer thematisiert.[8]

1.3.2 Erklärende Variablen:[9]

Rechtsform

Ein wesentliches Unterscheidungsmerkmal der deutschen Versicherungsunternehmen ist die Eigentümerstruktur, welche sich in den drei verschiedenen Rechtsformen ‚private Versicherungsunternehmen (AG), Versicherungsvereine auf Gegenseitigkeit (VVaG) und öffentlich-rechtlichen Versicherungsunternehmen (ör VU)' widerspiegelt (Diboky & Ubl, 2007). Die Unterschiede dieser Rechtsformen und deren Auswirkungen auf Profitabilität und Wettbewerbsfähigkeit wurden in der Literatur bereits ausführlich diskutiert. Im Hinblick auf internationale Publikationen wurden in der Vergangenheit insbesondere Effizienzunterschiede zwischen AGs und VVaGs untersucht. Während einige Studien basierend auf dem amerikanischen Versicherungsmarkt eher Effizienzvorteile bei den AGs feststellen, können andere Veröffentlichungen mit dem Fokus auf internationale Versicherungsmärkte tendenziell Effizienzvorteile bei den VVaGs erkennen (Eling & Luhnen, 2010). Bezogen auf den deutschen Lebensversicherungsmarkt identifizieren Diboky & Ubl (2007) bei AGs im Vergleich zu VVaGs und ör VUs Effizienzvorteile bzgl. der Kostenstruktur und führen diese Ergebnisse ähnlich wie Williamson (1963) auf die umfassenden Kontrollrechte der Eigentümer der AGs zurück. Im Gegensatz hierzu betonen Breuer & Breuer (2005) in einer theoretischen Arbeit die Vorteile der ör VUs gegenüber den AGs und argumentieren, dass die jährliche Trägerversammlung der ör VUs eine noch intensivere Kontrolle ermöglicht als die jährliche Hauptversammlung der AGs. Zudem sehen die Autoren grundsätzlich bei den ör VUs im Vergleich zu den AGs ein geringeres Potential für Interessenskollisionen zwischen den Stakeholdern, da der Kreis der Eigentümer wesentlich kleiner ist (Konflikt zwischen Eigentümer und Manager) und die Gewinnmaximierung nicht im Vordergrund steht (Konflikt zwischen Eigentümer und VN). Die genannten Unterschiede zwischen den drei Rechtsformen lassen Auswirkungen auf die

[8] Die Assekurata Assekuranz Rating-Agentur GmbH beziffert den Anteil des Schlussüberschusses an der Gesamtverzinsung im Branchendurchschnitt aktuell auf ca. 20% (Klotz, 2024), wodurch die Relevanz der laufenden Verzinsung (Anteil von 80%) im Hinblick auf die Gesamtverzinsung unterstrichen wird.

[9] Die Variablen Umsatzrendite, Aktionärsausschüttungsquote, Abschlussaufwendungen, Verwaltungsaufwendungen und Produktstruktur werden ausschließlich im Regressionsmodell zur Messung der Höhe der laufenden Verzinsung verwendet.

Kapitalanlageperformance und die Höhe der laufenden Verzinsung vermuten, weshalb diese als Dummy-Variable mit der VVaG als Referenzkategorie im Regressionsmodell Berücksichtigung finden. Die Zuordnung der Rechtsform zu den einzelnen VUs erfolgt anhand der Rechtsform der Obergesellschaft bzw. der rechtsformspezifischen Grundausrichtung des Konzerns bzw. der Gruppe.

Umlaufrendite

Insbesondere aufgrund der für das Geschäftsmodell erforderlichen Planbarkeit der Zahlungsströme sowie der aufsichtsrechtlichen Anforderungen investieren VUs im Wesentlichen in festverzinsliche Wertpapiere (GDV, 2023).[10] Da der Erfolg der Kapitalanlage und die hieran anschließende Überschussbeteiligung somit maßgeblich vom jeweils gültigen Zinsniveau abhängt, wird als Proxy des Zinsniveaus die Umlaufrendite auf Basis aller inländischer Inhaberschuldverschreibungen, die die Bundesbank monatlich veröffentlicht, in das Regressionsmodell miteinbezogen.[11]

Größe

Zimmermann & Schramm (2015) konnten zeigen, dass die Größe eines VUs Einfluss auf die Vermögenslage, Überschussbeteiligung und Kapitalausstattung bei der Umsetzung des Solvency II Regulierungsregimes hat. Gleichermaßen lassen Skaleneffekte und damit verbundene Kosteneinsparungen bei größeren VUs eine höhere Überschussbeteiligung vermuten. Des Weiteren könnte die Größe eines VUs ihre Systemrelevanz begründen, sodass höhere Risiken bei der Kapitalanlage eingegangen werden, die im Idealfall in einer höheren Kapitalanlageperformance münden. Analog zu Jost et al. (2020) wird die Größe der VUs in dieser Arbeit anhand der gebuchten Bruttobeiträge gemessen.[12]

Run-off

Einige Versicherer haben in den vergangenen Jahren die Abwicklung ihrer Bestände in Verbindung mit der Einstellung des Neugeschäfts beschlossen und befinden sich somit im sog. Run-off. Die Abwicklung der Bestände erfolgt entweder eigenständig (interner Run-off) oder wird durch einen externen Anbieter (externer Run-off) übernommen (Kipp & Franck, 2021).

[10] Statistiken des GDV beziffern den Anteil von Renten an den gesamten Kapitalanlagen deutscher Lebensversicherer für das Jahr 2020 auf über 82% (GDV, 2021c).

[11] Die Monatswerte wurden annualisiert, da alle anderen Variablen lediglich auf jährlicher Basis verfügbar sind.

[12] In den Regressionsanalysen wird für die Variable ‚Größe' der natürliche Logarithmus (ln) der gebuchten Bruttobeiträge in Mrd. Euro verwendet.

Verbraucherschützer weisen jedoch darauf hin, dass insbesondere für externe Run-off Anbieter ein hoher Anreiz besteht, bei der Überschussbeteiligung der VNs lediglich die gesetzlichen Mindestquoten zu erfüllen, da für diese Unternehmen kein Neugeschäftsdruck besteht (Schröder & Krause, 2021). Um etwaige Unterschiede zwischen normalen VUs und den Run-off Gesellschaften festzustellen, werden VUs im Run-off daher durch eine Dummy-Variable im Regressionsmodell gesondert berücksichtigt.[13] Die Klassifikation, welche VUs sich seit wann im Run-off befinden, erfolgt anhand den Informationen der Assekurata Assekuranz Rating-Agentur GmbH (2021b).

Bestandsstruktur

Die Variable ‚Bestandsstruktur' soll den Anteil der Zinsgarantien im Versicherungsbestand abbilden. Hierbei handelt es sich um einen der drei Heterogenisierungsfaktoren, da Verträge mit einem Rechnungszins über der laufenden Verzinsung bevorzugt gegenüber dem Versicherungskollektiv behandelt werden. Um die Bestandsstruktur darstellen zu können, wird als Proxy das Verhältnis zwischen der Höhe der Zinszusatzreserve (ZZR) und der Deckungsrückstellung (DR) betrachtet. Die ZZR wurde im Zuge der Niedrigzinsphase 2011 zur Sicherstellung der Erfüllbarkeit der eingegangen Garantiezusagen vom Gesetzgeber eingeführt. Die ZZR wird für alle Verträge gebildet, deren Rechnungszins einen bestimmten Referenzzins überschreitet und ist ein Bestandteil der DR (Wolfsdorf, 2021). Finanziert wird der Aufbau der ZZR dabei vor allem durch die Auflösung von Bewertungsreserven, was sich wiederum positiv auf die Nettoverzinsung als einer der beiden gewählten Proxys für die Kapitalanlageperformance auswirkt (Albrecht & Weinmann, 2015b; Lang, 2017). Da die freigewordenen Reserven innerhalb der ZZR reserviert werden, fließen diese nicht in den Rohüberschuss mit ein und können daher auch vorerst nicht mehr für die Überschussbeteiligung verwendet werden (Wolfsdorf, 2021).[14]

Einmalbeitragsgeschäft

Das Geschäft gegen Einmalbeträge (Einmalbeitragsgeschäft) weist im Vergleich zu den klassischen Policen mit laufenden Beiträgen keine Ansparphase auf, was grundsätzlich zu wesentlich kürzeren Vertragslaufzeiten führt. Typische Vertragsformen sind hierbei sofort beginnende oder aufgeschobene Rentenversicherungen sowie Verträge, die eher einer klassischen Kapitalanlage

[13] Mit der Dummy-Variable wird keine weitere Unterscheidung zwischen internem und externem Run-off getroffen. Ein Großteil der VUs bzw. (Teil-)Bestände im externen Run-off war zu Beginn im internen Run-off (Schröder & Krause, 2021).

[14] Mit der Einführung der sog. Korridormethode im Jahr 2018 wurde die ursprüngliche Berechnungsmethode der ZZR reformiert und dadurch die Aufbaugeschwindigkeit der ZZR in der Niedrigzinsphase reduziert (Assekurata Assekuranz Rating-Agentur GmbH, 2019; Wolfsdorf, 2021).

mit kurzen Laufzeiten ähneln (Assekurata Assekuranz Rating-Agentur GmbH, 2021a; Surminski, 2022). Insbesondere die kürzeren Vertragslaufzeiten dieser Policen stehen in einem gewissen Widerspruch zu den auf Langfristigkeit angelegten kollektiven Investmentprozessen. Das Einmalbeitragsgeschäft könnte sich folglich negativ auf die Höhe der Überschussbeteiligung von Altkunden mit laufenden Beitragszahlungen auswirken (Bundesanstalt für Finanzdienstleistungsaufsicht, 2010) und stellt somit einen weiteren Heterogenisierungsfaktor dar. Um vorgenannte Auswirkungen des Einmalbeitragsgeschäfts zu berücksichtigen, wird das Verhältnis aus Einmalbeiträgen zu den gebuchten Bruttobeiträgen des direkten Geschäfts in die Regression mit einbezogen.

Eigenmittelquote

Da SCR-Solvabilitätsquoten erst seit 2016 auszuweisen sind, wird stellvertretend die Eigenmittelquote des Gesamtverbands der Deutschen Versicherungswirtschaft (GDV) im Regressionsmodell verwendet. Hierbei werden die Eigenmittel des VUs im Verhältnis zu den bilanzierten Risiken betrachtet (GDV, 2022).[15] Eine robuste Ausstattung von Eigenmitteln ermöglicht den VUs angemessen auf unvorhersehbare Entwicklungen an den Kapitalmärkten oder in der Sterblichkeit zu reagieren (Weinmann, 2018). Zudem kann vermutet werden, dass VUs mit einer höheren Eigenmittelquote riskanter anlegen können, was sich positiv auf die Kapitalanlageperformance und Höhe der laufenden Verzinsung auswirken sollte.

Stille Reserven

Ähnlich zur obigen Argumentation bzgl. der Eigenmittelquote, können stille Reserven (Bewertungsreserven) auf Kapitalanlagen als ein Maß für die Stärke und Risikotragfähigkeit eines VUs gesehen werden, dass neben seiner Nachvollziehbarkeit wenig Spielraum zur Manipulation zulässt. Hohe Bewertungsreserven ermöglichen den VUs die Auswirkungen von Schwankungen auf den Kapitalmärkten abzumildern und sollten somit grundsätzlich einen positiven Effekt auf den Erfolg der Kapitalanlage aufweisen (Lang, 2017; Weinmann, 2018). Aufgrund der hier diskutierten Zusammenhänge wird daher der Anteil stiller Reserven am Buchwert aller Kapitalanlagen in das Regressionsmodell mit aufgenommen.

[15] Eigenmittel bezeichnen hierbei die Summe aus Eigenkapital sowie der nicht festgelegten Mittel der RfB (Summe aus Schlussüberschussanteilsfonds (SÜAV) und freie RfB).

Risiko in der Kapitalanlage

Der Einbezug eines Proxys zur Messung des Kapitalanlagerisikos soll dem gängigen Verständnis der Portfoliotheorie Rechnung tragen. VUs, die riskanter anlegen, sollten demnach eine höhere Rendite erwarten können. Da das Handelsrecht für die Mischkategorie Investmentanteile keine weitere Unterscheidung nach den verschiedenen Anlageklassen innerhalb dieser Bilanzposition vorsieht, ist die exakte Vermögensallokation und das dazugehörige Anlagerisiko eines VUs anhand von Jahresabschlussdaten nicht zu ermitteln (Zimmermann & Schramm, 2015). Um dennoch den Einfluss des Kapitalanlagerisikos untersuchen zu können, werden Informationen aus den Berichten über Solvabilität und Finanzlage (SFCR) der VUs berücksichtigt. Konkret wird für die neue Variable ‚Risiko in der Kapitalanalage' die Summe aus dem Wert des für die Kapitalanlage besonders relevanten Marktrisikomoduls und des Kreditrisikomoduls bzw. Gegenparteiausfallrisikomoduls im Verhältnis zur Position Anlagen (außer Vermögenswerte für indexgebundene und fondsgebundene Verträge) betrachtet. Wichtig ist hierbei zu erwähnen, dass diese Informationen erst seit dem Jahr 2016 zur Verfügung stehen, das entspricht genau der Hälfte des ursprünglichen Untersuchungszeitraums. Der hier beschriebene Risikoproxy fließt neben den Regressionen zur Messung der Kapitalanlageperformance (Nettoverzinsung, laufende Durchschnittsverzinsung) auch in die Regression zur laufenden Verzinsung ein, da die Kapitalerträge nach wie vor die mit Abstand wichtigste Überschussquelle in der klassischen Lebensversicherung darstellen.[16]

Umsatzrendite

Die Umsatzrendite spiegelt die allgemeine Ertragskraft eines VUs wider und findet demnach lediglich in der Regression zur Messung der Höhe der laufenden Verzinsung Anwendung. Definiert ist die Kennzahl als Summe aus dem Jahresüberschuss, den abgeführten Gewinnen sowie dem Betrag aus der Zuführung zur RfB und der Direktgutschrift im Verhältnis zur Summe aus gebuchten Bruttobeiträgen (ohne die Beiträge der fondsgebundenen Lebensversicherung) und dem Kapitalanlageergebnis. Letztendlich sollte eine höhere Umsatzrendite zu einer potenziell höheren Ausschüttung an die VNs führen.

[16] Nach den Angaben gemäß § 15 Mindestzuführungsverordnung beträgt der Anteil der Kapitalerträge an den gesamten Erträgen zur Beteiligung der Versicherten über alle in die Untersuchung einbezogenen VUs hinweg im Mittel (gewichtetes Mittel) im Zeitraum von 2014 bis 2020 über 83%. Für weitere Details siehe Tabelle 1.14 im Anhang.

Aktionärsausschüttungsquote

In der vorherigen Diskussion zu den Auswirkungen verschiedener Rechtsformen auf die Höhe der Überschussbeteiligung wurde bereits der potenzielle Interessenskonflikt zwischen VNs und Eigentümern (Aktionäre) einer AG thematisiert. Ob letztendlich AGs entstehende Rohüberschüsse tendenziell eher zu Gunsten von Aktionären und damit zu Lasten von VNs verteilen, wird mit Einbezug der Aktionärsausschüttungsquote im Regressionsmodell zur Höhe der Überschussbeteiligung versucht zu berücksichtigen. Die Kennzahl berechnet sich aus der Summe von Dividenden und abgeführten Gewinnen im Verhältnis zum bilanziellen Eigenkapital. Wichtig ist zu erwähnen, dass sowohl VVaGs als auch ör VUs auf operativer (Gesellschafts-)Ebene als AGs formieren können und sich erst über die Obergesellschaft in eine der beiden Rechtsformen untergliedern. Daher kann die Quote auch in diesen Fällen berechnet werden.

Abschlussaufwendungen

In der Sparte der Lebensversicherung stellen im Branchenmittel die Kosten für den Abschluss von neuen Versicherungspolicen (Abschlussaufwendungen) die mit Abstand größte Position der Betriebsaufwendungen dar (Schaumlöffel, 2020). Abschlussaufwendungen werden gewöhnlich im Verhältnis zur Beitragssumme des Neugeschäfts, aber auch im Verhältnis zu den verdienten Bruttobeiträgen berechnet (Beenken, 2022). Auch wenn ein Vergleich dieser Quoten ohne weitere Informationen (z. B. Vertriebswege, Stornoquoten oder Anteil klassisches vs. fondsgebundenes Geschäft) nur bedingt möglich ist (Beenken, 2022; Billmeyer, 2022b), soll der allgemeine Einfluss der Abschlussaufwendungen im Regressionsmodell zur Höhe der laufenden Verzinsung berücksichtigt werden. Hierbei wird sich an der Definition der Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) orientiert und die Quote in Relation zu den verdienten Bruttobeiträgen berechnet (Bundesanstalt für Finanzdienstleistungsaufsicht, 2021a).

Verwaltungsaufwendungen

Die unter den Abschlusskosten genannten Problematiken bezüglich der eingeschränkten Vergleichbarkeit aufgrund fehlender Informationen (z. B. detaillierte Kostenstruktur der VUs) ergeben sich bei den Verwaltungsaufwendungen gleichermaßen. Hinzu kommt, dass Teile der Verwaltungsaufwendungen tendenziell als fixkostenlastig gelten und folglich große VUs aufgrund von Skaleneffekten eher niedrigere Kostenquoten aufweisen (Jost et al., 2020). Dennoch ist eine Berücksichtigung im Regressionsmodell zur Höhe der Überschussbeteiligung als sinnvoll zu erachten. Die Quote wird ebenfalls in Relation zu den verdienten Bruttobeiträgen berechnet.

Produktstruktur

Die letzte Variable, die im Regressionsmodell zur Höhe der Überschussbeteiligung berücksichtigt wird, ist ein Proxy für die Produktstruktur im Bestand der VUs. Hierzu wird das Verhältnis von gebuchten Bruttobeiträgen in der fondsgebundenen Lebensversicherung (FLV) des direkten Geschäfts zu den (gesamten) Bruttobeiträgen des direkten Geschäfts betrachtet. Im Gegensatz zu den Variablen der Bestandsstruktur und des Einmalbeitragsgeschäfts stellt die Produktstruktur einen Heterogenisierungsfaktor im weiteren Sinne dar. Vermutet wird hierbei, dass VUs, die sich frühzeitig auf das Geschäft mit FLVs fokussieren und dadurch eine hohe Quote aufweisen, den Altbestand mit klassischen Policen bzw. die Kollektivanlage eher vernachlässigen könnten.

Die nachfolgende Tabelle 1.1 fasst die unterschiedlichen Modellspezifikationen und die jeweils verwendete Einheit (in Klammern) der entsprechenden Variablen zusammen.

Tabelle 1.1 Übersicht Modellspezifikationen

Untersuchungsgegenstand	Kapitalanlageperformance		Jährliche (laufende) Rendite für die VNs
Erklärte Variablen	Nettoverzinsung (%)	Laufende Durchschnittsverzinsung (%)	Laufende Verzinsung (%)
Erklärende Variablen	Rechtsform (Dummy)	Rechtsform (Dummy)	Rechtsform (Dummy)
	Umlaufrendite (%)	Umlaufrendite (%)	Umlaufrendite (%)
	Größe (EUR Mrd.)	Größe (EUR Mrd.)	Größe (EUR Mrd.)
	Run-off (Dummy)	Run-off (Dummy)	Run-off (Dummy)
	Bestandsstruktur (%)	**Bestandsstruktur (%)**	**Bestandsstruktur (%)**
	Einmalbeitragsgeschäft (%)	**Einmalbeitragsgeschäft (%)**	**Einmalbeitragsgeschäft (%)**
	Eigenmittelquote (%)	Eigenmittelquote (%)	Eigenmittelquote (%)
	Stille Reserven (%)	Stille Reserven (%)	Stille Reserven (%)
	Risiko in der Kapitalanlage (%)	Risiko in der Kapitalanlage (%)	Umsatzrendite (%)
			Aktionärsausschüttungsquote (%)
			Abschlussaufwendungen (%)
			Verwaltungsaufwendungen (%)
			Produktstruktur (%)
			Nettoverzinsung (%)
			Laufende Durchschnittsverzinsung (%)
			Risiko in der Kapitalanlage (%)

Erläuterungen: Zuordnung der unabhängigen Variablen zu den drei erklärten Variablen (Nettoverzinsung, laufende Durchschnittsverzinsung, laufende Verzinsung). Nettoverzinsung und laufende Durchschnittsverzinsung als erklärte Variable in den Regressionen zur Kapitalanlageperformance werden als erklärende Variable zusätzlich in der Regression zur Höhe der jährlich (laufenden) Rendite mit einbezogen. Heterogenisierungsfaktoren sind textlich hervorgehoben.

1.4 Datengrundlage und ökonometrische Modelle

1.4.1 Datenbasis

Gegenstand der Untersuchung sind alle auf dem deutschen Markt tätigen VUs, deren Jahresabschlussdaten in der Datenbank der KIVI GmbH Kölner Institut für Versicherungsinformation und Wirtschaftsdienste gelistet sind und die während des Untersuchungszeitraums von 2011 bis 2020 jährliche Prämieneinnahmen im selbstabgeschlossenen (direkten) Geschäft von mehr als 40 Mio. Euro erzielt haben.[17] Falls diese Summe in einem Geschäftsjahr unterschritten wird, bleibt das VU zunächst ein weiteres Jahr Teil der Untersuchung, um sicherzustellen, dass die Unterschreitung möglicherweise nur vorübergehend ist. Im Falle von fehlenden Werten für die in der Untersuchung einbezogenen Variablen, wird die entsprechende Beobachtung für das jeweilige Unternehmen und dem dazugehörigen Jahr aus dem Datensatz entfernt. Nicht berücksichtigt werden Pensionskassen, Pensionsfonds, Sterbekassen und VUs, die ausschließlich Risikolebensversicherungspolicen vertreiben. Daten zur Umlaufrendite stammen aus Veröffentlichungen der Bundesbank (Deutsche Bundesbank, 2023). Informationen über die laufende Verzinsung der VUs wurden den allgemein zugänglichen Veröffentlichungen der Assekurata Assekuranz Rating-Agentur GmbH (2023a), Cash. Media Group GmbH (2023), cecu.de GmbH (2023), Kholghi Finanz- & Vermögensplanung (2023), Policen Direkt Versicherungsvermittlung GmbH (2023), Versicherungsbote GmbH (2023), VersicherungsJournal Verlag GmbH (2023) und VorsorgeWiki e.K. (2023) entnommen. Ergänzt werden die Informationen aus den Jahresabschlüssen der VUs um Daten aus den SFCR-Berichten der Jahre 2016 bis 2020. Der für die Untersuchung verwendete Datensatz umfasst somit insgesamt 73 VUs, wobei die genaue Anzahl der VUs zwischen den Jahren aufgrund der o. g. Größenkriterien, der Bereinigung von fehlenden Werten und der Berücksichtigung von Fusionen und Übernahmen variiert. Gemessen an den Prämieneinnahmen im direkten Geschäft beträgt die durchschnittliche Marktabdeckung (gewichtetes Mittel) der einbezogenen VUs über den gesamten Untersuchungszeitraum hinweg über 88%.[18]

Bei der Datenbasis handelt es sich um Paneldaten, da die Merkmale der gleichen VUs mehrfach zu unterschiedlichen Zeitpunkten erhoben werden. Konkret liegt ein sog. short und unbalanciertes Panel vor: die Zahl der VUs (73) ist größer als die Zahl der Messzeitpunkte (10) und die

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[17] Nach Angaben der KIVI GmbH Kölner Institut für Versicherungsinformation und Wirtschaftsdienste werden die deutschen Niederlassungen ausländischer VUs nur erfasst, wenn ein Jahresabschluss über das deutsche Geschäft vorliegt. Nicht erfasst wird das deutsche Geschäft von VUs aus dem Europäischen Wirtschaftsraum, welches über deutsche Niederlassungen oder im freien Dienstleistungsverkehr abgeschlossen wurde sowie das über ausländische Töchter von deutschen VUs betriebene Geschäft.

[18] Weiterführende Informationen und Daten zur jährlichen Marktabdeckung sind den Tabellen 1.11, 1.12 und 1.13 im Anhang zu entnehmen.

VUs weisen teilweise aufgrund der genannten Gründe eine ungleiche Anzahl an Beobachtungen auf.

Tabelle 1.2 Definition der Variablen

Variablenbezeichnung	Variablentyp	Definition	Datenquelle
Nettoverzinsung	Erklärte Variable (Erklärende Variable)	Ergebnis aus Kapitalanlagen in % des mittleren Kapitalanlagebestands	Datenbank der KIVI GmbH
Laufende Durchschnittsverzinsung	Erklärte Variable (Erklärende Variable)	Laufende Durchschnittsverzinsung gemäß GDV (ordentliches Ergebnis aus Kapitalanlagen in % des mittleren Kapitalanlagebestands)	Datenbank der KIVI GmbH
Laufende Verzinsung	Erklärte Variable	Deklarierte laufende Verzinsung der Lebensversicherer für die klassischen Renten- und Lebensversicherungen. Eine Unterscheidung zwischen der laufenden Verzinsung von Renten- und Lebensversicherung wird nicht vorgenommen, da sich beide Werte im gesamten Untersuchungszeitraum nur marginal unterscheiden.	Öffentlich zugängliche Daten der Assekurata Assekuranz Rating-Agentur GmbH (2023a), Cash. Media Group GmbH (2023), cecu.de GmbH (2023), Kholghi Finanz- & Vermögensplanung (2023), Policen Direkt Versicherungsvermittlung GmbH (2023), Versicherungsbote GmbH (2023), Versicherungs-Journal Verlag GmbH (2023) und VorsorgeWiki e.K. (2023)
Umlaufrendite	Erklärende Variable (Makrofaktor)	Umlaufrendite auf Basis aller inländischen Inhaberschuldverschreibungen	Deutsche Bundesbank (2023)
Rechtsform	Erklärende Variable (Mikrofaktor)	Rechtsform der Obergesellschaft bzw. rechtsformspezifische Grundausrichtung des Konzerns bzw. der Gruppe (Dummyvariable)	Datenbank der KIVI GmbH
Größe	Erklärende Variable (Mikrofaktor)	Natürlicher Logarithmus (ln) der gebuchten Bruttobeiträge in Mrd. Euro	Datenbank der KIVI GmbH
Run-off	Erklärende Variable (Mikrofaktor)	Lebensversicherer im internen oder externen Run-off (Dummyvariable)	Datenbank der KIVI GmbH, öffentlich zugängliche Daten der Assekurata Assekuranz Rating-Agentur GmbH (2022)
Eigenmittelquote	Erklärende Variable (Mikrofaktor)	Eigenmittelquote gemäß GDV	Datenbank der KIVI GmbH
Stille Reserven	Erklärende Variable (Mikrofaktor)	Verhältnis stiller Reserven zum Buchwert der Kapitalanlagen (ohne FLV)	Datenbank der KIVI GmbH
Umsatzrendite	Erklärende Variable (Mikrofaktor)	Summe von Jahresüberschuss, abgeführten Gewinnen, Zuführung zur RfB und Direktgutschrift im Verhältnis zur Summe aus gebuchten Bruttobeiträgen (ohne FLV) und dem Kapitalanlageergebnis	Datenbank der KIVI GmbH
Aktionärsausschüttungsquote	Erklärende Variable (Mikrofaktor)	Summe von Dividenden und abgeführten Gewinnen im Verhältnis zum bilanziellen Eigenkapital	Datenbank der KIVI GmbH
Abschlussaufwendungen	Erklärende Variable (Mikrofaktor)	Verhältnis der Abschlussaufwendungen zu den verdienten Bruttobeiträgen	Datenbank der KIVI GmbH
Verwaltungsaufwendungen	Erklärende Variable (Mikrofaktor)	Verhältnis der Verwaltungsaufwendungen zu den verdienten Bruttobeiträgen	Datenbank der KIVI GmbH
Risiko in der Kapitalanlage	Erklärende Variable (Mikrofaktor)	Summe aus dem Markt- und Kreditrisiko im Verhältnis zu zeitwertbilanzierten Kapitalanlagen (ohne FLV)	SFCR-Berichte der Lebensversicherungsunternehmen (2016-2020)
Bestandsstruktur	Erklärende Variable (Heterogenisierungsfaktor)	Verhältnis des Bestands der ZZR zum Bestand der DR	Datenbank der KIVI GmbH
Einmalbeitragsgeschäft	Erklärende Variable (Heterogenisierungsfaktor)	Verhältnis aus Einmalbeträgen zu den gebuchten Bruttobeiträgen des direkten Geschäfts	Datenbank der KIVI GmbH
Produktstruktur	Erklärende Variable (Heterogenisierungsfaktor)	Verhältnis von gebuchten Bruttobeiträgen in der FLV des direkten Geschäfts zu den gesamten gebuchten Bruttobeiträgen des direkten Geschäfts	Datenbank der KIVI GmbH

Erläuterungen: Übersicht aller in die Untersuchung einbezogenen Variablen. Sortierung erfolgt nach Variablentyp.

1.4.2 Beschreibung der verwendeten ökonometrischen Modelle

Die Schätzung der Regressionskoeffizienten der erklärenden Variablen erfolgt für die drei erklärten Variablen (Nettoverzinsung, laufende Durchschnittsverzinsung, laufende Verzinsung) jeweils anhand von drei unterschiedlichen Regressionsmodellen. Um die unbeobachteten

Unterschiede zwischen den VUs und über die Zeit kontrollieren zu können, kommen ein Modell mit der Berücksichtigung von ausschließlich individuellen Effekten (FE-Modell), von ausschließlich zeitfixen Effekten (OLS-Modell mit zeitfixen Effekten) sowie ein Modell, das sowohl individuelle als auch zeitfixe Effekte (Two-Way-FE-Modell) berücksichtigt, zur Anwendung. Modell (1) ist ein klassisches Fixed-Effects-Modell und kontrolliert unternehmensfixe Effekte (zeitinvariante unternehmensindividuelle fixe Effekte), die zwischen den Unternehmen variieren:

$$y_{it} = \alpha_i + \sum_{k=1}^{K} \beta_k \, x_{kit} + \epsilon_{it,} \tag{1}$$

mit y_{it} als erklärte bzw. abhängige Variable des i-ten VUs im Jahr t, α_i als (nicht-zufälliger) zeitinvarianter individueller fixer Effekt des i-ten VUs, x_{kit} als erklärende bzw. unabhängige Variable k des i-ten VUs im Jahr t, β_k als Regressionskoeffizient für die erklärende Variable k und ϵ_{it} als Störterm des i-ten VUs im Jahr t. Modell (2) ist ein klassisches OLS-Regressionsmodell mit zeitfixen Effekten und kontrolliert zeitfixe Effekte, die innerhalb eines Jahres invariant über alle VUs sind, sich jedoch über die Zeit verändern (z. B. makroökonomische Effekte):

$$y_{it} = \alpha + \gamma_t + \sum_{k=1}^{K} \beta_k \, x_{kit} + \epsilon_{it,} \tag{2}$$

mit y_{it} als erklärte bzw. abhängige Variable des i-ten VUs im Jahr t, α als Achsenabschnitt (Konstante) des Modells, γ_t als (nicht-zufälliger) zeitfixer Effekt des Jahres t (der invariant über alle VUs ist), x_{kit} als erklärende bzw. unabhängige Variable k des i-ten VUs im Jahr t, β_k als Regressionskoeffizient für die erklärende Variable k und ϵ_{it} als Störterm des i-ten VUs im Jahr t. Modell (3) basiert ebenfalls wie Modell (1) auf einem Fixed-Effects-Modell und kontrolliert sowohl unternehmensfixe als auch zeitfixe Effekte. Durch die Berücksichtigung von sowohl zeitinvarianten unternehmensspezifischen Unterschieden als auch zeitfixen Effekten, die innerhalb eines Jahres invariant über alle VUs sind, sich jedoch im Zeitverlauf verändern, soll eine möglichst unverzerrte Schätzung der Effekte der unabhängigen Variablen zwischen den Unternehmen und im Zeitverlauf erreicht werden:

$$y_{it} = \alpha_i + \gamma_t + \sum_{k=1}^{K} \beta_k \, x_{kit} + \epsilon_{it}, \quad (3)$$

Modell (3) entspricht Modell (1), ergänzt um γ_t als (nicht-zufälliger) zeitfixer Effekt des Jahres t (der invariant über alle VUs ist).

Die Schätzung der Regressionskoeffizienten erfolgt bei allen Modellen unter Berücksichtigung der Panel-Datenstruktur. Zudem werden robuste Standardfehler verwendet, um Autokorrelation und Heteroskedastizität zu berücksichtigen.

1.5 Empirische Ergebnisse

1.5.1 Deskriptive Ergebnisse

Tabelle 1.3 und 1.4 stellen gängige deskriptive Statistiken der in die Untersuchung einbezogen Variablen gegenüber. Dabei steht N für die Anzahl der Beobachtungen, Mittelwert für das arithmetische Mittel, SD für die Standardabweichung, Min (Max) für den Minimalwert (Maximalwert) und Q_1 (Q_3) für das erste (dritte) Quartil. Grundsätzlich liegen für die einzelnen Variablen über den gesamten Untersuchungszeitraum hinweg 603 vollständige Beobachtungen vor. Eine Ausnahme stellt das ‚Risiko in der Kapitalanlage‘ dar, da die Werte dieser Variable auf den Angaben aus den SFCR-Berichten der VUs basieren und diese lediglich für den Zeitraum von 2016 bis 2020 verfügbar sind.

Tabelle 1.3 Deskriptive Statistiken - Überblick

Variable	N	Mittelwert	SD	Min	Q_1	Median	Q_3	Max
Umlaufrendite	603	0.66	0.78	-0.19	0.11	0.43	1.35	2.55
Größe (ln)	603	-0.67	1.35	-3.32	-1.79	-0.53	0.27	3.36
Bestandsstruktur	603	5.24	4.04	0.02	1.92	4.77	8.07	32.57
Einmalbeitragsgeschäft	603	23.52	15.80	0.05	10.83	20.67	34.04	74.85
Eigenmittelquote	603	158.92	43.13	48.21	131.32	153.89	177.46	333.66
Stille Reserven	603	12.32	5.67	-4.78	8.20	12.16	16.19	30.80
Umsatzrendite	603	13.10	12.38	-0.03	6.96	10.30	14.84	144.52
Aktionärsausschüttungsquote	603	7.91	21.63	0.00	0.00	0.00	7.33	306.40
Abschlussaufwendungen	603	9.30	4.81	0.95	6.44	8.53	11.64	37.23
Verwaltungsaufwendungen	603	2.80	1.62	0.71	1.82	2.50	3.23	13.00
Produktstruktur	603	16.27	18.24	0.00	1.91	8.88	27.30	96.78
Nettoverzinsung	603	4.09	0.79	0.91	3.59	4.14	4.59	6.98
Laufende Durchschnittsverzinsung	603	3.35	0.79	-0.10	2.79	3.40	3.94	7.40
Laufende Verzinsung	603	2.96	0.69	1.25	2.40	2.90	3.50	4.80
Risiko in der Kapitalanlage	329	10.79	6.16	0.59	7.87	10.13	13.25	47.85

Erläuterungen: Deskriptive Statistiken der in den Regressionsmodellen verwendeten (stetigen) Variablen. Variable ‚Größe‘ als natürlicher Logarithmus (ln) in Mrd. Euro, alle weiteren Variablen stellen anteilige Werte in Prozent dar.

Tabelle 1.4 Deskriptive Statistiken - Mittelwerte der (stetigen) Variablen sortiert nach Jahren

	Mittelwerte									
Variable	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Umlaufrendite	2.55	1.38	1.35	1.03	0.46	0.11	0.27	0.43	-0.05	-0.19
Größe (ln)	-0.69	-0.66	-0.71	-0.73	-0.61	-0.68	-0.72	-0.68	-0.62	-0.59
Bestandsstruktur	0.23	0.96	1.73	2.79	3.98	5.47	7.15	7.58	9.10	10.10
Einmalbeitragsgeschäft	20.63	20.95	23.92	27.03	25.35	24.54	22.07	21.82	23.80	24.46
Eigenmittelquote	183.44	178.94	172.82	163.05	159.19	153.90	151.14	148.06	147.43	144.56
Stille Reserven	4.65	11.36	7.52	16.79	12.75	13.98	11.77	9.16	15.29	17.78
Umsatzrendite	14.02	13.01	13.37	12.43	11.58	10.58	12.08	12.56	16.59	14.62
Aktionärsausschüttungsquote	7.05	6.18	6.14	6.55	5.64	5.68	7.72	6.83	11.35	14.50
Abschlussaufwendungen	11.03	11.04	9.57	10.07	9.29	8.74	8.40	8.65	8.54	8.65
Verwaltungsaufwendungen	2.77	2.91	2.80	2.78	2.80	2.71	2.80	2.83	2.83	2.79
Produktstruktur	12.71	13.18	12.61	12.68	14.60	15.29	16.88	18.17	21.11	22.54
Nettoverzinsung	4.02	4.67	4.57	4.48	4.39	4.25	4.28	3.29	3.65	3.61
Laufende Durchschnittsverzinsung	4.16	4.09	3.92	3.81	3.65	3.29	3.17	2.74	2.66	2.61
Laufende Verzinsung	4.06	3.84	3.55	3.37	3.15	2.82	2.51	2.38	2.37	2.19
Risiko in der Kapitalanalage	-	-	-	-	-	10.57	10.19	10.47	11.41	11.29
Anzahl der Beobachtungen	52	49	55	57	61	64	65	66	67	67

Erläuterungen: Mittelwerte der in den Regressionsmodellen verwendeten (stetigen) Variablen, sortiert nach Jahren. Variable ‚Größe' als natürlicher Logarithmus (ln) in Mrd. Euro, alle weiteren Variablen stellen anteilige Werte in Prozent dar.

Die paarweisen Korrelationen der unabhängigen Variablen über den gesamten Untersuchungszeitraum werden in der nachfolgenden Korrelationsmatrix (Tabelle 1.5) abgebildet.[19] Keine der Korrelationen übersteigt hierbei den Schwellenwert für Multikollinearität (größer +0.8 bzw. kleiner -0.8), weshalb alle vorgesehen Variablen bei der Parameterschätzung berücksichtigt wurden. Eine auffällig hohe (negative) Korrelationen zeigt sich bei der Umlaufrendite und den stillen Reserven mit -0.5 bzw. bei dem Run-off Dummy und den Abschlussaufwendungen mit -0.4. Wie an anderer Stelle bereits erwähnt, sind die Kapitalanlagen zum Großteil in festverzinslichen Wertpapieren investiert. Das Zinsniveau in Form der Umlaufrendite und die Marktpreise festverzinslicher Wertpapiere stehen in einem inversen Verhältnis. Steigt das Zinsniveau, so sinken i. d. R. die Markpreise für festverzinsliche Wertpapiere. In der Folge nehmen die stillen Reserven ab, was den vergleichsweise hohen negativen Zusammenhang somit erklären kann.

Tabelle 1.5 Korrelationsmatrix (2011 bis 2020)

	AG	ör VU	Umlaufrendite	Größe	Run-off	Bestandsstruktur	Einmalbeitragsgeschäft	Eigenmittelquote	Stille Reserven	Umsatzrendite	Aktionärsausschüttungsquote	Abschlussaufwendungen	Verwaltungsaufwendungen	Produktstruktur	Nettoverzinsung	Laufende Durchschnittsverzinsung
AG	1	-0.3	-0.0	0.1	0.2	0.1	-0.1	-0.2	-0.0	0.2	0.2	0.1	0.1	0.3	-0.0	-0.1
ör VU	-0.3	1	-0.0	0.0	-0.1	-0.1	0.4	-0.2	0.1	-0.2	-0.1	-0.1	-0.2	-0.2	-0.1	-0.1
Umlaufrendite	-0.0	-0.0	1	-0.0	-0.1	-0.7	-0.0	0.3	-0.5	-0.0	-0.1	0.2	0.0	-0.1	0.2	0.6
Größe	0.1	0.0	-0.0	1	-0.2	-0.0	0.2	-0.3	0.2	-0.1	0.1	-0.0	-0.2	0.2	0.1	0.1
Run-off	0.2	-0.1	-0.1	-0.2	1	0.4	-0.2	0.2	-0.0	0.2	0.2	-0.4	0.2	0.0	-0.0	-0.1
Bestandsstruktur	0.1	-0.1	-0.7	-0.0	0.4	1	-0.2	-0.1	0.3	0.2	0.2	-0.3	-0.0	0.2	-0.3	-0.5
Einmalbeitragsgeschäft	-0.1	0.4	-0.0	0.2	-0.2	-0.2	1	-0.1	0.1	-0.3	0.0	0.1	0.1	-0.0	-0.0	-0.0
Eigenmittelquote	-0.2	-0.2	0.3	-0.3	0.2	-0.1	-0.1	1	-0.1	-0.1	-0.0	-0.1	0.2	-0.3	0.2	0.3
Stille Reserven	-0.0	0.1	-0.5	0.2	-0.0	0.3	0.1	-0.1	1	-0.2	0.0	-0.2	0.0	-0.1	0.1	-0.1
Umsatzrendite	0.2	-0.2	-0.0	-0.1	0.2	0.2	-0.3	-0.1	-0.2	1	0.5	-0.0	-0.1	0.1	-0.0	-0.0
Aktionärsausschüttungsquote	0.2	-0.1	-0.1	0.1	0.2	0.2	0.0	-0.0	0.0	0.5	1	-0.0	0.3	0.1	-0.1	0.0
Abschlussaufwendungen	0.1	-0.1	0.2	-0.0	-0.4	-0.3	0.1	-0.1	-0.2	-0.0	-0.0	1	0.2	0.2	-0.0	0.1
Verwaltungsaufwendungen	0.1	-0.2	0.0	-0.2	0.2	-0.0	0.1	0.2	0.0	-0.1	0.3	0.2	1	-0.0	-0.0	0.0
Produktstruktur	0.3	-0.2	-0.1	0.2	0.0	0.2	-0.0	-0.3	-0.1	0.1	0.1	0.2	-0.0	1	-0.0	-0.2
Nettoverzinsung	-0.0	-0.1	0.2	0.1	-0.0	-0.3	-0.0	0.2	0.1	-0.0	-0.1	-0.0	-0.0	-0.0	1	0.6
Laufende Durchschnittsverzinsung	-0.1	-0.1	0.6	0.1	-0.1	-0.5	-0.0	0.3	-0.1	-0.0	0.0	0.1	0.0	-0.2	0.6	1

Erläuterungen: Paarweise Korrelationen der über den gesamten Untersuchungszeitraum (2011-2020) einbezogenen unabhängigen Variablen (N = 603).

[19] Die Korrelationsmatrix einschließlich der Variable ‚Risiko in der Kapitalanlage' über den Untersuchungszeitraum von 2016 bis 2020 ist im Anhang (Tabelle 1.15) zu finden.

VUs im Run-off haben das Neugeschäft weitgehend eingestellt und weisen daher kaum bzw. keine Abschlusskosten auf (Dennstedt et al., 2021), sodass der negative Zusammenhang auch hier erklärt werden kann. Eine auffällig hohe (positive) Korrelation lässt sich zwischen dem ör VU Dummy und dem Einmalbeitragsgeschäft mit +0.4 beobachten. Dies könnte darauf zurückgeführt werden, dass ör VUs überwiegend Bancassurance betreiben und folglich bankähnliche Produkte wie z. B. bestimmte Einmalbeitragspolicen verstärkt nachgefragt werden.[20] Auffällig hohe (negative) Korrelationen weisen auch die Umlaufrendite (Laufende Durchschnittsverzinsung) mit der Bestandsstruktur mit -0.7 (-0.5) auf. Das Zinsniveau in Form der Umlaufrendite hat direkten Einfluss auf den nach § 5 DeckRV berechneten Referenzzins, welcher wiederum einen unmittelbaren Einfluss auf die Bestandsstruktur hat. Sinkt das Zinsniveau, so sinkt nachgelagert auch der Referenzzins. Im Zuge dessen ist eine Nachreservierung für Verträge mit höherem Rechnungszins erforderlich, wodurch sich der Anteil der ZZR an der DR erhöht und der vergleichsweise hohe negative Zusammenhang somit erklärt werden kann. Hieran anknüpfend ist der negative Zusammenhang zwischen laufender Durchschnittsverzinsung und Bestandsstruktur möglicherweise darauf zurückzuführen, dass zur Finanzierung der ZZR in der Niedrigzinsphase stille Reserven aufgelöst werden und die Neuanlage nur noch mit geringerer Verzinsung erfolgen kann, was die laufende Durchschnittsverzinsung sukzessive verringert. Auf das vorgenannte Spannungsfeld zwischen Umlaufrendite, Bestandsstruktur und laufender Durchschnittsverzinsung weist ebenso die auffällig hohe (positive) Korrelation (+0.6) zwischen Umlaufrendite und laufender Durchschnittsverzinsung hin. Je höher das Zinsniveau, desto höher die Verzinsung der festverzinslichen Wertpapiere als dominierende Anlageklasse und desto höher demnach auch die laufende Durchschnittsverzinsung.

[20] Bürger (2019) beziffert den Anteil des Vertriebswegs Bancassurance am Neugeschäft von ör VUs auf über 70%.

1.5.2 Ergebnisse der Regressionsanalysen

Kapitalanlageperformance

Tabelle 1.6 zeigt die Ergebnisse der Regression mit der Nettoverzinsung als erklärte Variable. Während die Modelle (1), (2) und (3) den gesamten Untersuchungszeitraum von 2011 bis 2020 umfassen, bilden die Modelle (4), (5) und (6) einen verkürzten Untersuchungszeitraum (2016 bis 2020) ab und ermöglichen so die Einbeziehung der Variable ‚Risiko in der Kapitalanlage'. Im Detail unterscheiden sich die Modelle wie folgt: Modell (1) und (4) kontrolliert für unternehmensfixe Effekte, wodurch insbesondere Effekte, die innerhalb der Unternehmen über die Zeit hinweg variieren (z. B. makroökonomische Effekte) besser erkennbar werden.[21] Im Gegensatz dazu werden bei Modell (2) und (5) Effekte, die auf zeitliche Schwankungen zurückzuführen sind kontrolliert, um so die unternehmensindividuellen Unterschiede besser sichtbar zu machen. Modell (3) und (6) kontrollieren sowohl für unternehmensfixe als auch zeitfixe Effekte. Durch das herausfilternd aller zeitinvarianten unternehmensspezifischen Unterschiede sowie jährlicher Schwankungen soll eine möglichst unverzerrte Schätzung der Effekte der unabhängigen Variablen innerhalb der Unternehmen und über die Zeit erreicht werden.

Es zeigt sich, dass der ör VU Dummy sowohl in seiner Größenordnung als auch hinsichtlich statistischer Signifikanz, einen bedeutenden Einfluss auf die Nettoverzinsung hat. In der vorliegenden Datenbasis ist die Nettoverzinsung im Modell (2) und (5) im Vergleich zu den VVaGs um 0.288 bzw. 0.334 Prozentpunkte geringer, wenn es sich um ein ör VU handelt. Die im vorangegangenen Unterabschnitt dargestellte Korrelationsmatrix weist zudem auf einen negativen Zusammenhang zwischen dem ör VU Dummy und der Bestandsstruktur hin. Daraus kann geschlossen werden, dass ör VUs im Vergleich zu den beiden anderen Rechtsformen einen geringeren Anteil besonders hochverzinster Policen im Versicherungsbestand haben und daher weniger stark dazu tendieren, stille Reserven aufzulösen, was sich positiv auf die Nettoverzinsung auswirken würde. Der direkte Effekt der stillen Reserven auf die Nettoverzinsung ist im Modell (2) und (5) mit 0.036 und 0.049 schwach positiv und statistisch signifikant. Eine Erhöhung der stillen Reserven um 1 Prozentpunkt führt demnach zu einem Anstieg der Nettoverzinsung um 0.036 bzw. 0.049 Prozentpunkte. Gleiches gilt für die Bestandsstruktur, die im Modell (3) und (6) einen positiven und statistisch signifikanten Zusammenhang mit der Nettoverzinsung aufweist. Die Vermutung, dass stille Reserven vornehmlich zur Finanzierung der ZZR aufgelöst werden und damit die Nettoverzinsung erhöhen, lässt sich demnach aus den einzelnen Effekten

[21] Bei der Interpretation der Ergebnisse treten die Modelle (1) und (4) eher in den Hintergrund, da der Regressionsoutput dieser Modelle weitgehend von makroökonomischen Effekten überlagert wird.

von stillen Reserven und Bestandsstruktur auf die Nettoverzinsung mit der hier verwendeten Datenbasis noch einmal empirisch bestätigen.

Tabelle 1.6 Regressionsoutput Nettoverzinsung

	Erklärte Variable: Nettoverzinsung					
	(1)	(2)	(3)	(4)	(5)	(6)
	FE	OLS	FE	FE	OLS	FE
AG		-0.071			-0.049	
		(0.109)			(0.140)	
ör VU		-0.288*			-0.334*	
		(0.149)			(0.187)	
Umlaufrendite	-0.358***			-0.440		
	(0.080)			(0.325)		
Größe	-0.243	0.043	0.600***	0.855**	0.060	0.873***
	(0.305)	(0.037)	(0.215)	(0.337)	(0.050)	(0.300)
Run-off	-0.366	0.025	-0.214	-0.290	0.097	-0.094
	(0.305)	(0.165)	(0.453)	(0.528)	(0.224)	(0.570)
Bestandsstruktur	-0.141***	0.049	0.133***	-0.149***	0.038	0.231**
	(0.022)	(0.036)	(0.032)	(0.041)	(0.035)	(0.096)
Einmalbeitragsgeschäft	-0.002	0.004	-0.001	-0.010	0.005	0.002
	(0.008)	(0.005)	(0.006)	(0.010)	(0.006)	(0.008)
Eigenmittelquote	0.008***	0.002	0.006***	0.014***	0.003	0.007*
	(0.002)	(0.002)	(0.002)	(0.005)	(0.002)	(0.004)
Stille Reserven	0.020***	0.036**	0.008	0.006	0.049***	-0.029
	(0.006)	(0.014)	(0.015)	(0.021)	(0.013)	(0.023)
Risiko in der Kapitalanlage				0.021	0.011	0.028
				(0.034)	(0.016)	(0.028)
Unternehmensindividuelle FE	Ja	Nein	Ja	Ja	Nein	Ja
Jahr FE	Nein	Ja	Ja	Nein	Ja	Ja
N	603	603	603	329	329	329
Adj. R^2	-	0.390	-	-	0.327	-
Within R^2	0.285	-	0.504	0.195	-	0.464
Between R^2	0.019	-	0.057	0.036	-	0.024
Overall R^2	0.046	-	0.173	0.039	-	0.093
						Bemerkung: *p<0.1; **p<0.05; ***p<0.01

Erläuterungen: Unterscheidung zwischen den Rechtsformen (VVaG, AG, ör VU) anhand von Dummy-Variablen mit VVaG als Referenzkategorie. Die Schätzung der Regressionskoeffizienten erfolgt durch Modelle mit individuellen Effekten (1) & (4), Modelle mit zeitfixen Effekten (2) & (5) und Modelle mit individuellen und zeitfixen Effekten (3) & (6). Modell (1), (2) und (3) bezieht sich auf den Untersuchungszeitraum 2011 bis 2020, Modell (4), (5) und (6) auf den Untersuchungszeitraum 2016 bis 2020.

Der zugleich negative und statistisch signifikante Zusammenhang in Modell (1) und (4) in Bezug auf die Bestandsstruktur spiegelt die Entwicklung über die Zeit wider. Während bei der Bestandsstruktur über die Zeit im Mittel ein starker Anstieg zu beobachten ist, zeigt die Nettoverzinsung dagegen im Mittel eine uneindeutige Entwicklung (siehe Tabelle 1.4). Des Weiteren deuten die Koeffizienten der Größe (Eigenmittelquote) in den Modellen (3) und (6) auf einen stark (schwach) positiven und statistisch signifikanten Zusammenhang hin. Im Gegensatz dazu scheint der Anteil des Einmalbeitragsgeschäfts keinen eindeutigen und signifikanten Einfluss auf die Nettoverzinsung zu haben. Ferner zeigt sich in Modell (1) ein negativer und signifikanter Zusammenhang zwischen Umlaufrendite und Nettoverzinsung von wesentlicher Größenordnung. So ist die Umlaufrendite über die Zeit hinweg stark rückläufig, wohingegen die Nettoverzinsung, wie bereits erwähnt, im Mittel einen uneindeutigen Verlauf zeigt (siehe Tabelle 1.4).

Tabelle 1.7 Regressionsoutput Laufende Durchschnittsverzinsung

	Erklärte Variable: Laufende Durchschnittsverzinsung					
	(1)	(2)	(3)	(4)	(5)	(6)
	FE	OLS	FE	FE	OLS	FE
AG		-0.082			0.008	
		(0.089)			(0.112)	
ör VU		-0.358***			-0.368***	
		(0.099)			(0.106)	
Umlaufrendite	0.090			0.198		
	(0.068)			(0.334)		
Größe	-0.535**	0.059*	0.008	0.261	0.072*	0.249
	(0.243)	(0.034)	(0.284)	(0.500)	(0.043)	(0.500)
Run-off	-0.207	-0.206	-0.105	-0.257	-0.224	-0.176
	(0.319)	(0.157)	(0.438)	(0.183)	(0.211)	(0.272)
Bestandsstruktur	-0.131***	0.020	0.043	-0.110**	0.013	0.182
	(0.019)	(0.029)	(0.043)	(0.042)	(0.027)	(0.144)
Einmalbeitragsgeschäft	0.003	0.002	0.003	-0.008	0.001	0.000
	(0.006)	(0.003)	(0.006)	(0.008)	(0.004)	(0.008)
Eigenmittelquote	0.005**	0.002**	0.003**	0.011**	0.003**	0.007**
	(0.002)	(0.001)	(0.002)	(0.004)	(0.001)	(0.003)
Stille Reserven	0.016**	0.023**	0.011	0.010	0.044***	-0.014
	(0.006)	(0.011)	(0.014)	(0.023)	(0.010)	(0.028)
Risiko in der Kapitalanlage				0.041	0.017	0.046
				(0.048)	(0.012)	(0.043)
Unternehmensindividuelle FE	Ja	Nein	Ja	Ja	Nein	Ja
Jahr FE	Nein	Ja	Ja	Nein	Ja	Ja
N	603	603	603	329	329	329
Adj. R^2	-	0.577	-	-	0.290	-
Within R^2	0.588	-	0.652	0.219	-	0.350
Between R^2	0.049	-	0.415	0.093	-	0.003
Overall R^2	0.110	-	0.544	0.117	-	0.068

Bemerkung: *p<0.1; **p<0.05; ***p<0.01

Erläuterungen: Unterscheidung zwischen den Rechtsformen (VVaG, AG, ör VU) anhand von Dummy-Variablen mit VVaG als Referenzkategorie. Die Schätzung der Regressionskoeffizienten erfolgt durch Modelle mit individuellen Effekten (1) & (4), Modelle mit zeitfixen Effekten (2) & (5) und Modelle mit individuellen und zeitfixen Effekten (3) & (6). Modell (1), (2) und (3) bezieht sich auf den Untersuchungszeitraum 2011 bis 2020, Modell (4), (5) und (6) auf den Untersuchungszeitraum 2016 bis 2020.

Die Ergebnisse der zweiten Regression (Tabelle 1.7) mit der laufenden Durchschnittsverzinsung als erklärte Variable weisen für den ör VU Dummy, ähnlich wie bei der Nettoverzinsung, im Modell (2) und (5) auf einen negativen und statistisch signifikanten Zusammenhang mit der laufenden Durchschnittsverzinsung hin. Insbesondere ör VUs scheinen im Vergleich zu den VVaGs eine weniger erfolgreiche Kapitalanlagepolitik implementiert zu haben. Zudem deutet der positiv statistisch signifikante Zusammenhang zwischen der Größenvariable und der laufenden Durchschnittsverzinsung im Modell (2) und (5) darauf hin, dass generell größere VUs eine höhere Kapitalanlageperformance erzielen. Des Weiteren lässt sich über alle Modelle hinweg ein signifikanter positiver Effekt der Eigenmittelquote auf die laufende Durchschnittsverzinsung feststellen, der jedoch von vernachlässigbarer Größenordnung ist. Ferner stellt sich im Modell (2) und (5) ein positiver sowie statistisch signifikanter Zusammenhang der stillen Reserven mit der laufenden Durchschnittsverzinsung ein. Grund hierfür könnte sein, dass bei der Hebung stiller Reserven nicht nur die Nettoverzinsung erhöht wird, sondern auch die laufende Durchschnittsverzinsung. Wie an anderer Stelle bereits erwähnt, fließen außerordentliche Erträge in Spezialfonds, die wiederum an die VUs ausgeschüttet werden, ebenfalls in die Berechnung dieser Kennzahl mit ein. Im Hinblick auf das Risiko in der Kapitalanlage ist, ähnlich wie bei der Nettoverzinsung, für alle entsprechenden Modelle, aufgrund der klassischen Risko-Rendite-Beziehung, ein zu erwartender positiver Zusammenhang mit der laufenden Durchschnittsverzinsung zu beobachten. Dieser ist jedoch in keinem der Modelle statistisch signifikant. Möglicherweise ist diese fehlende Signifikanz auf Verzerrungen durch die bereits erläuterte Ausschüttungspraxis von Spezialfonds zurückzuführen. Des Weiteren umfasst der Datensatz auch einige große AGs, die im Hinblick auf Solvency II zu den Anwendern von (partiellen) internen Modellen zählen, was zu gewissen Verzerrungen der Risikovariable führt.

Laufende Verzinsung

Tabelle 1.8 zeigt die Ergebnisse der Regression mit der laufenden Verzinsung als erklärte Variable. Sowohl der ör VU Dummy, der Run-off Dummy, die laufende Durchschnittsverzinsung und das Risiko in der Kapitalanlage weisen in einem oder mehreren der Modelle (2), (3), (5) und (6) auf einen statistisch signifikanten Zusammenhang mit der laufenden Verzinsung hin, welcher zudem bei allen vorgenannten Variablen von wesentlicher Größenordnung ist.

Für die laufende Durchschnittsverzinsung zeigt Modell (3) unter Berücksichtigung von unternehmensindividuellen- und zeitfixen Effekten einen positiven signifikanten Zusammenhang mit der laufenden Verzinsung. Wer kontinuierlich hohe Erträge in der Kapitalanlage generiert, lässt seine VNs auch durch eine höhere laufende Verzinsung daran partizipieren. Des Weiteren

ist ein positiver Zusammenhang zwischen dem Risiko in der Kapitalanlage und der laufenden Verzinsung in Modell (6) zu erkennen, was mit der überproportionalen Relevanz des Kapitalanlageergebnis bei der Beteiligung der VNs an den Gesamterträgen zu erklären ist.[22] Die laufende Verzinsung scheint für den Untersuchungszeitraum 2016 bis 2020 auch im Vergleich zu den Regressionen zur Kapitalanlageperformance (Regressionen zur Netto- und laufenden Durchschnittsverzinsung) im Zusammenhang mit dem Risiko in der Kapitalanlage der geeignetere Indikator zu sein.[23] Dies könnte darauf zurückzuführen sein, dass im Gegensatz zur Netto- und laufenden Durchschnittsverzinsung, die laufende Verzinsung weniger von den bereits erläuterten Verzerrungen (Realisierung von stillen Reserven zur Finanzierung der ZZR) betroffen ist. Im Vergleich zur laufenden Durchschnittsverzinsung ist der Zusammenhang zwischen Nettoverzinsung und laufender Verzinsung in den Modellen (2), (3), (5) und (6) insignifikant. Die statistische Insignifikanz der Nettoverzinsung lässt sich möglicherweise damit erklären, dass diese aufgrund der verstärkten Zuführungen der ZZR mittels Realisierung stiller Reserven zu Beginn des Untersuchungszeitraums gestiegen und später durch die Reformierung der Berechnungsmethodik der ZZR (sog. Korridormethode) im Jahr 2018 wieder gesunken ist (Assekurata Assekuranz Rating-Agentur GmbH, 2019).
Die Dummy-Variablen der ör VUs sowie der Run-off VUs weisen in den Modellen (2), (5) bzw. (6) auf eine im Vergleich zu den VVaGs bzw. Nicht-Run-off VUs geringere laufende Verzinsung hin.[24] Ein möglicher Einflussfaktor hinsichtlich der ör VUs könnte die im Unterschied zu den VVaGs niedrigere laufende Durchschnittsverzinsung in Verbindung mit einem geringeren Risikoappetit in der Kapitalanlage sein (vgl. Unterabschnitt Risiko in der Kapitalanlage im Rechtsformvergleich). Bezüglich der Run-off VUs vermuten insbesondere Verbraucherschützer, wie bereits im Kapitel zu den theoretischen Einflussfaktoren erwähnt, dass diese bei der Überschussbeteiligung der VNs lediglich die gesetzlichen Mindestquoten erfüllen. Die vorliegende Datenbasis kann zumindest eine gegenüber Nicht-Run-off VUs geringere laufende Verzinsung empirisch bestätigen. Für die allgemeine Größenvariable lässt sich, im Gegensatz zu den Regressionen zur Netto- und laufenden Durchschnittsverzinsung, kein (positiver) Größeneffekt beobachten.

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[22] Nach den Angaben gemäß § 15 Mindestzuführungsverordnung beträgt der Anteil der Kapitalerträge an den gesamten Erträgen zur Beteiligung der Versicherten über alle in die Untersuchung einbezogenen VUs hinweg im Mittel (gewichtetes Mittel) im Zeitraum von 2014 bis 2020 über 83% (siehe Anhang Tabelle 1.14).
[23] Regressionen zur laufenden Verzinsung ohne die Anwender von internen Risikomodellen bestätigen den positiv signifikanten Zusammenhang zwischen laufender Verzinsung und dem Risiko in der Kapitalanlage (siehe Anhang Tabelle 1.19).
[24] Die Dummy Variablen der ör VUs weisen auch bei den jährlichen OLS-Regressionsmodellen auf eine, im Vergleich zu den VVaGs geringere laufende Verzinsung hin (siehe Anhang Tabelle 1.17).

Tabelle 1.8 Regressionsoutput Laufende Verzinsung

	Erklärte Variable: Laufende Verzinsung					
	(1) FE	(2) OLS	(3) FE	(4) FE	(5) OLS	(6) FE
AG		0.029			0.087	
		(0.055)			(0.060)	
ör VU		-0.171***			-0.162*	
		(0.061)			(0.082)	
Umlaufrendite	0.290***			-0.034		
	(0.041)			(0.133)		
Größe	-0.269*	-0.014	0.056	-0.187	-0.006	-0.107
	(0.157)	(0.015)	(0.160)	(0.180)	(0.021)	(0.158)
Run-off	-0.228	-0.304***	-0.206	-0.294**	-0.288**	-0.250**
	(0.232)	(0.106)	(0.186)	(0.140)	(0.143)	(0.121)
Bestandsstruktur	-0.102***	-0.009	0.004	-0.128***	-0.010	0.013
	(0.011)	(0.015)	(0.020)	(0.013)	(0.016)	(0.027)
Einmalbeitragsgeschäft	0.009**	0.004**	0.009***	0.002	0.005**	0.004
	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)
Eigenmittelquote	0.003***	0.003***	0.002***	0.001	0.003***	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Stille Reserven	0.013***	0.007	0.009	0.009	0.012*	0.002
	(0.003)	(0.005)	(0.007)	(0.008)	(0.007)	(0.007)
Umsatzrendite	-0.002	0.009***	0.002	-0.002	0.008***	-0.002
	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)
Aktionärsausschüttungsquote	-0.001	0.002**	-0.000	-0.000	0.002*	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Abschlussaufwendungen	0.003	0.006	0.007	-0.015	0.005	-0.003
	(0.007)	(0.004)	(0.006)	(0.016)	(0.006)	(0.012)
Verwaltungsaufwendungen	-0.026	-0.009	-0.022	-0.030	-0.013	-0.019
	(0.031)	(0.012)	(0.031)	(0.028)	(0.014)	(0.028)
Produktstruktur	0.001	-0.001	0.001	-0.005	-0.002	-0.001
	(0.003)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)
Nettoverzinsung	0.055***	-0.028	-0.008	0.022	-0.035	-0.017
	(0.018)	(0.027)	(0.022)	(0.017)	(0.031)	(0.017)
Laufende Durchschnittsverzinsung	0.099***	0.069	0.061**	0.051**	0.042	0.021
	(0.033)	(0.042)	(0.024)	(0.020)	(0.039)	(0.021)
Risiko in der Kapitalanlage				0.010	0.009	0.011**
				(0.007)	(0.007)	(0.005)
Unternehmensindividuelle FE	Ja	Nein	Ja	Ja	Nein	Ja
Jahr FE	Nein	Ja	Ja	Nein	Ja	Ja
N	603	603	603	329	329	329
Adj. R^2	-	0.874	-	-	0.524	-
Within R^2	0.907	-	0.934	0.682	-	0.769
Between R^2	0.265	-	0.450	0.018	-	0.021
Overall R^2	0.566	-	0.787	0.095	-	0.244
						Bemerkung: *p<0.1; **p<0.05; ***p<0.01

Erläuterungen: Unterscheidung zwischen den Rechtsformen (VVaG, AG, ör VU) anhand von Dummy-Variablen mit VVaG als Referenzkategorie. Die Schätzung der Regressionskoeffizienten erfolgt durch Modelle mit individuellen Effekten (1) & (4), Modelle mit zeitfixen Effekten (2) & (5) und Modelle mit individuellen und zeitfixen Effekten (3) & (6). Modell (1), (2) und (3) bezieht sich auf den Untersuchungszeitraum 2011 bis 2020, Modell (4), (5) und (6) auf den Untersuchungszeitraum 2016 bis 2020.

Für die Variablen ‚Eigenmittelquote, Stille Reserven und Umsatzrendite' kann in mindestens einem der Modelle (2), (3), (5) und (6) ein positiver signifikanter Zusammenhang mit der laufenden Verzinsung beobachtet werden, was im Einklang mit den vorangegangenen theoretischen Überlegungen steht. Auffallend ist das Ergebnis der Aktionärsausschüttungsquote. Instinktiv ist bei dieser Variable von einem eher negativen Zusammenhang mit der laufenden Verzinsung auszugehen. Möglicherweise ist der schwach positiv signifikante Zusammenhang in Modell (2) und (5) auf Verzerrungen durch die VVaGs zurückzuführen, da Gewinne bei dieser Rechtsform für gewöhnlich thesauriert werden. Die zwei Kostenvariablen ‚Abschluss- und Verwaltungsaufwendungen' zeigen je nach Modell einen schwach positiven bzw. negativen Zusammenhang mit der laufenden Verzinsung auf, welcher jedoch in keinem der Modelle von statistischer Signifikanz geprägt ist.

Im Hinblick auf die drei Heterogenisierungsfaktoren (Bestandsstruktur, Einmalbeitragsgeschäft, Produktstruktur) lässt sich ein gemischtes Bild erkennen. Während die Variablen ‚Bestands- und Produktstruktur' in den Modellen (2), (3), (5) und (6) einen statistisch insignifikanten und uneindeutigen Zusammenhang aufweisen, zeigt sich für die Variable ‚Einmalbeitragsgeschäft' in den Modellen (2), (3) und (5) ein positiver signifikanter Zusammenhang, jedoch von geringer Stärke. Der in der Theorie vermutete negative Einfluss der Heterogenisierungsfaktoren lässt sich in dieser Untersuchung somit empirisch nicht bestätigen. Ein weiterer wichtiger Faktor bei der Erklärung der laufenden Verzinsung ist die Variation innerhalb der einzelnen VUs über die Zeit (sog. within-variation). So deuten die sehr hohen ‚Within R^2' Werte der Modelle (1) und (3) darauf hin, dass ein Großteil der Erklärungskraft bei allen Modellen auf die zeitlichen Dynamiken innerhalb der VUs zurückzuführen ist. Dies wird insbesondere bei dem stark positiven und statistisch signifikanten Zusammenhang zwischen der Umlaufrendite und der laufenden Verzinsung im Modell (1) sichtbar. So passten die VUs im Zuge des über die Jahre sinkenden Zinsniveaus auch die laufende Verzinsung nach unten an.

Eine bisher außer Acht gelassene, jedoch nicht zu vernachlässigende Besonderheit stellt der Ablauf der Überschussdeklaration dar. So wird die Überschussbeteiligung bzw. laufende Verzinsung i. d. R. schon während des laufenden Geschäftsjahres für das Folgejahr verbindlich festgelegt. Um mögliche systematisch Verzerrungen der Schätzungen auszuschließen, wurden weitere Regressionsanalysen mit der laufenden Verzinsung des Folgejahres (y_{it+1}) durchgeführt. Der Output dieser Regressionen zeigt für alle Variablen keine wesentlichen Abweichungen zu den bisherigen Ergebnissen bzw. Erkenntnissen (siehe Anhang Tabelle 1.20).

1.5.3 Ergänzende (deskriptive) Analysen

Risiko in der Kapitalanlage im Rechtsformvergleich

Um potenzielle Unterschiede zwischen den Rechtsformen hinsichtlich des Risikoappetits in der Kapitalanlage sichtbar zu machen, zeigt Tabelle 1.9 die gewichteten Mittel der Variable ‚Risiko in der Kapitalanlage' über den Untersuchungszeitraum 2016 bis 2020.[25] Eine Besonderheit stellen dabei VUs, die im Rahmen von Solvency II (partielle) interne Bewertungsmodelle nutzen, dar. Anwender der (partiellen) internen Modelle können Diversifikationseffekte umfassender berücksichtigen und somit ihr individuelles Risikoprofil besser abbilden, was i. d. R. zu einem geringeren Risikoproxy dieser VUs führt (Liebwein, 2006; Zimmermann & Schramm, 2015). Zur besseren Vergleichbarkeit wurden deshalb die Rechtsformen der AGs und VVaGs zusätzlich um die Anwender von (partiellen) internen Modellen und VUs im Run-off bereinigt.[26] Es gilt jedoch zu beachten, dass die (partiellen) internen Modelle überwiegend von großen AGs, die tendenziell eine überdurchschnittlich hohe Risikobereitschaft in der Kapitalanlage aufweisen, genutzt werden. Folglich ist der Risikoproxy der Rechtsform AG (adjustiert) durch die nicht Berücksichtigung dieser großen AGs im Vergleich zu den anderen Rechtsformen weiterhin nach unten verzehrt und deshalb schwer zu interpretieren.[27] Der Risikoproxy der ör VUs ist von diesen Anpassungen nicht betroffen, da das Aggregat dieser Rechtsform weder Anwender (partieller) interner Modelle noch VUs im Run-off beinhaltet.

Im Vergleich zur Rechtsform VVaG und VVaG (adjustiert) weist die Rechtsform ör VU ein geringeres gewichtetes Mittel für die Variable ‚Risiko in der Kapitalanlage' auf. Der geringere Risikoappetit von ör VUs in der Kapitalanlage könnte sich langfristig negativ auf die Anlagenrendite auswirken und somit eine potenzielle Ursache für den im vorherigen Kapitel gezeigten negativen und statistisch signifikanten Zusammenhang des ör VU Dummys mit der laufenden Verzinsung von VVaGs sein. Ausführliche Erläuterungen zur Ermittlung des Risikoproxys sind im Anhang zu finden.

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[25]Die Gewichtung erfolgt hierbei anhand der Solvency II Position Anlagen (Position R0070) innerhalb der jeweiligen Rechtsform, um die Marktstruktur hinsichtlich der Kapitalanlagevolumina (Größe) der einzelnen VUs besser abbilden zu können.

[26]I. d. R. führt die Einstellung des Neugeschäfts bei Run-off VUs zu einem relativ stabilen Ablaufprofil der Passivseite, was den Run-off Unternehmen eine Reduzierung der Durationslücke zwischen Aktiv- und Passivseite sowie eine optimierte Liquiditätssteuerung ermöglicht (Deutsche Aktuarvereinigung e.V., 2018; Zielke, 2021) und sich folglich positiv auf den Risikoproxy auswirken kann.

[27] So wird z. B. die Allianz Lebensversicherungs-AG aufgrund der Anwendung des (partiellen) Modells bei der Rechtsform AG (adjustiert) nicht berücksichtigt. Laut eigenen Angaben lag die Aktienquote der Allianz Lebensversicherung AG im Geschäftsjahr 2018 dreimal so hoch wie der Branchendurchschnitt (Allianz Deutschland AG, 2018), weshalb bei Anwendung des Standardmodells erhebliche Auswirkungen auf den Risikoproxy zu erwarten wären.

Tabelle 1.9 Risiko in Prozent der Anlagen gemäß Solvency II

Rechtsform	Risiko in der Kapitalanlage (% der Anlagen gemäß Solvency II)
AG	6.0%
AG (adjustiert)[28]	9.5%
VVaG	11.3%
VVaG (adjustiert)[28]	12.1%
ör VU[28]	10.2%

Erläuterungen: Risiko als Proxy für die Risiken in der Kapitalanlage (nach dem Solvency II-Standardmodell) als gewichtetes Mittel je Rechtsform über den Untersuchungszeitraum 2016-2020. Aggregaten AG (adjustiert), VVaG (adjustiert) und ör VU ohne die Anwender von (partiellen) internen Modellen und Run-off Gesellschaften.

RFB Analyse

Wie im Kapitel zu den theoretischen Einflussfaktoren angedeutet, ist es grundsätzlich schwierig, die Höhe vertragsindividueller Schlussüberschüsse zu prognostizieren, weshalb diese bis jetzt keine Betrachtung fanden. Da die Analyse zur Höhe der Überschussbeteiligung jedoch zeigt, dass das Aggregat der ör VUs eine statistisch signifikant niedrigere laufende Verzinsung als die AGs und VVaGs aufweisen, stellt sich die Frage, ob im Gegenzug jedoch etwaige Schlussüberschüsse an die VNs höher sind. Um sich dieser Frage anzunähern, wurden deshalb drei verschiedene Metriken im Verhältnis zu den gebuchten Bruttobeiträgen betrachtet. Diese werden innerhalb der jeweiligen Rechtsform mit den gebuchten Bruttobeiträgen gewichtet, um, analog zum vorherigen Unterabschnitt, die Marktstruktur besser abbilden zu können. Die Summe des ‚erweiterten Schlussüberschussanteilfonds' (erweiterter SÜAF) berechnet sich in dieser Analyse aus den Positionen lit. b bis g der RfB gemäß § 28 Abs. 8 Satz 2 RechVersV und stellt einen Indikator für die potenzielle Höhe des Schlussüberschusses dar.[29] Die Position der ‚freien RfB' bezieht sich auf lit. h gemäß § 28 Abs. 8 Satz 2 RechVersV und wird von den VUs grundsätzlich für die eingangs erläuterte Glättungsfunktion der RfB genutzt. Die Position ‚Summe RfB' zeigt die Höhe der gesamten RfB der VUs und bezieht sich auf lit. a bis h gemäß des genannten Paragrafen. Direktgutschriften haben, wie bereits erwähnt, im Zuge der Niedrigzinsphase in der klassischen Lebensversicherung erheblich an Bedeutung verloren und werden deshalb bei diesem Vergleich explizit nicht berücksichtigt. Zudem werden Direktgutschriften auf die laufende Überschussbeteiligung des jeweiligen Jahres angerechnet (Sachverständigenrat, 2015) und wurden somit in der vorherigen Analyse zur laufenden Verzinsung indirekt miteinbezogen. Ferner sei noch einmal drauf hinzuweisen, dass nicht festgelegte Überschussanteile (freie RfB, SÜAF) nach § 93 Abs. 1 VAG grundsätzlich als Eigenmittel anerkannt werden. Das ist insofern von Relevanz, da vor allem VUs mit schwächeren Solvabilitätsquoten zum Schutz

[28] Aggregat beinhaltet keine Anwender von (partiellen) internen Modellen und keine Run-off Gesellschaften.
[29] I. d. R. umfasst der SÜAV lediglich die Positionen lit. e bis g.

ihrer Eigenmittel dazu tendieren könnten, die VNs nur im geringen Ausmaß an der freien RfB und dem SÜAF zu beteiligen (Weinmann, 2019).

Tabelle 1.10 Struktur der RfB

Rechtsform	Summe erweiterter SÜAF (% gebuchten Bruttobeiträge)	Freie RfB (% gebuchten Bruttobeiträge)	Summe RfB (% gebuchten Bruttobeiträge)
AG	22.8%	27.3%	56.3%
VVaG	27.4%	28.2%	62.6%
ör VU	28.0%	22.2%	54.9%

Erläuterungen: Summe erweiterter SÜAF, Freie RfB und gesamte RfB in Relation zu den gebuchten Bruttobeiträgen als gewichtetes Mittel je Rechtsform über den Untersuchungszeitraum 2011 bis 2020.

Tabelle 1.10 zeigt die gewichteten Mittel nach Rechtsform für den gesamten Untersuchungszeitraum von 2011 bis 2020. Die ör VUs weisen für die erste Metrik (Summe erweiterter SÜAV) die höchsten Quoten auf. Bei Betrachtung der ‚Summe RfB' weist das Aggregat der VVaGs die höchsten Quoten auf. Anhand dieser Ergebnisse und des Einbezugs o. g. Faktoren lässt sich insgesamt nicht eindeutig feststellen, wie sich die Höhe des Schlussüberschusses darstellt. Dennoch lassen die Zahlen vermuten, dass ör VUs im Vergleich zu den AGs und VVaGs einen höheren Schlussüberschuss gewähren. Es erscheint jedoch eher unwahrscheinlich, dass die ör VUs durch einen potenziell etwas höheren Schlussüberschuss ihre tendenziell niedrigere laufende Verzinsung, insbesondere bei langlaufenden Verträgen, kompensieren können und so bei einer ähnlichen oder gar höheren Gesamtverzinsung für die VNs landen.
Die hier aufgeführten Erkenntnisse stellen sich sehr ähnlich dar, wenn alle vorgenannten Metriken in Relation zur DR berechnet werden.

1.6 Zusammenfassung und Schlussbemerkung

Die vorangegangenen Analysen haben gezeigt, dass die Kapitalanlageperformance und Höhe der laufenden Verzinsung bei klassischen Lebensversicherungspolicen ein komplexes Zusammenspiel diverser Faktoren ist. Die Kapitalanlageperformance wird hierbei durch die Nettoverzinsung und die laufende Durchschnittsverzinsung approximiert. Die laufende Verzinsung approximiert die Höhe der jährlichen (laufenden) Rendite für die Versicherungsnehmer. Sowohl bei der Kapitalanlageperformance als auch der laufenden Verzinsung spielt die Rechtsform der VUs eine zentrale Rolle. Bei öffentlich-rechtlichen Versicherungsunternehmen ist im Vergleich zu den VVaGs sowohl die Netto- und laufende Durchschnittsverzinsung als auch die laufende Verzinsung an die Versicherungsnehmer im Untersuchungszeitraum geringer. Der positive Zusammenhang zwischen laufender Durchschnittsverzinsung und laufender Verzinsung deutet darauf hin, dass eine nachhaltig konkurrenzfähige Überschussbeteiligung eine solide Kapitalanlageperformance voraussetzt. Ein möglicher Einflussfaktor für die niedrigere laufende Verzinsung von öffentlich-rechtlichen Versicherungsunternehmen könnte folglich der, im Unterschied zu den VVaGs, geringere Risikoappetit in der Kapitalanlage sein. Zudem wirkt sich grundsätzlich das Vorhandensein stiller Reserven und die Höhe der Eigenmittelquote positiv auf die Kapitalanlageperformance und die laufende Verzinsung aus. Im Gegensatz dazu scheinen die Heterogenisierungsfaktoren ‚Bestandsstruktur, Einmalbeitragsgeschäft und Produktstruktur' von geringerer Bedeutung zu sein. Lediglich der Faktor ‚Einmalbeitragsgeschäft' weist auf einen schwach positiven Zusammenhang mit der laufenden Verzinsung des Kollektivs hin. Der in der Theorie vermutete negative Einfluss der Heterogenisierungsfaktoren lässt sich in dieser Untersuchung somit insgesamt empirisch nicht bestätigen.

Es bleibt anzumerken, dass der Untersuchungszeitraum gänzlich in der Niedrigzinsphase liegt und das Ergebnis der Analysen aufgrund tiefgreifender regulatorischer Maßnahmen wie der Einführung einer Zinszusatzreserve, dem Lebensversicherungsreformgesetz und der damit einhergehenden Änderung der Mindestzuführungsverordnung sowie der Einführung von Solvency II beeinflusst wird. Aus diesem Grund ist abzuwarten, ob zukünftige Analysen ähnliche Erkenntnisse hervorbringen. Eine erneute Untersuchung mit erweiterter Datenbasis erscheint daher sinnvoll. Es sollte analysiert werden, ob die hier dargestellten Ergebnisse robust gegenüber einem Untersuchungszeitraum sind, der die Zinswende im Jahr 2022 beinhaltet und weitere Datenpunkte für Run-off Gesellschaften bereithält. Weiterführende Arbeiten, die etwa Mediationsanalysen und Interaktionsterme zur Identifikation von Kausalzusammenhängen umfassen, eine zusätzliche Unterscheidung zwischen internem und externem Run-off treffen oder alternative Risikomaße sowie Performanceindikatoren analysieren, erscheinen ebenfalls diskutabel.

1.7 Anhang

1.7.1 Weiterführende Statistiken

Tabelle 1.11 Jährliche Marktanteile der Datenbasis im Untersuchungszeitraum

Jahr	Gebuchte Bruttobeiträge (direkt) - Gesamt (EUR Mio.)	Gebuchte Bruttobeiträge (direkt) - Datensatz (EUR Mio.)	Marktabdeckung (%)
2020	98,079.09	94,844.21	96.7%
2019	97,634.53	94,300.50	96.6%
2018	87,699.79	83,450.35	95.2%
2017	85,479.04	80,322.00	94.0%
2016	85,411.06	79,801.01	93.4%
2015	86,859.33	80,256.39	92.4%
2014	89,204.96	71,499.87	80.2%
2013	86,341.48	67,725.78	78.4%
2012	82,986.17	60,242,05	72.6%
2011	82,126.72	64,186.52	78.2%
Durchschnittliche Marktabdeckung für den Zeitraum 2011 bis 2020 (gewichtetes Mittel)			88.1%

Erläuterungen: Berechnung der Marktanteile auf Basis der Summe der gebuchten Bruttobeiträge im selbst abgeschlossenen Versicherungsgeschäft im Bereich Leben laut BaFin (Bundesanstalt für Finanzdienstleistungsaufsicht, 2021b).

Tabelle 1.12 Überblick Teilaggregate

Jahr	VUs Gesamt	Run-off	Nicht Run-off	AG	VVaG	ör VU
2020	67	9	58	26	31	10
2019	67	9	58	27	30	10
2018	66	7	59	26	30	10
2017	65	4	61	25	30	10
2016	64	2	62	23	31	10
2015	61	2	59	23	28	10
2014	57	2	55	20	27	10
2013	55	2	53	18	28	9
2012	49	2	47	17	25	7
2011	52	1	51	18	28	6

Erläuterungen: Anzahl der Beobachtungen nach Jahr und Teilaggregat.

Tabelle 1.13 Überblick aller in die Untersuchung einbezogenen VUs

VVaG			
1	Alte Leipziger Lebensversicherung	18	Itzehoer Lebensversicherung
2	Barmenia Lebensversicherung	19	Lebensversicherung von 1871
3	Bayerische Beamten Lebensversicherung	20	LVM Lebensversicherung
4	BL die Bayerische Lebensversicherung	21	Mecklenburgische Lebensversicherung
5	Concordia oeco Lebensversicherung	22	MÜNCHENER VEREIN Lebensversicherung
6	Continentale Lebensversicherung	23	neue leben Lebensversicherung
7	Debeka Lebensversicherungsverein	24	LPV Lebensversicherung
8	DEVK Allgemeine Lebensversicherung	25	SIGNAL IDUNA Lebensversicherung
9	DEVK Deutsche Eisenbahn Lebensversicherung	26	Stuttgarter Lebensversicherung
10	DIREKTE LEBEN Versicherung	27	Süddeutsche Lebensversicherung
11	Europa Lebensversicherung	28	TARGO Lebensversicherung
12	Gothaer Lebensversicherung	29	uniVersa Lebensversicherung
13	Hannoversche Lebensversicherung	30	VOLKSWOHL BUND Lebensversicherung
14	HanseMerkur Lebensversicherung	31	VPV Lebensversicherung
15	HUK-COBURG Lebensversicherung	32	VRK Lebensversicherung
16	IDEAL Lebensversicherung	33	WGV Lebensversicherung
17	INTER Lebensversicherung	34	WWK Lebensversicherung
AG			
1	Allianz Lebensversicherung	16	Heidelberger Lebensversicherung
2	AXA Lebensversicherung	17	HELVETIA schweizerische Lebensversicherung
3	Baloise Lebensversicherung	18	InterRisk Lebensversicherung
4	Condor Lebensversicherung	19	Karlsruher Lebensversicherung
5	Cosmos Lebensversicherung	20	myLife Lebensversicherung
6	Credit Life	21	NÜRNBERGER Lebensversicherung
7	Deutsche Ärzteversicherung	22	Proxalto Lebensversicherung
8	Dialog Lebensversicherung	23	R+V Lebensversicherung
9	Entis Lebensversicherung	24	Rheinland Lebensversicherung
10	ERGO Direkt Lebensversicherung	25	Skandia Lebensversicherung
11	ERGO Lebensversicherung	26	Swiss Life
12	ERGO Vorsorge Lebensversicherung	27	Victoria Lebensversicherung
13	Frankfurter Münchener Lebensversicherung	28	Württembergische Lebensversicherung
14	Frankfurter Lebensversicherung	29	Zurich Deutscher Herold Lebensversicherung
15	Generali Deutschland Lebensversicherung		
ör VU			
1	Bayern-Versicherung Lebensversicherung	7	Provinzial NordWest Lebensversicherung
2	Ö. Lebensversicherung Berlin-Brandenburg	8	Provinzial Rheinland Lebensversicherung
3	Ö. Lebensversicherung Braunschweig	9	Sparkassen-Vers. Sachsen Lebensversicherung
4	Ö. Lebensversicherung Sachsen-Anhalt	10	SV SparkassenVersicherung Lebensversicherung
5	Ö. Lebensversicherungsanstalt Oldenburg		
6	Provinzial Lebensversicherung Hannover		

Erläuterungen: Sortierung nach Rechtsform und alphabetischer Reihenfolge. Die Zuordnung der Rechtsform zu den einzelnen VUs erfolgt anhand der Rechtsform der Obergesellschaft bzw. der rechtsformspezifischen Grundausrichtung des Konzerns bzw. der Gruppe. Für jedes VU liegt mindestens eine vollständige Beobachtung (Jahr) vor.

Tabelle 1.14 Beteiligung der Versicherten an den Erträgen gemäß § 15 Mindestzuführungsverordnung

Rechtsform	Anzurechnende Kapitalerträge (% der Erträge)	Risikoergebnis (% der Erträge)	Übriges Ergebnis (% der Erträge)	Summe	Rechnungszins (% der Erträge)
AG	84.35%	12.90%	2.75%	100.00%	71.64%
VVaG	78.49%	16.76%	4.75%	100.00%	77.87%
ör VU	86.84%	11.84%	1.32%	100.00%	83.73%
Gesamt	83.00%	13.85%	3.16%	100.00%	74.54%

Erläuterungen: Die Berechnungen basieren auf den Angaben zur Beteiligung der Versicherten an den Erträgen gemäß § 15 Mindestzuführungsverordnung aller in die Untersuchung mit einbezogenen VUs über den Zeitraum 2014 bis 2020 (gewichtete Mittelwerte). Aufteilung nach den Ertragsquellen: anzurechnende Kapitalerträge, Risikoergebnis und übrigen Ergebnis.

Tabelle 1.15 Korrelationsmatrix (2016 bis 2020)

	AG	ör VU	Umlaufrendite	Größe	Run-off	Bestandsstruktur	Einmalbeitragsgeschäft	Eigenmittelquote	Stille Reserven	Umsatzrendite	Aktionärsausschüttungsquote	Abschlussaufwendungen	Verwaltungsaufwendungen	Produktstruktur	Nettoverzinsung	Laufende Durchschnittsverzinsung	Risiko in der Kapitalanlage
AG	1	-0.3	-0.0	0.2	0.3	0.1	-0.1	-0.2	-0.1	0.3	0.3	-0.0	0.1	0.3	-0.0	-0.0	-0.1
ör VU	-0.3	1	0.0	-0.0	-0.1	-0.1	0.4	-0.2	0.1	-0.2	-0.1	-0.1	-0.2	-0.1	-0.1	-0.2	-0.1
Umlaufrendite	-0.0	0.0	1	-0.0	-0.1	-0.3	-0.1	0.0	-0.5	-0.1	-0.1	-0.0	0.0	-0.1	-0.0	0.2	-0.1
Größe	0.2	-0.0	-0.0	1	-0.2	-0.1	0.2	-0.3	0.2	-0.1	0.1	0.1	-0.1	0.2	0.1	0.1	-0.2
Run-off	0.3	-0.1	-0.1	-0.2	1	0.5	-0.2	0.3	-0.0	0.3	0.3	-0.4	0.2	0.0	0.0	-0.1	0.1
Bestandsstruktur	0.1	-0.1	-0.3	-0.1	0.5	1	-0.4	0.2	0.1	0.4	0.3	-0.3	-0.0	0.2	0.0	-0.1	0.3
Einmalbeitragsgeschäft	-0.1	0.4	-0.1	0.2	-0.2	-0.4	1	-0.1	0.1	-0.3	-0.1	0.1	0.0	-0.0	0.0	-0.0	-0.0
Eigenmittelquote	-0.2	-0.2	0.0	-0.3	0.3	0.2	-0.1	1	0.0	-0.1	-0.1	-0.3	0.2	-0.3	0.2	0.2	0.0
Stille Reserven	-0.1	0.1	-0.5	0.2	-0.0	0.1	0.1	0.0	1	-0.2	-0.1	-0.1	0.1	-0.2	0.2	0.1	-0.3
Umsatzrendite	0.3	-0.2	-0.1	-0.1	0.3	0.4	-0.3	-0.1	-0.2	1	0.6	-0.0	-0.0	0.2	-0.0	-0.0	0.3
Aktionärsausschüttungsquote	0.3	-0.1	-0.1	0.1	0.3	0.3	-0.1	-0.1	-0.1	0.6	1	0.0	0.2	0.1	-0.0	0.1	0.0
Abschlussaufwendungen	-0.0	-0.1	-0.0	0.1	-0.4	-0.3	0.1	-0.3	-0.1	-0.0	0.0	1	0.1	0.2	-0.2	-0.1	0.0
Verwaltungsaufwendungen	0.1	-0.2	0.0	-0.1	0.2	-0.0	0.0	0.2	0.1	-0.0	0.2	0.1	1	-0.0	-0.0	-0.0	-0.2
Produktstruktur	0.3	-0.1	-0.1	0.2	0.0	0.2	-0.0	-0.3	-0.2	0.2	0.1	0.2	-0.0	1	0.0	-0.1	0.4
Nettoverzinsung	-0.0	-0.1	-0.0	0.1	0.0	0.0	0.0	0.2	0.2	-0.0	-0.0	-0.2	-0.0	0.0	1	0.6	-0.0
Laufende Durchschnittsverzinsung	-0.0	-0.2	0.2	0.1	-0.1	-0.1	-0.0	0.2	0.1	-0.0	0.1	-0.1	-0.0	-0.1	0.6	1	-0.0
Risiko in der Kapitalanlage	-0.1	-0.1	-0.1	-0.2	0.1	0.3	-0.0	0.0	-0.3	0.3	0.0	0.0	-0.2	0.4	-0.0	-0.0	1

Erläuterungen: Paarweise Korrelationen der über den Untersuchungszeitraum 2016-2020 einbezogenen unabhängigen Variablen, einschließlich der Variable ‚Risiko in der Kapitalanlage' (N = 329).

Tabelle 1.16 Korrelationsmatrix ohne die Anwender interner Modelle (2016 bis 2020)

	AG	ör VU	Umlaufrendite	Größe	Run-off	Bestandsstruktur	Einmalbeitragsgeschäft	Eigenmittelquote	Stille Reserven	Umsatzrendite	Aktionärsausschüttungsquote	Abschlussaufwendungen	Verwaltungsaufwendungen	Produktstruktur	Nettoverzinsung	Laufende Durchschnittsverzinsung	Risiko in der Kapitalanlage
AG	1	-0.3	-0.0	0.0	0.4	0.1	-0.1	-0.1	-0.1	0.2	0.3	-0.0	0.4	0.3	-0.1	-0.1	-0.0
ör VU	-0.3	1	0.0	0.1	-0.2	-0.2	0.5	-0.2	0.2	-0.2	-0.1	-0.0	-0.3	-0.1	-0.1	-0.2	-0.2
Umlaufrendite	-0.0	0.0	1	-0.0	-0.1	-0.3	-0.1	0.0	-0.5	-0.1	-0.1	0.0	0.0	-0.1	-0.0	0.1	-0.1
Größe	0.0	0.1	-0.0	1	-0.1	-0.0	0.1	-0.3	0.2	-0.1	-0.0	0.1	-0.2	0.2	0.1	0.1	-0.0
Run-off	0.4	-0.2	-0.1	-0.1	1	0.5	-0.3	0.3	-0.0	0.4	0.4	-0.4	0.4	0.1	0.1	-0.1	0.1
Bestandsstruktur	0.1	-0.2	-0.3	-0.0	0.5	1	-0.5	0.1	0.1	0.6	0.5	-0.3	0.1	0.2	-0.0	-0.1	0.2
Einmalbeitragsgeschäft	-0.1	0.5	-0.1	0.1	-0.3	-0.5	1	-0.2	0.1	-0.2	-0.2	0.2	-0.2	0.0	0.0	-0.1	0.1
Eigenmittelquote	-0.1	-0.2	0.0	-0.3	0.3	0.1	-0.2	1	-0.0	-0.0	-0.0	-0.4	0.1	-0.3	0.2	0.2	-0.1
Stille Reserven	-0.1	0.2	-0.5	0.2	-0.0	0.1	0.1	-0.0	1	-0.2	-0.1	-0.1	0.1	-0.2	0.2	0.1	-0.4
Umsatzrendite	0.2	-0.2	-0.1	-0.1	0.4	0.6	-0.2	-0.0	-0.2	1	0.6	-0.1	0.0	0.3	-0.0	-0.0	0.4
Aktionärsausschüttungsquote	0.3	-0.1	-0.1	-0.0	0.4	0.5	-0.2	-0.0	-0.1	0.6	1	-0.1	0.0	0.2	0.0	0.1	0.2
Abschlussaufwendungen	-0.0	-0.0	0.0	0.1	-0.4	-0.3	0.2	-0.4	-0.1	-0.1	-0.1	1	-0.1	0.1	-0.2	-0.1	0.1
Verwaltungsaufwendungen	0.4	-0.3	0.0	-0.2	0.4	0.1	-0.2	0.1	0.1	0.0	0.0	-0.1	1	-0.0	0.1	0.0	-0.1
Produktstruktur	0.3	-0.1	-0.1	0.2	0.1	0.2	0.0	-0.3	-0.2	0.3	0.2	0.1	-0.0	1	-0.1	-0.2	0.6
Nettoverzinsung	-0.1	-0.1	-0.0	0.1	0.1	-0.0	0.0	0.2	0.2	-0.0	0.0	-0.2	0.1	-0.1	1	0.6	-0.0
Laufende Durchschnittsverzinsung	-0.1	-0.2	0.1	0.1	-0.1	-0.1	-0.1	0.2	0.1	-0.0	0.1	-0.1	0.0	-0.2	0.6	1	0.1
Risiko in der Kapitalanlage	-0.0	-0.2	-0.1	-0.0	0.1	0.2	0.1	-0.1	-0.4	0.4	0.2	0.1	-0.1	0.6	-0.0	0.1	1

Erläuterungen: Paarweise Korrelationen der über den Untersuchungszeitraum 2016-2020 einbezogenen unabhängigen Variablen, einschließlich der Variable ‚Risiko in der Kapitalanlage‘. VUs, die interne Modelle zur Bestimmung des Risikos in der Kapitalanlage anwenden, werden nicht berücksichtigt (N = 284).

Tabelle 1.17 Regressionsoutput Laufende Verzinsung auf Jahresbasis (2011 bis 2020)

	Erklärte Variable: Laufende Verzinsung									
Variable	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AG	-0.012	-0.026	0.023	0.023	0.005	0.004	0.034	0.061	0.102	0.030
	(0.121)	(0.111)	(0.077)	(0.072)	(0.073)	(0.072)	(0.081)	(0.087)	(0.086)	(0.115)
ör VU	-0.053	-0.008	-0.177	-0.164*	-0.267**	-0.278**	-0.193*	-0.085	-0.047	-0.353**
	(0.095)	(0.118)	(0.127)	(0.085)	(0.116)	(0.115)	(0.101)	(0.111)	(0.115)	(0.158)
Umlaufrendite	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Größe	-0.019	-0.028	0.004	-0.010	-0.033	0.008	-0.010	-0.018	-0.022	-0.043
	(0.025)	(0.029)	(0.029)	(0.025)	(0.025)	(0.025)	(0.029)	(0.029)	(0.034)	(0.034)
Run-off	-0.306	-0.498*	-0.214	-0.297	-0.005	0.036	0.044	-0.212	-0.400*	-0.204
	(0.268)	(0.285)	(0.223)	(0.263)	(0.172)	(0.153)	(0.193)	(0.203)	(0.208)	(0.232)
Bestandsstruktur	0.425	-0.108	-0.104	-0.034	-0.001	0.015	-0.005	0.005	-0.000	0.004
	(0.531)	(0.118)	(0.082)	(0.054)	(0.047)	(0.035)	(0.025)	(0.027)	(0.019)	(0.018)
Einmalbeitragsgeschäft	0.004	-0.005	-0.004	0.001	0.004	0.008**	0.003	0.006*	0.006*	0.009**
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)
Eigenmittelquote	0.002**	0.002	0.002**	0.002**	0.002*	0.003***	0.002**	0.004***	0.003**	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Stille Reserven	0.004	0.021	-0.024	-0.006	-0.001	0.006	-0.004	0.017	-0.001	0.020*
	(0.010)	(0.015)	(0.020)	(0.008)	(0.010)	(0.007)	(0.011)	(0.013)	(0.010)	(0.011)
Umsatzrendite	0.015***	0.021***	0.013**	0.006	0.004	0.012**	0.008***	0.012***	0.010**	0.009*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.002)	(0.004)	(0.005)	(0.005)
Aktionärsausschüttungsquote	0.003	0.012**	0.011***	0.004*	0.009***	0.002	0.002	0.004	0.001	0.001
	(0.005)	(0.005)	(0.004)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.001)
Abschlussaufwendungen	0.008	0.008	0.023**	0.010	0.009	0.001	0.010	0.012	0.005	0.019
	(0.008)	(0.011)	(0.010)	(0.008)	(0.008)	(0.008)	(0.009)	(0.011)	(0.008)	(0.012)
Verwaltungsaufwendungen	-0.004	-0.019	-0.017	-0.004	-0.057**	-0.044*	-0.034	-0.033	-0.006	-0.022
	(0.029)	(0.031)	(0.030)	(0.034)	(0.023)	(0.026)	(0.023)	(0.022)	(0.021)	(0.023)
Produktstruktur	-0.000	-0.002	-0.006	-0.003	-0.001	0.001	-0.002	0.000	-0.002	-0.001
	(0.003)	(0.004)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Nettoverzinsung	-0.129	-0.045	-0.069	0.026	0.021	0.001	-0.004	-0.069	-0.016	-0.192***
	(0.100)	(0.080)	(0.077)	(0.065)	(0.065)	(0.053)	(0.055)	(0.081)	(0.065)	(0.068)
Laufende Durchschnittsverzinsung	0.219	0.013	0.106	0.170**	0.020	-0.102	0.125	0.045	0.155**	0.120
	(0.150)	(0.121)	(0.128)	(0.084)	(0.090)	(0.098)	(0.094)	(0.105)	(0.075)	(0.077)
N	52	49	55	57	61	64	65	66	67	67
Adj. R^2	0.322	0.471	0.481	0.457	0.230	0.251	0.225	0.237	0.278	0.254

Bemerkung: *p<0.1; **p<0.05; ***p<0.01

Erläuterungen: Unterscheidung zwischen den Rechtsformen (VVaG, AG, ör VU) anhand von Dummy-Variablen mit VVaG als Referenzkategorie. Die Schätzung der Regressionskoeffizienten erfolgt mittels klassischer OLS-Regression für das jeweilige Jahr. Untersuchungszeitraum 2011 bis 2020, ohne die Variable ‚Risiko in der Kapitalanlage'.

Tabelle 1.18 Regressionsoutput Laufende Verzinsung auf Jahresbasis (2016 bis 2020)

	Erklärte Variable: Laufende Verzinsung				
Variable	2016	2017	2018	2019	2020
AG	0.030	0.027	0.112	0.129	0.159*
	(0.067)	(0.076)	(0.083)	(0.082)	(0.086)
ör VU	-0.310**	-0.202*	-0.015	-0.043	-0.294**
	(0.125)	(0.106)	(0.100)	(0.113)	(0.127)
Umlaufrendite	-	-	-	-	-
	-	-	-	-	-
Größe	0.007	-0.011	0.006	-0.020	-0.030
	(0.022)	(0.032)	(0.026)	(0.034)	(0.033)
Run-off	0.098	0.051	-0.274	-0.416**	-0.362*
	(0.149)	(0.190)	(0.171)	(0.206)	(0.197)
Bestandsstruktur	0.015	-0.006	0.026	-0.001	-0.014
	(0.034)	(0.025)	(0.024)	(0.020)	(0.017)
Einmalbeitragsgeschäft	0.008**	0.003	0.006**	0.006*	0.005
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Eigenmittelquote	0.003***	0.002**	0.003***	0.003**	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Stille Reserven	0.012	-0.005	0.028**	0.001	0.028***
	(0.008)	(0.011)	(0.010)	(0.011)	(0.009)
Umsatzrendite	0.011**	0.008***	0.013***	0.008*	0.003
	(0.004)	(0.003)	(0.004)	(0.005)	(0.005)
Aktionärsausschüttungsquote	0.005**	0.002	0.007***	0.002	0.003**
	(0.002)	(0.003)	(0.002)	(0.003)	(0.001)
Abschlussaufwendungen	-0.001	0.010	0.010	0.005	0.010
	(0.007)	(0.009)	(0.010)	(0.008)	(0.010)
Verwaltungsaufwendungen	-0.053**	-0.035	-0.029	-0.005	-0.008
	(0.021)	(0.025)	(0.023)	(0.021)	(0.018)
Produktstruktur	-0.001	-0.002	-0.002	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Nettoverzinsung	0.014	-0.003	-0.078	-0.009	-0.160***
	(0.051)	(0.057)	(0.065)	(0.064)	(0.056)
Laufende Durchschnittsverzinsung	-0.160	0.130	0.012	0.149*	0.088
	(0.101)	(0.092)	(0.105)	(0.079)	(0.068)
Risiko in der Kapitalanlage	0.017*	-0.003	0.024***	0.006	0.028***
	(0.009)	(0.012)	(0.006)	(0.010)	(0.009)
N	64	65	66	67	67
Adj. R^2	0.281	0.211	0.361	0.271	0.356
					Bemerkung: *p<0.1; **p<0.05; ***p<0.01

Erläuterungen: Unterscheidung zwischen den Rechtsformen (VVaG, AG, ör VU) anhand von Dummy-Variablen mit VVaG als Referenzkategorie. Die Schätzung der Regressionskoeffizienten erfolgt mittels klassischer OLS-Regression für das jeweilige Jahr. Untersuchungszeitraum 2016 bis 2020, einschließlich der Variable ‚Risiko in der Kapitalanlage'.

Tabelle 1.19 Regressionsoutput Laufende Verzinsung ohne Anwender von internen Risikomodellen

	Erklärte Variable: Laufende Verzinsung					
	(1)	(2)	(3)	(4)	(5)	(6)
	FE	OLS	FE	FE	OLS	FE
AG		0.029			0.064	
		(0.055)			(0.063)	
ör VU		-0.171***			-0.184**	
		(0.061)			(0.092)	
Umlaufrendite	0.290***			-0.032		
	(0.041)			(0.128)		
Größe	-0.269*	-0.014	0.056	-0.109	-0.012	-0.061
	(0.157)	(0.015)	(0.160)	(0.183)	(0.022)	(0.165)
Run-off	-0.228	-0.304***	-0.206	-0.227	-0.243*	-0.210
	(0.232)	(0.106)	(0.186)	(0.151)	(0.127)	(0.132)
Bestandsstruktur	-0.102***	-0.009	0.004	-0.127***	-0.018	0.006
	(0.011)	(0.015)	(0.020)	(0.014)	(0.014)	(0.030)
Einmalbeitragsgeschäft	0.009**	0.004**	0.009***	0.003	0.005**	0.006
	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)
Eigenmittelquote	0.003***	0.003***	0.002***	0.002	0.002***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Stille Reserven	0.013***	0.007	0.009	0.009	0.013*	0.003
	(0.003)	(0.005)	(0.007)	(0.008)	(0.007)	(0.007)
Umsatzrendite	-0.002	0.009***	0.002	-0.006	0.007***	-0.005
	(0.003)	(0.002)	(0.004)	(0.004)	(0.002)	(0.003)
Aktionärsausschüttungsquote	-0.001	0.002**	-0.000	0.000	0.002**	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Abschlussaufwendungen	0.003	0.006	0.007	-0.003	0.001	0.005
	(0.007)	(0.004)	(0.006)	(0.015)	(0.007)	(0.013)
Verwaltungsaufwendungen	-0.026	-0.009	-0.022	-0.002	-0.012	0.002
	(0.031)	(0.012)	(0.031)	(0.031)	(0.027)	(0.030)
Produktstruktur	0.001	-0.001	0.001	-0.007*	-0.006***	-0.003
	(0.003)	(0.002)	(0.003)	(0.004)	(0.001)	(0.003)
Nettoverzinsung	0.055***	-0.028	-0.008	0.032*	-0.026	-0.007
	(0.018)	(0.027)	(0.022)	(0.018)	(0.028)	(0.017)
Laufende Durchschnittsverzinsung	0.099***	0.069	0.061**	0.020	-0.026	-0.013
	(0.033)	(0.042)	(0.024)	(0.018)	(0.035)	(0.017)
Risiko in der Kapitalanlage				0.014*	0.022***	0.015**
				(0.007)	(0.008)	(0.005)
Unternehmensindividuelle FE	Ja	Nein	Ja	Ja	Nein	Ja
Jahr FE	Nein	Ja	Ja	Nein	Ja	Ja
N	603	603	603	284	284	284
Adj. R^2	-	0.874	-	-	0.591	-
Within R^2	0.907	-	0.934	0.692	-	0.769
Between R^2	0.265	-	0.450	0.023	-	0.058
Overall R^2	0.566	-	0.787	0.116	-	0.334
						Bemerkung: *p<0.1; **p<0.05; ***p<0.01

Erläuterungen: Unterscheidung zwischen den Rechtsformen (VVaG, AG, ör VU) anhand von Dummy-Variablen mit VVaG als Referenzkategorie. Die Schätzung der Regressionskoeffizienten erfolgt durch Modelle mit individuellen Effekten (1) & (4), Modelle mit zeitfixen Effekten (2) & (5) und Modelle mit individuellen und zeitfixen Effekten (3) & (6). Modell (1), (2) und (3) bezieht sich auf den Untersuchungszeitraum 2011 bis 2020. Modell (4), (5) und (6) bezieht sich auf den Untersuchungszeitraum 2016 bis 2020, wobei VUs, die interne Modelle zur Bestimmung des Risikos in der Kapitalanlage anwenden, nicht berücksichtigt werden.

Tabelle 1.20 Regressionsoutput Laufende Verzinsung des Folgejahrs y_{it+1}

	Erklärte Variable: Laufende Verzinsung (y_{it+1})					
	(1)	(2)	(3)	(4)	(5)	(6)
	FE	OLS	FE	FE	OLS	FE
AG		0.008			0.060	
		(0.057)			(0.061)	
ör VU		-0.172***			-0.163**	
		(0.060)			(0.081)	
Umlaufrendite	0.415***			0.600***		
	(0.034)			(0.172)		
Größe	-0.155	-0.015	0.097	-0.156	-0.004	-0.168
	(0.168)	(0.016)	(0.178)	(0.194)	(0.021)	(0.203)
Run-off	-0.188	-0.249***	-0.182	-0.135	-0.253*	-0.139
	(0.148)	(0.093)	(0.136)	(0.109)	(0.136)	(0.105)
Bestandsstruktur	-0.064***	-0.002	0.007	-0.065***	-0.002	0.011
	(0.011)	(0.016)	(0.020)	(0.012)	(0.017)	(0.034)
Einmalbeitragsgeschäft	0.005	0.005**	0.005	-0.001	0.005**	0.001
	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)	(0.004)
Eigenmittelquote	0.002***	0.002***	0.002***	0.003*	0.003***	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Stille Reserven	0.010***	0.012**	0.020***	0.019**	0.019**	0.017*
	(0.003)	(0.006)	(0.007)	(0.010)	(0.008)	(0.010)
Umsatzrendite	0.001	0.011***	0.001	-0.004	0.010***	-0.005
	(0.004)	(0.002)	(0.004)	(0.004)	(0.003)	(0.004)
Aktionärsausschüttungsquote	-0.001	0.001	-0.000	0.000	0.002	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Abschlussaufwendungen	0.004	0.010**	0.007	-0.017	0.012**	-0.014
	(0.006)	(0.004)	(0.005)	(0.015)	(0.006)	(0.013)
Verwaltungsaufwendungen	-0.036	-0.008	-0.028	-0.026	-0.009	-0.014
	(0.038)	(0.013)	(0.040)	(0.048)	(0.017)	(0.052)
Produktstruktur	-0.003	-0.001	-0.001	-0.004	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
Nettoverzinsung	0.047**	-0.016	0.013	0.036*	-0.014	0.033
	(0.018)	(0.030)	(0.022)	(0.018)	(0.033)	(0.022)
Laufende Durchschnittsverzinsung	0.094***	0.085*	0.067**	0.023	0.053	0.006
	(0.032)	(0.043)	(0.027)	(0.025)	(0.040)	(0.026)
Risiko in der Kapitalanlage				0.011*	0.011	0.010*
				(0.007)	(0.007)	(0.006)
Unternehmensindividuelle FE	Ja	Nein	Ja	Ja	Nein	Ja
Jahr FE	Nein	Ja	Ja	Nein	Ja	Ja
N	603	603	603	329	329	329
Adj. R^2	-	0.852	-	-	0.471	-
Within R^2	0.905	-	0.920	0.601	-	0.643
Between R^2	0.260	-	0.349	0.002	-	0.002
Overall R^2	0.666	-	0.732	0.068	-	0.076
						Bemerkung: *p<0.1; **p<0.05; ***p<0.01

Erläuterungen: Unterscheidung zwischen den Rechtsformen (VVaG, AG, ör VU) anhand von Dummy-Variablen mit VVaG als Referenzkategorie. Die Schätzung der Regressionskoeffizienten erfolgt durch Modelle mit individuellen Effekten (1) & (4), Modelle mit zeitfixen Effekten (2) & (5) und Modelle mit individuellen und zeitfixen Effekten (3) & (6). Modell (1), (2) und (3) bezieht sich auf den Untersuchungszeitraum 2011 bis 2020, Modell (4), (5) und (6) auf den Untersuchungszeitraum 2016 bis 2020. Alle Regressionen erfolgen auf Basis der laufenden Verzinsung des Folgejahrs y_{it+1}.

1.7.2 Weiterführende Informationen zur Messung des Kapitalanlagerisikos

Wie bereits im Kapital zu den theoretischen Einflussfaktoren beschrieben, soll mit Hilfe des entwickelten Risikoproxys ‚Risiko in der Kapitalanlage' auf Grundlage von Solvency II Daten (SFCR-Berichte) der Einfluss des Kapitalanlagerisikos auf die Kapitalanlageperformance und die laufende Verzinsung untersucht werden. Im Fokus steht hierbei das sog. Marktrisikomodel, welches Risiken durch Veränderungen an den Kapitalmärkten (insb. Zins- bzw. Vermögenspreisänderungen) abbildet. Aufgrund der Anleihe-lastigen Kapitalanlage der VUs, wird neben dem Marktrisikomodul (Position R0010) auch das (Gegenpartei)-Ausfallrisikomodul/Kreditrisikomodul (Position R0020) berücksichtigt. Zudem soll dieses Vorgehen eine bessere Vergleichbarkeit zwischen den Anwendern des Standardmodells und den Anwendern des (partiellen) internen Modells ermöglichen, da bei den internen Modellen das Spreadrisiko, nicht wie im Standardmodell einheitlich dem Marktrisikomodul, sondern teilweise dem Kreditrisikomodul zuordnen wird. Für die konkrete Berechnung der Variable ‚Risiko in der Kapitalanalage' wird die Summe aus dem Wert des Marktrisikomoduls R0010 und des (Gegenpartei)-Ausfallrisikomoduls bzw. Kreditrisikomoduls R0020 im Verhältnis zur Position Anlagen R0070 (Marktwert aller Kapitalanalgen, außer Vermögenswerte für indexgebundene und fondsgebundene Verträge) betrachtet.

2. Essay 2: Underwriting profitability of the German P&C insurance industry during COVID-19: An analysis of pandemic impacts

Abstract

This study examines how the COVID-19 pandemic influenced the underwriting profitability of German property and casualty (P&C) insurers, both overall and by line of business. The empirical analysis relies on panel data covering the German P&C insurance industry from 2004 to 2023 and applies fixed effects regression models. The findings show that premium volumes remained largely stable during the pandemic, whereas underwriting profitability increased, driven largely by a reduction in motor claims following lower traffic volumes and accident frequencies. Additional improvements were recorded in household contents and personal accident insurance, associated with declines in burglaries and injury-related events. Overall, the findings suggest that the German P&C insurance industry, a mature and highly penetrated market, proved resilient to pandemic-related shocks and provide valuable insights for regulators, insurers, and policyholders regarding the potential impacts of future pandemics.

Keywords: COVID-19, pandemic, P&C insurance industry, premium growth, underwriting profitability

2.1 Introduction

On 11 March 2020, the World Health Organization declared the COVID-19 pandemic (WHO, 2020). Especially in 2020 and 2021, governments around the globe took measures such as lockdowns and mobility restrictions that heavily disrupted people's daily lives in order to prevent the further spread of the virus. As a consequence, the world experienced a global economic crisis, with global GDP growth declining by approximately 3 percent in 2020 (World Bank, 2022), while the concrete economic impacts of COVID-19 policies varied significantly across industries (Naseer et al., 2023; Nayak et al., 2021).

When looking at the insurance industry, it seems reasonable to assume that the underwriting business is particularly affected, as it covers a wide range of everyday life risks. Two fundamental influencing factors can be identified: First, the direct health impacts of the COVID-19 virus, which could especially affect the business of life and health insurance. Second, the indirect consequences, i.e., behavioral changes triggered among policyholders, whether simply due to fear of the virus or as a result of government-imposed lockdowns and mobility restrictions. The second factor is likely to have a particular impact on the P&C insurance business, as substantial behavioral changes can be expected to influence the development of claims, both in relation to property damage and liability towards third parties.

Even though research on the impact of COVID-19 on the P&C insurance industry has already been conducted, the existing studies remain limited in scope. They have primarily focused on insurance markets in developing economies such as Ghana (Babuna et al., 2020) and Bangladesh (Haque et al., 2021), in countries with low insurance penetration and density such as China (Wang et al., 2020), or in comparatively small national economies such as Portugal (Costa et al., 2022) and North Macedonia (Stojkoski et al., 2021). Moreover, none of these studies examines the impact of COVID-19 on underwriting profitability.

An identified research gap therefore concerns the effect of COVID-19 on the underwriting profitability of the P&C insurance industry in a mature market of substantial size. Thus, this paper assesses the impact of COVID-19 on underwriting profitability both at the overall business level and across individual business lines of the P&C insurance industry in Germany, employing panel data regression with individual fixed effects. This market not only represents a mature insurance market, characterized by high penetration and density, but also ranked as the world's third-largest non-life insurance market in terms of premium volume (USD) in 2023 (Swiss Re Institute, 2024).

Our analysis shows that premium volume in the German P&C insurance industry remained broadly stable during the pandemic years. By contrast, underwriting profitability improved overall, driven mainly by reduced losses in the motor line and, to a lesser extent, in household contents and personal accident insurance.

The remainder of the paper proceeds as follows. Section 2.2 reviews the relevant literature, while Section 2.3 outlines the conceptual framework and derives the hypotheses. Section 2.4 describes the data and methodology. The empirical results are presented in Section 2.5 and further discussed in Section 2.6. Finally, Section 2.7 concludes.

2.2 Literature Review

Although the academic literature addressing the impact of COVID-19 on the P&C insurance industry is relatively scarce, several topics have already been investigated. For instance, Richter and Wilson (2020) examine the insurability of pandemic risk, while Hartwig et al. (2020) analyze how government support can facilitate the coverage of pandemic-related economic losses. Farooq et al. (2021) investigate the effect of COVID-19 on abnormal stock returns of insurance companies, and Puławska (2021) analyzes its implications for insurers' financial stability.

Most of the existing studies, however, focus on broad business performance metrics. Babuna et al. (2020) examine the Ghanaian life and non-life insurance market and report substantial declines in premiums and profits, alongside an increase in losses during the first year of COVID-19. Wang et al. (2020) analyze premium growth, insurance density, and insurance penetration in the Chinese insurance market, finding a negative impact of the pandemic on all three indicators across both life and non-life business. Haque et al. (2021) investigate the Bangladeshi market and report similar results, identifying adverse effects on premium growth, density, and penetration without distinguishing between life and non-life insurance. With respect to premium development, Stojkoski et al. (2021) also document a decline in the North Macedonian P&C insurance market; however, unlike Babuna et al. (2020), they additionally observe a decrease in losses. A somewhat different perspective is offered by Costa et al. (2022), who examine only the overall profitability of non-life insurers in Portugal and find that profitability, measured by return on assets, is positively affected by COVID-19. In contrast to these contributions, two studies by Fung et al. (2024, 2025) do not examine the direct effects of COVID-19 but rather the success factors that help P&C insurers cope with the pandemic. Fung et al. (2024) show that insurers with higher asset or product risks are less resilient to COVID-19 in terms of overall profitability. Furthermore, Fung et al. (2025) find that insurers with less mature enterprise risk management frameworks experience a stronger negative impact of COVID-19 on their financial performance.

Overall, while previous research on the direct effects of COVID-19 has examined its impact on premiums, density, penetration and overall profitability across various countries, its implications for underwriting profitability, particularly in large mature markets and with respect to line of business distinctions, remain underexplored.

2.3 Conceptual Framework and Hypothesis development

The specific objective of this paper is to investigate the effects of the COVID-19 pandemic on the underwriting profitability of the German P&C insurance industry. Since our focus is on the P&C sector, the potential impacts of the pandemic are expected to be primarily driven by changes in the behavior of policyholders, influenced not only by fear of the virus itself but especially by the COVID-19 measures implemented by the German federal and state governments. In contrast to health and life insurance, the direct health implications caused by the coronavirus are expected to play a relatively minor role in the P&C business. The implementation of comprehensive lockdown measures was concentrated primarily in the pandemic years 2020 and 2021, whereas in 2022, only minor restrictive measures remained in place, such as mask mandates in public transport and certain testing requirements, particularly for unvaccinated individuals.

Table 2.1 presents the specific key government-imposed restrictions, which can be assigned to six distinct main phases between 2020 and 2021 based on their type and duration of applicability. In particular, strict measures such as school and daycare closures, the shutdown of cultural institutions, restaurants, bars, clubs, gyms, and service businesses, work-from-home mandates, and contact restrictions are expected to have had a significant impact on the everyday behavior of policyholders and consequently, on the operational business performance of P&C insurers.

To assess the impact of these two COVID-19 years on underwriting profitability, we examine the development of premiums alongside the expense side in terms of claims and business expenses. Specifically, we consider the year-over-year change in premium volume as well as the common KPIs used to measure underwriting performance: loss ratio, expense ratio, and combined ratio. Furthermore, to obtain a more differentiated view, the main lines of business as defined by German accounting standards (fire, homeowners building, household contents, legal expenses, liability, motor and personal accident) are examined separately from the overall business of the P&C insurance companies. Certain niche lines of business within the P&C insurance sector, such as business interruption insurance or international travel health insurance, are excluded from the analysis due to a lack of detailed data, as insurers typically do not disclose specific figures for these lines, even though a significant impact from COVID-19 can be assumed. The analysis is grounded in several hypotheses, primarily derived from practical observations, such as industry reports and annual financial statements of insurance companies. The objective is to subject previously descriptive insights to systematic empirical investigation.

Table 2.1 Overview of the key government-imposed restrictions in Germany between 2020 and 2021

Period	Government-imposed restrictions	References
Mar 2020 - Apr 2020 (First Lockdown)	• School and daycare closures • Closure of cultural institutions, restaurants, bars, clubs, gyms and service businesses • Contact restrictions • Mask mandate (shops, public transport, etc.)	Kuhlmann and Franzke 2022; Kuhlmann et al. 2023, p. 21-22; Artz 2025, p. 271-273
Nov 2020 - Dec 2020 (Lockdown Light)	• Closure of cultural institutions, restaurants, bars, clubs, gyms and service businesses • Contact restrictions • Strict mask mandate	Kuhlmann and Franzke 2022; Kuhlmann et al. 2023, p. 22-24; Artz 2025, p. 273-274, 283-284
Dec 2020 - Feb 2021 (Full Lockdown)	• School and daycare closures • Closure of cultural institutions, restaurants, bars, clubs, gyms and service businesses • Work-from-home mandate • Contact restrictions • Local curfews • Strict mask mandate	Bundesregierung 2021a; Bundesregierung 2021b; Bundesregierung 2021c; Corona Datenplattform 2021; Kuhlmann et al. 2023, p. 24-25; Artz 2025, p. 273-274, 283-284
Feb 2021 - Jun 2021	• Closure of restaurants, bars, clubs, gyms, etc. • Work-from-home mandate • Contact restrictions • Strict mask mandate	Bundesregierung 2021c; Bundesregierung 2021d; Corona Datenplattform 2021; Kuhlmann et al. 2023, p. 24-25; Artz 2025, p. 274, 284-286
Aug 2021 - Nov 2021	• Introduction of the 3G rule, i.e., access to certain facilities such as public institutions, restaurants, gyms, etc., is only permitted for individuals who are vaccinated, recovered, or tested • Mask mandate (shops, public transport, etc.)	Bundesregierung 2021e; Artz 2025, p. 274-275, 286-288
Nov 2021 - Dec 2021	• Reintroduction of the work-from-home mandate • The scope of the 3G rule is expanded to include workplaces and public transportation • Application of the 2G rule (access only for vaccinated or recovered individuals) when certain thresholds are exceeded, for specific areas such as leisure events, gastronomy, close-contact services, etc. • Mask mandate (shops, public transport, etc.)	Bundesregierung 2021f; Bundesregierung 2021g; Kuhlmann et al. 2023, p. 25-27; Artz 2025, p. 274-275, 286-288

Note: Overview of the key government-imposed restrictions in Germany between 2020 and 2021, grouped into six distinct phases according to type and implementation duration.

2.3.1 Premium growth

Over the ten years prior to the COVID-19 pandemic, insurance penetration fluctuated only marginally, ranging between 2.10 and 2.20 percentage points, which indicates a relatively low-volatility and stable P&C insurance market (GDV, 2024e). This kind of stability should be maintained even in times of a pandemic, as increased uncertainty typically reinforces the importance of insurance rather than leading policyholders to give up their existing coverage.

> **H1:** *The COVID-19 pandemic years are not associated with substantial changes in premium growth, either at the aggregate market level or across individual lines of business.*

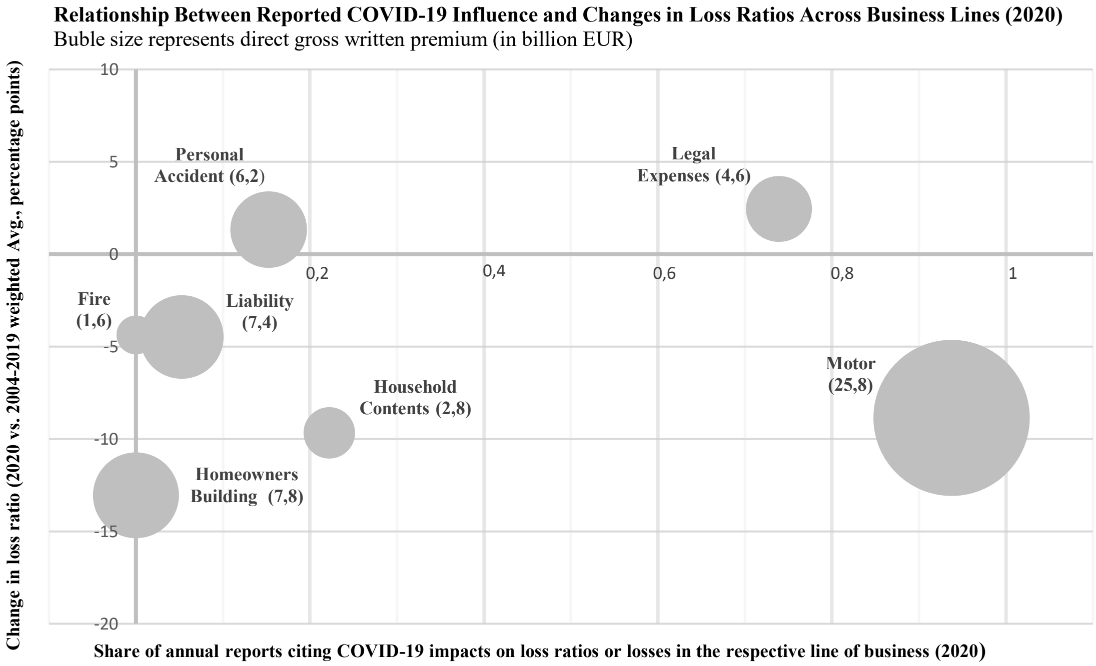
2.3.2 Loss ratio

Losses result from the combined effect of claim frequency and claim severity. Depending on the line of business, changes in the everyday behavior of policyholders as influenced by the COVID-19 pandemic and the respective lockdown measure are expected to primarily impact claim frequency. Assuming a relatively stable premium volume, significant changes in the total loss amount should directly affect the loss ratio, which is calculated as the ratio of incurred losses to earned premiums.[30] To identify potential effects of COVID-19 on the loss ratios of different lines of business from a practical insurance perspective, the management view as presented in the 2020 annual financial statements of all 83 insurers included in the study was systematically analyzed. Specifically, it was examined whether COVID-19 was explicitly mentioned as a factor influencing loss ratios or losses within each respective line of business.
Figure 2.1 illustrates the relationship between reported COVID-19 influences and changes in weighted average loss ratios across business lines in 2020, compared to the weighted average loss ratios from 2004 to 2019, and includes the premium volume of each line of business in 2020. According to the analysis of all insurers included in the study, 93.8% of those operating in the motor line, 22.2% in the household contents line, 15.3% in the personal accident line, and 5.3% in the liability line reported that COVID-19 had a reducing effect on loss ratios or losses in the respective business line. An increasing effect of COVID-19 on loss ratios or losses was reported by insurers only in the legal expenses line, with 73.9% of all companies operating in this line observing such an impact. In contrast to the lines mentioned previously, the

[30] The loss ratio (LR) is calculated as follows: $LR = \frac{(Gross\ Claims\ Payments\ (Direct) + Change\ in\ Gross\ Loss\ Reserves\ (Direct))}{Gross\ Earned\ Premiums\ (Direct)}$

development of loss ratios or losses in the homeowners building and fire lines was not linked to COVID-19 by any insurer in 2020.

Figure 2.1 Company-reported COVID-19 effects across various lines of business



Note: Relationship between reported COVID-19 impacts and changes in weighted average loss ratios across business lines in 2020, compared to the weighted average loss ratios from 2004 to 2019. Bubble size represents the direct gross written premium for each line of business in 2020. The calculation of the share of annual reports citing a COVID-19 impact, as well as the weighted average loss ratios, is based on the 83 insurers included in the study that were also active in the respective line of business. For 2020, the sample represents the following market coverage by line: fire 50.0%, homeowners building 89.8%, household contents 88.4%, legal expenses 93.8%, liability 63.7%, motor 86.7%, and personal accident 91.8%.

Moreover, as loss development in both lines is typically heavily influenced by accumulation and large-scale events, the variance observed during the two COVID-19 years (2020 and 2021) is difficult to distinguish and interpret in comparison to non-COVID-19 years. For this reason, both lines are excluded from the subsequent analysis. Based on the previously discussed assessments provided by the management of the insurance companies, the following hypotheses can be derived for the following lines of business: motor, legal expenses, household, personal accident, and liability.

H2: *The COVID-19 pandemic years are associated with a reduction in the loss ratio of the motor line.*

H3: *The COVID-19 pandemic years are associated with an increase in the loss ratio of the legal expenses line.*

H4: *The COVID-19 pandemic years are associated with a reduction in the loss ratio of the household contents line.*

H5: *The COVID-19 pandemic years are associated with a reduction in the loss ratio of the personal accident line.*

H6: *The COVID-19 pandemic years are associated with a reduction in the loss ratio of the liability line.*

2.3.3 Expense ratio

In German insurance companies, expenses are composed of acquisition and administrative costs. While acquisition costs are to some extent linked to premium volume, administrative expenses tend to be relatively inelastic in the short term, as they are primarily driven by fixed personnel costs resulting from a workforce largely composed of permanent employees. Assuming stable premium volume development during the COVID-19 pandemic, the expense ratio should likewise not exhibit any notable volatility during this period.[31]

H7: *The COVID-19 pandemic years are not associated with substantial changes in the expense ratio, either at the aggregate market level or across individual lines of business.*

2.3.4 Combined ratio

Given relatively stable expense ratios and cost structures, combined with volatility in loss ratios driven by the COVID-19 pandemic, any unusual changes in profitability are likely to be primarily attributable to loss development.[32]

H8: *The impact of the COVID-19 pandemic years on underwriting profitability, as measured by the combined ratio, is primarily driven by loss ratios rather than expenses.*

[31] The expense ratio (ER) is calculated as follows: $ER = \frac{(Gross\ Acquisition\ Costs\ (Direct) + Gross\ Administrative\ Expenses\ (Direct))}{Gross\ Earned\ Premiums\ (Direct)}$

[32] The combined ratio (CR) is calculated as follows:
$CR = LR + ER = \frac{(Gross\ Claims\ Payments\ (Direct) + Change\ in\ Gross\ Loss\ Reserves\ (Direct) + Gross\ Operating\ Expenses\ (Direct))}{Gross\ Earned\ Premiums\ (Direct)}$

2.4 Data and Methodology

2.4.1 Sample and data

The analysis focuses on all primary P&C insurers operating in the German market between 2004 and 2023 whose annual financial statements are listed in the database of the University of Cologne and the Cologne Institute for Insurance Information and Business Services (KIVI GmbH).[33] To ensure relevance and comparability, and to enable a reliable analysis of the impact of the COVID-19 years 2020 and 2021, the sample is restricted to insurance companies with annual gross written premiums of more than €40 million in direct business and at least complete data coverage between 2016 and 2023. Furthermore, specialty insurers are excluded from the analysis, as the focus of this study lies on the examination of the traditional main industry lines. The result is a final dataset structured as an unbalanced short panel, covering 83 insurance companies across 20 years (2004-2023) and capturing approximately 76% of the total German P&C insurance market in 2023, based on the official market volume (gross written premiums in direct business) reported by the German supervisory authority BaFin (Bundesanstalt für Finanzdienstleistungsaufsicht, 2025). Comparable levels of coverage are achieved for the other years in the observation period. At the line level, lines with annual gross written premiums in direct business of less than €4 million, as well as observations with negative loss ratios, expense ratios, or combined ratios, are excluded from the analysis, since these typically represent lines in run-off or development, whose figures are difficult to interpret reliably. In addition, the dataset is supplemented with selected macro-level data, which serve as control variables in the analysis: information on natural catastrophe (NatCat) losses provided by the German Insurance Association (GDV 2024b; GDV 2024c; GDV 2024d), as well as data on the inflation rate and GDP growth obtained from the German Federal Statistical Office (Destatis 2025a; Destatis 2025c).

2.4.2 Measuring the influence of the COVID-19 pandemic

To analyze the impact of the COVID-19 pandemic years on underwriting profitability, four distinct regression models are employed. The first model examines the effect on premium growth, while the other three assess the impact on key profitability ratios: the loss ratio, expense

[33] KIVI GmbH analyzes the financial statements of German insurance companies (see http://www.kivi-online.de) and publishes firm-level performance indicators in annual reports.

ratio, and combined ratio. All four models use a fixed effects estimator to account for unobserved, time-invariant firm-level characteristics.

Each model is applied at both the total business and line of business level. The same year dummies for the two COVID-19 years (COV20 and COV21) are used as the main explanatory variables in all models. Moreover, all models control for macroeconomic conditions using inflation and GDP growth, and include a NatCat loss variable in those lines of business where exposure to such events is material.

Model (1) measures the impact of the COVID-19 years on premium growth:

$$\ln(Direct\ GWP_{it}) - \ln(Direct\ GWP_{it-1}) = \alpha_i + \sum_{k=1}^{K} \beta_k\, x_{kit} + \epsilon_{it,} \tag{1}$$

where $\Delta \ln(Direct\ GWP_{it})$ is the dependent variable for insurer i in year t; α_i denotes the (non-random) time-invariant individual fixed effect of insurer i; x_{kit} is the independent variable k for insurer i in year t; β_k is the regression coefficient for the independent variable k; and ϵ_{it} is the error term for insurer i in year t.

Unlike the first model, the other three ratio-based models include firm size (measured in Direct GWP) as an additional control. For each of the three models, we estimate four variants: two that include the lagged dependent variable (the prior-year ratio) and two that do not, to account for potential line-specific persistence in the ratios. Given the relatively long observation period (T = 20), a fixed effects model is used throughout, and we refrain from applying a GMM or system GMM estimator for models including the lagged dependent variable. This choice is justified by the fact that the estimation bias declines as the observation period increases and becomes relatively minor over longer observation periods (Judson and Owen, 1999). Moreover, the focus of our analysis lies not on the dynamic structure but rather on the exogenous COVID-19 dummy variables. For robustness checks, all four fixed effects models use alternative variable specifications.

Model (2) measures the impact of the COVID-19 years on the loss ratio:

$$\mathrm{LR_t} = \alpha_i + \beta_1 LR_{i,t-1} + \sum_{k=1}^{K} \beta_k\, x_{kit} + \epsilon_{it} \tag{2}$$

Model (3) measures the impact of the COVID-19 years on the expense ratio:

$$\mathrm{ER_t} = \alpha_i + \beta_1 ER_{i,t-1} + \sum_{k=1}^{K} \beta_k \, x_{kit} + \epsilon_{it} \tag{3}$$

Model (4) measures the impact of the COVID-19 years on the combined ratio:

$$\mathrm{CR_t} = \alpha_i + \beta_1 CR_{i,t-1} + \sum_{k=1}^{K} \beta_k \, x_{kit} + \epsilon_{it} \tag{4}$$

In contrast to Model (1), Models (2), (3), and (4) additionally include the respective lagged dependent variable to account for potential persistence in the ratios.

2.5 Results

2.5.1 Descriptive Result

Table 2.2 provides summary statistics for the dependent and control variables, disaggregated by the overall business segment and the five primary insurance lines examined. The number of insurance companies included in the analysis varies across insurance lines, as not all insurers operate in each line of business. Accordingly, the motor, household contents, personal accident, and liability lines each exhibit a similar number of observations, around 1,000 to 1,200 over the entire observation period (2004-2023), corresponding to approximately 50 to 60 companies per year. In contrast, the legal expense line is operated by only about 20 insurers, resulting in a lower total number of observations compared to the other lines. The economic control variables CPI inflation and GDP growth are identical across all lines and firms. In the overall business segment and in the lines with explicit NatCat exposure (motor and household contents), the respective NatCat losses for these lines are additionally included as control variables. A descriptive comparison of the means between the non-COVID-19 years (2004-2019 and 2022-2023) and the COVID-19 years (2020 and 2021) for the four underwriting performance measures reveals clear differences only in the loss ratio and the combined ratio within the motor line. The average loss ratio is 9 percentage points and the average combined ratio 8 percentage points lower during the two COVID-19 years compared to the reference period.

Table 2.2 Descriptive statistics of the dependent and control variables by line of business

	Overall business						**Motor**					
	Overall study period (2004-2023)				Non-COVID-19 years	COVID-19 years	Overall study period (2004-2023)				Non-COVID-19 years	COVID-19 years
Variable	N	Mean	Median	SD	Mean	Mean	N	Mean	Median	SD	Mean	Mean
Δln_dGWP	1,500	0.04	0.03	0.08	0.04	0.04	1,155	0.02	0.02	0.11	0.02	0.03
LR	1,583	67.75	67.33	13.03	67.8	67.24	1,221	83.12	82.51	10.22	84.1	74.81
ER	1,583	28.05	27.88	9.32	28.03	28.27	1,221	17.95	18.45	4.88	17.84	18.88
CR	1,583	95.80	95.48	8.62	95.83	95.52	1,221	101.07	99.94	10.30	101.94	93.69
dGWP	1,583	663.30	250.01	1242.98	-	-	1,221	341.30	154.58	524.19	-	-
CPI Infl.	20	1.99	1.60	1.69	-	-	20	1.99	1.60	1.69	-	-
GDPG	20	1.24	1.30	2.44	-	-	20	1.24	1.30	2.44	-	-
NatCat	20	5320.00	4400.00	3338.70	-	-	20	1125.00	950.00	605.13	-	-

	Legal expenses						**Household contents**					
	Overall study period (2004-2023)				Non-COVID-19 years	COVID-19 years	Overall study period (2004-2023)				Non-COVID-19 years	COVID-19 years
Variable	N	Mean	Median	SD	Mean	Mean	N	Mean	Median	SD	Mean	Mean
Δln_dGWP	404	0.04	0.03	0.12	0.04	0.03	936	0.03	.02	0.07	0.03	0.02
LR	430	69.33	65.92	15.01	69.36	69.14	994	43.2	42.1	9.49	43.11	43.93
ER	430	29.54	31.46	9.45	29.57	29.3	994	35.15	36.2	8.68	35.11	35.44
CR	430	98.88	98.54	12.70	98.93	98.44	994	78.35	78.36	12.95	78.22	79.37
dGWP	430	154.32	97.65	156.89	-	-	994	47.59	23.57	59.66	-	-
CPI Infl.	20	1.99	1.60	1.69	-	-	20	1.99	1.60	1.69	-	-
GDPG	20	1.24	1.30	2.44	-	-	20	1.24	1.30	2.44	-	-
NatCat	-	-	-	-	-	-	20	220.00	150.00	274.53	-	-

	Personal accident						**Liability**					
	Overall study period (2004-2023)				Non-COVID-19 years	COVID-19 years	Overall study period (2004-2023)				Non-COVID-19 years	COVID-19 years
Variable	N	Mean	Median	SD	Mean	Mean	N	Mean	Median	SD	Mean	Mean
Δln_dGWP	1,036	0.03	0.02	0.10	0.03	0.02	1,016	0.03	0.02	0.09	0.03	0.02
LR	1,098	45.64	44.18	15.63	45.76	44.67	1,079	49.21	47.66	15.76	49.64	45.62
ER	1,098	36.44	35.72	8.47	36.67	34.53	1,079	36	36.41	6.92	36.00	36.02
CR	1,098	82.08	81.52	15.29	82.43	79.2	1,079	85.21	84.58	15.41	85.63	81.64
dGWP	1,098	100.19	34.86	208.21	-	-	1,079	114.58	40.63	201.49	-	-
CPI Infl.	20	1.99	1.60	1.69	-	-	20	1.99	1.60	1.69	-	-
GDPG	20	1.24	1.30	2.44	-	-	20	1.24	1.30	2.44	-	-
NatCat	-	-	-	-	-	-	-	-	-	-	-	-

Note: Mean, median, and standard deviation (SD) values are based on the pooled sample. The variables *CPI Inflation* and *GDPG* serve as economic controls and are identical across all lines and firms. The variable *NatCat* is included as an additional control for lines with explicit natural catastrophe exposure. Non-COVID-19 years refer to 2004-2019 and 2022-2023, whereas COVID-19 years are defined as 2020 and 2021.

2.5.2 Regression Analysis

Table 2.3 presents the results of the regressions examining the effect of the COVID-19 pandemic on premium growth (Hypothesis H1). While variant (1) includes only the COVID-19 year dummies for 2020 and 2021 along with a time trend, variant (2) additionally incorporates further control variables. The results show that the first pandemic year, 2020, exhibits a negative coefficient in both models, for the overall business as well as across all lines of business, however at different levels of statistical significance. For example, the COV20 dummy in the overall business is significantly negative in both models, with coefficients of -0.013 and -0.025, respectively, which corresponds to a 1.3 and 2.5 percentage point lower premium growth in 2020 compared to the non-COVID-19 years. With respect to the control variables, CPI inflation shows a negative relationship with premium growth, which may be linked to declining purchasing power in times of inflation and, consequently, reduced demand for insurance. By contrast, the positive relationship between GDP growth and premium growth, for instance in the motor line, may reflect increasing purchasing power and thus a higher demand for insurance. Overall, it can be concluded that the COVID-19 year 2020 led to somewhat lower premium growth depending on the line of business, but did not undermine premium stability as such, whereas no significant effect can be observed for 2021.

For each of the three ratio-based models (LR, ER, CR), we estimate four fixed effects variants: (1) COVID-19 dummies plus a time trend; (2) as in (1) plus economic controls; (3) LR_{t-1} plus COVID-19 dummies and a time trend; and (4) as in (3) plus economic controls.

Table 2.4 reports the regression results on the effect of the COVID-19 pandemic on loss ratios for the overall business and the individual insurance lines (Hypotheses H2-H6). In specification (1), the motor, legal expenses, and household contents lines show higher R^2 (0.111, 0.107, and 0.270) than the overall business (0.040), personal accident (0.011), and liability (0.035), indicating that the FE model with COVID-19 year dummies and a time trend explains a comparatively larger share of the within variation for those lines.

Regarding the concrete effects of the COVID-19 years by line, the following emerges. Depending on the variable specification, the motor line's loss ratio declined by 8-13 percentage points in 2020 and by 3-9 percentage points in 2021 relative to the reference years (2004-2019, 2022-2023). When we account for carryover from 2020 in the dynamic specifications, the total 2021 deviation in (3) and (4) is about 7-8 percentage points ($\beta_{21} + \rho\beta_{20}$), close to the estimates from (1) and (2). Restricting attention to (2) and (4), both of which include controls for NatCat losses and macro conditions, and with (4) also accounting for the 2021 carryover, the year effects are closely aligned: -8 to -9 percentage points in 2020 and -7 to -9 percentage points in 2021. Overall, the significant declines observed across all specifications and both years are consistent with strong support for hypothesis H2.

Table 2.3 Estimated effects of the COVID-19 period (2020-2021) on premium growth

	Overall business		Motor		Legal expenses	
	(1)	(2)	(1)	(2)	(1)	(2)
COV20	-0.013**	-0.025**	-0.021**	-0.010	-0.018	-0.017
	(0.005)	(0.011)	(0.010)	(0.013)	(0.015)	(0.025)
COV21	-0.009	-0.019	-0.007	-0.031	-0.006	-0.015
	(0.010)	(0.014)	(0.017)	(0.019)	(0.013)	(0.014)
CPI Infl.		-0.002*		-0.008***		-0.005
		(0.001)		(0.003)		(0.003)
GDPG		-0.002		0.003**		0.003***
		(0.001)		(0.001)		(0.001)
NatCat		0.000		0.000***		
		(0.000)		(0.000)		
t	0.002***	0.002***	0.002**	0.003***	0.000	0.001
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Constant	0.022***	0.019***	0.008	-0.015*	0.040***	0.036***
	(0.004)	(0.007)	(0.007)	(0.008)	(0.012)	(0.011)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.014	0.019	0.008	0.033	0.001	0.007
N	1,500	1,500	1,155	1,155	404	404
	Household contents		**Personal accident**		**Liability**	
	(1)	(2)	(1)	(2)	(1)	(2)
COV20	-0.019***	-0.010	-0.003	-0.018	-0.019***	-0.020***
	(0.003)	(0.008)	(0.004)	(0.013)	(0.005)	(0.007)
COV21	-0.012	-0.035	0.006	0.006	0.007	0.006
	(0.015)	(0.024)	(0.013)	(0.014)	(0.014)	(0.015)
CPI Infl.		0.000		-0.004***		-0.001
		(0.001)		(0.001)		(0.001)
GDPG		0.001		-0.001		0.000
		(0.001)		(0.002)		(0.001)
NatCat		0.000				
		(0.000)				
t	0.000	0.000	-0.001**	-0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Constant	0.026***	0.021***	0.040***	0.043***	0.030***	0.030***
	(0.006)	(0.007)	(0.006)	(0.007)	(0.005)	(0.006)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.006	0.009	0.005	0.010	0.003	0.004
N	936	936	1,036	1,036	1,016	1,016

Note: All regressions are estimated using panel fixed effects. Robust standard errors are clustered at the company level. The dependent variable is premium growth (*Δln_dGWP*); the key independent variables are the COVID-19 year dummies (*COV20* and *COV21*). Variant (1) includes only the COVID-19 dummies for 2020 and 2021 together with a time trend, while variant (2) additionally incorporates further control variables. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables is provided in the Appendix.

When examining the year dummies for the legal expense line, it stands out as the only line that (almost) consistently exhibits positive coefficients. Statistical significance occurs only in 2020 and only in specifications (1) and (3), which tends to indicate an increase in the loss ratio in 2020 compared to the reference years. Consequently, the results provide only limited evidence in support of hypothesis H3, as an increase is observed solely in 2020 and attains statistical significance in only two of the four specifications.

For the household contents line, the R^2 in specification (1) is substantially higher than the other lines (0.270), suggesting that, conditional on the common time trend, the year dummies for

2020 and 2021 explain an unusually large share of the within-line variation. In addition to potential COVID-19 year effects, NatCat events are likely to play a major role. The household contents line is generally more exposed to NatCat risk than other lines. Moreover, this line experienced low NatCat losses in 2020 and unusually high NatCat losses in 2021 due to the floods in the Rhine Valley. With respect to the COVID-19 year dummies, 2020 shows a significant reduction in the loss ratio, even in specifications (2) and (4), which control for NatCat losses. By contrast, for 2021 the year dummy in (2) and (4) is small and statistically insignificant relative to (1) and (3), suggesting that the exceptional increase in the 2021 loss ratio is largely attributable to the unusually high NatCat losses rather than to COVID-19 effects. The evidence suggests that hypothesis H4 can only be regarded as partially supported, as the decrease is restricted to 2020.

The year dummies of the personal accident line show negative coefficients in both years and across all specifications, with only the year 2021 being statistically significant, indicating a decrease of about 4 percentage points across all four specifications compared to the reference period. Since the personal accident line represents a classic long-tail business in terms of claims settlement, some time lag in reserve adjustments is possible, so that COVID-19 effects from 2020 may only become visible in the loss ratios of 2021. As the effects in this line reach significance in only one of the two COVID-19 years, the evidence can be considered to provide only partial support for hypothesis H5.

Within the liability line, the coefficients are consistently negative, while statistical significance emerges only in the year 2020 and exclusively in specifications (2) and (4), which points to weak support for hypothesis H6.

In analyzing the regression results for the overall business, particular attention is given to specifications (2) and (4), as the portfolio as a whole is characterized by substantial NatCat exposure. This includes not only the previously discussed motor and household contents lines but also, for example, the homeowners building line, which was excluded from the individual analyses due to its disproportionately high NatCat exposure. Both specifications indicate a decline of approximately 3 percentage points in 2020 relative to the reference years. This decline is likely driven primarily by the sharp reduction in losses in the motor line, which represented around 30% of the overall business in 2020.

Table 2.4 Estimated effects of the COVID-19 period (2020-2021) on loss ratios (LR)

	Overall business				Motor			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
LR_{t-1}			0.220***	0.231***			0.338***	0.316***
			(0.051)	(0.051)			(0.056)	(0.052)
COV20	-4.085***	-3.459***	-3.322***	-2.945**	-12.766***	-9.283***	-12.232***	-8.424***
	(1.283)	(1.258)	(1.207)	(1.187)	(1.375)	(1.499)	(1.186)	(1.272)
COV21	4.068***	-2.858	5.211***	-2.111	-6.939***	-8.761***	-3.273***	-4.889***
	(1.389)	(1.796)	(1.418)	(1.739)	(0.845)	(0.928)	(1.233)	(1.355)
ln_dGWP		2.440		2.726*		5.479**		4.630**
		(1.785)		(1.631)		(2.486)		(2.015)
CPI Infl.		0.072		0.020		0.641***		0.890***
		(0.117)		(0.109)		(0.171)		(0.161)
GDPG		-0.224***		-0.260***		-0.209**		-0.210**
		(0.064)		(0.064)		(0.099)		(0.101)
NatCat		0.001***		0.001***		0.003***		0.003***
		(0.000)		(0.000)		(0.000)		(0.001)
t	-0.102*	-0.222***	-0.110**	-0.220***	0.094	-0.229**	0.096*	-0.252***
	(0.053)	(0.076)	(0.043)	(0.067)	(0.057)	(0.100)	(0.051)	(0.094)
Constant	68.744***	52.884***	53.852***	35.477***	83.243***	53.873***	55.213***	32.207***
	(0.514)	(9.523)	(3.392)	(7.561)	(0.580)	(11.626)	(4.567)	(9.361)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.040	0.086	0.090	0.143	0.111	0.191	0.213	0.287
N	1,583	1,583	1,500	1,500	1,221	1,221	1,155	1,155

	Legal expenses				Household contents			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
LR_{t-1}			0.204*	0.180			0.147***	0.168***
			(0.119)	(0.113)			(0.047)	(0.045)
COV20	7.280***	1.275	7.213***	1.025	-8.852***	-10.160***	-7.711***	-9.625***
	(1.749)	(2.793)	(1.755)	(2.433)	(0.624)	(0.914)	(0.642)	(0.888)
COV21	1.161	1.664	-0.187	0.645	13.203***	-0.436	14.779***	1.012
	(1.903)	(2.066)	(1.958)	(2.162)	(2.129)	(2.316)	(2.008)	(2.209)
ln_dGWP		4.123		3.140		3.468*		3.046**
		(2.962)		(2.237)		(1.777)		(1.450)
CPI Infl.		-1.477***		-1.344***		-0.164		-0.321**
		(0.325)		(0.329)		(0.163)		(0.143)
GDPG		-0.369		-0.460		-0.359***		-0.419***
		(0.400)		(0.323)		(0.080)		(0.085)
NatCat						0.013***		0.013***
						(0.002)		(0.002)
t	-0.520***	-0.475**	-0.443***	-0.367*	-0.231***	-0.331***	-0.216***	-0.266***
	(0.117)	(0.222)	(0.109)	(0.196)	(0.049)	(0.062)	(0.044)	(0.054)
Constant	74.098***	59.047***	59.254***	49.706***	45.260***	33.497***	38.547***	27.052***
	(1.163)	(11.073)	(8.664)	(12.106)	(0.474)	(5.410)	(2.063)	(4.614)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.107	0.183	0.143	0.210	0.270	0.312	0.290	0.340
N	430	430	404	404	994	994	936	936

	Personal accident				Liability			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
LR_{t-1}			0.368***	0.359***			0.290***	0.272***
			(0.058)	(0.059)			(0.056)	(0.057)
COV20	-0.606	-1.600	-0.097	-0.478	-1.254	-4.079**	-1.639	-4.863**
	(1.460)	(1.721)	(1.422)	(1.704)	(1.613)	(1.889)	(1.742)	(2.070)
COV21	-3.759***	-4.480***	-3.396**	-3.941***	-1.784	-1.253	-1.863	-1.182
	(1.390)	(1.431)	(1.429)	(1.442)	(1.332)	(1.508)	(1.350)	(1.513)
ln_dGWP		1.749		0.628		9.561***		7.258***
		(3.117)		(2.100)		(2.133)		(1.927)
CPI Infl.		-0.819***		-0.454*		-0.570		-0.547*
		(0.307)		(0.242)		(0.366)		(0.299)
GDPG		0.221		0.159		-0.259		-0.338
		(0.134)		(0.137)		(0.200)		(0.208)
NatCat								
t	0.203	0.286	0.086	0.154	-0.387***	-0.592***	-0.198*	-0.339**
	(0.144)	(0.207)	(0.106)	(0.143)	(0.127)	(0.160)	(0.109)	(0.146)
Constant	43.874***	37.988***	28.377***	26.481***	53.195***	20.791***	36.803***	13.283**
	(1.391)	(10.407)	(3.102)	(7.103)	(1.232)	(7.468)	(3.221)	(5.896)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.011	0.024	0.135	0.139	0.035	0.063	0.105	0.124
N	1,098	1,098	1,036	1,036	1,079	1,079	1,016	1,016

Note: All regressions are estimated using panel fixed effects. Robust standard errors are clustered at the company level. The dependent variable is loss ratio (*LR*); the key independent variables are the COVID-19 year dummies (*COV20* and *COV21*). The four model variants are specified as follows: (1) COVID-19 dummies plus a time trend; (2) as in (1) plus economic controls; (3) lagged LR (LR_{t-1}) plus COVID-19 dummies and a time trend; and (4) as in (3) plus economic controls. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables is provided in the Appendix.

Table 2.5 Estimated effects of the COVID-19 period (2020-2021) on expense ratios (ER)

	Overall business				Motor			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
ER_{t-1}			0.730***	0.731***			0.703***	0.656***
			(0.052)	(0.053)			(0.038)	(0.035)
COV20	0.062	-0.294	0.182	-0.141	0.657	0.837	1.046	0.896
	(0.160)	(0.240)	(0.125)	(0.281)	(0.587)	(0.725)	(0.765)	(0.887)
COV21	0.054	0.066	0.146	0.588*	0.837	1.172*	0.486	0.848**
	(0.156)	(0.328)	(0.128)	(0.347)	(0.619)	(0.655)	(0.405)	(0.393)
ln_dGWP		-1.512		0.091		-3.833***		-2.384**
		(1.246)		(0.528)		(1.090)		(1.056)
CPI Infl.		-0.045		0.010		0.224*		0.134**
		(0.062)		(0.026)		(0.121)		(0.055)
GDPG		-0.053**		-0.054		-0.068***		-0.056**
		(0.025)		(0.038)		(0.022)		(0.024)
NatCat		0.000		-0.000		-0.000		-0.000**
		(0.000)		(0.000)		(0.000)		(0.000)
t	0.039	0.102**	-0.006	-0.014	0.040	0.104***	-0.006	0.040
	(0.040)	(0.042)	(0.011)	(0.018)	(0.035)	(0.035)	(0.010)	(0.026)
Constant	27.661***	35.725***	7.675***	7.397**	17.480***	35.869***	5.416***	17.843***
	(0.389)	(6.808)	(1.487)	(3.337)	(0.353)	(5.205)	(0.655)	(5.333)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.008	0.019	0.585	0.587	0.017	0.129	0.479	0.517
N	1,583	1,583	1,500	1,500	1,221	1,221	1,155	1,155

	Legal expenses				Household contents			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
ER_{t-1}			0.574***	0.507***			0.651***	0.646***
			(0.082)	(0.106)			(0.074)	(0.073)
COV20	0.170	-0.317	-0.076	-0.693**	-0.372	-0.399	-0.082	-0.253
	(0.329)	(0.375)	(0.269)	(0.326)	(0.300)	(0.436)	(0.223)	(0.335)
COV21	-0.544***	-0.762***	-0.689***	-0.660***	-0.063	-0.259	0.113	0.171
	(0.193)	(0.233)	(0.201)	(0.201)	(0.385)	(1.076)	(0.312)	(0.805)
ln_dGWP		2.683***		1.871***		1.649		1.165
		(0.529)		(0.482)		(2.078)		(0.930)
CPI Infl.		-0.218***		-0.130*		-0.058		-0.037
		(0.075)		(0.069)		(0.104)		(0.062)
GDPG		0.035		-0.043		0.024		-0.010
		(0.037)		(0.039)		(0.035)		(0.043)
NatCat						0.000		-0.000
						(0.001)		(0.001)
t	0.004	-0.081	0.007	-0.056	0.054	0.021	0.036	0.012
	(0.046)	(0.055)	(0.023)	(0.037)	(0.056)	(0.068)	(0.026)	(0.043)
Constant	29.528***	18.884***	12.493***	7.101**	34.632***	29.617***	11.866***	8.524**
	(0.458)	(2.093)	(2.367)	(2.879)	(0.552)	(6.418)	(2.529)	(4.243)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.004	0.112	0.282	0.330	0.007	0.015	0.478	0.482
N	430	430	404	404	994	994	936	936

	Personal accident				Liability			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
ER_{t-1}			0.697***	0.701***			0.747***	0.737***
			(0.018)	(0.018)			(0.031)	(0.031)
COV20	-0.507	-0.825	-0.247	-0.857**	-0.557*	-0.761*	-0.207	-0.567*
	(0.394)	(0.563)	(0.252)	(0.341)	(0.279)	(0.425)	(0.243)	(0.328)
COV21	-0.901**	-0.767	-0.779**	-0.439	-0.113	-0.031	0.355	0.580**
	(0.424)	(0.476)	(0.358)	(0.371)	(0.242)	(0.282)	(0.248)	(0.269)
ln_dGWP		-0.627		0.280		-2.645***		-1.101***
		(1.808)		(0.500)		(0.991)		(0.364)
CPI Infl.		-0.011		0.027		-0.008		0.038
		(0.137)		(0.054)		(0.088)		(0.037)
GDPG		-0.054		-0.129**		-0.032		-0.086**
		(0.040)		(0.052)		(0.032)		(0.036)
NatCat								
t	-0.214***	-0.195**	-0.053**	-0.069**	0.071	0.152**	0.010	0.034
	(0.061)	(0.084)	(0.021)	(0.029)	(0.050)	(0.061)	(0.017)	(0.022)
Constant	38.626***	40.883***	11.524***	10.600***	35.331***	44.558***	9.048***	13.361***
	(0.594)	(6.313)	(0.765)	(1.846)	(0.498)	(3.478)	(1.180)	(1.731)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.099	0.101	0.580	0.585	0.016	0.048	0.557	0.566
N	1,098	1,098	1,036	1,036	1,079	1,079	1,016	1,016

Note: All regressions are estimated using panel fixed effects. Robust standard errors are clustered at the company level. The dependent variable is expense ratio (*ER*); the key independent variables are the COVID-19 year dummies (*COV20* and *COV21*). The four model variants are specified as follows: (1) COVID-19 dummies plus a time trend; (2) as in (1) plus economic controls; (3) lagged ER (ER_{t-1}) plus COVID-19 dummies and a time trend; and (4) as in (3) plus economic controls. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables is provided in the Appendix.

Table 2.6 Estimated effects of the COVID-19 period (2020-2021) on combined ratios (CR)

	Overall business				Motor			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CR_{t-1}			0.209***	0.220***			0.351***	0.338***
			(0.045)	(0.045)			(0.058)	(0.057)
COV20	-4.023***	-3.754***	-3.205***	-3.173***	-12.110***	-8.446***	-11.341***	-7.517***
	(1.278)	(1.246)	(1.195)	(1.172)	(1.015)	(1.035)	(0.907)	(0.942)
COV21	4.122***	-2.792	5.301***	-1.693	-6.102***	-7.589***	-2.451*	-3.594**
	(1.390)	(1.822)	(1.407)	(1.769)	(1.089)	(1.202)	(1.357)	(1.504)
ln_dGWP		0.928		2.158		1.646		1.288
		(1.788)		(1.478)		(2.156)		(1.307)
CPI Infl.		0.027		0.012		0.865***		1.086***
		(0.127)		(0.117)		(0.167)		(0.159)
GDPG		-0.277***		-0.315***		-0.277***		-0.271***
		(0.063)		(0.064)		(0.097)		(0.096)
NatCat		0.001***		0.001***		0.003***		0.003***
		(0.000)		(0.000)		(0.000)		(0.001)
t	-0.062	-0.120	-0.093**	-0.182**	0.134**	-0.125	0.109*	-0.177**
	(0.049)	(0.080)	(0.040)	(0.070)	(0.064)	(0.100)	(0.055)	(0.084)
Constant	96.406***	88.609***	76.681***	61.109***	100.723***	89.742***	65.679***	58.205***
	(0.472)	(9.534)	(4.338)	(7.530)	(0.600)	(10.279)	(5.885)	(6.245)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.036	0.082	0.083	0.134	0.090	0.158	0.203	0.272
N	1,583	1,583	1,500	1,500	1,221	1,221	1,155	1,155

	Legal expenses				Household contents			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CR_{t-1}			0.195	0.146			0.312***	0.325***
			(0.116)	(0.108)			(0.061)	(0.053)
COV20	7.450***	0.958	7.307***	0.630	-9.224***	-10.559***	-6.540***	-9.219***
	(1.844)	(2.859)	(1.843)	(2.498)	(0.730)	(1.141)	(0.721)	(1.002)
COV21	0.617	0.902	-0.714	0.041	13.140***	-0.695	16.740***	2.603
	(1.924)	(2.070)	(2.049)	(2.153)	(2.138)	(2.623)	(2.036)	(2.362)
ln_dGWP		6.806**		5.943**		5.118		4.262*
		(3.125)		(2.571)		(3.606)		(2.294)
CPI Infl.		-1.695***		-1.572***		-0.221		-0.457***
		(0.329)		(0.352)		(0.216)		(0.166)
GDPG		-0.334		-0.421		-0.335***		-0.485***
		(0.408)		(0.343)		(0.088)		(0.104)
NatCat						0.013***		0.014***
						(0.002)		(0.002)
t	-0.516***	-0.557**	-0.441***	-0.461*	-0.177**	-0.310***	-0.170***	-0.230***
	(0.129)	(0.243)	(0.116)	(0.226)	(0.084)	(0.100)	(0.063)	(0.080)
Constant	103.625***	77.931***	83.626***	66.143***	79.892***	63.114***	54.887***	39.701***
	(1.263)	(11.568)	(11.772)	(14.730)	(0.834)	(11.131)	(4.880)	(8.935)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.101	0.204	0.132	0.223	0.202	0.241	0.296	0.347
N	430	430	404	404	994	994	936	936

	Personal accident				Liability			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CR_{t-1}			0.399***	0.392***			0.299***	0.291***
			(0.055)	(0.056)			(0.053)	(0.054)
COV20	-1.114	-2.426	-0.338	-1.158	-1.811	-4.841**	-2.037	-5.630***
	(1.521)	(1.830)	(1.435)	(1.753)	(1.650)	(1.908)	(1.750)	(2.073)
COV21	-4.660***	-5.248***	-4.201***	-4.475***	-1.898	-1.284	-1.755	-0.859
	(1.375)	(1.419)	(1.421)	(1.437)	(1.321)	(1.534)	(1.357)	(1.542)
ln_dGWP		1.122		0.629		6.916***		4.967**
		(3.752)		(2.206)		(2.351)		(1.998)
CPI Infl.		-0.830**		-0.417*		-0.578		-0.523
		(0.333)		(0.243)		(0.385)		(0.314)
GDPG		0.167		0.057		-0.291		-0.417**
		(0.138)		(0.145)		(0.201)		(0.208)
NatCat								
t	-0.011	0.091	-0.047	0.010	-0.316**	-0.441**	-0.151	-0.225
	(0.150)	(0.213)	(0.113)	(0.145)	(0.134)	(0.173)	(0.113)	(0.150)
Constant	82.499***	78.870***	50.123***	48.605***	88.526***	65.349***	61.124***	45.511***
	(1.458)	(12.747)	(5.055)	(8.009)	(1.297)	(8.105)	(4.891)	(6.723)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.009	0.020	0.161	0.163	0.025	0.043	0.103	0.116
N	1,098	1,098	1,036	1,036	1,079	1,079	1,016	1,016

Note: All regressions are estimated using panel fixed effects. Robust standard errors are clustered at the company level. The dependent variable is combined ratio (C*R*); the key independent variables are the COVID-19 year dummies (*COV20* and *COV21*). The four model variants are specified as follows: (1) COVID-19 dummies plus a time trend; (2) as in (1) plus economic controls; (3) lagged CR (CR_{t-1}) plus COVID-19 dummies and a time trend; and (4) as in (3) plus economic controls. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables is provided in the Appendix.

With regard to the control variables, several systematic patterns emerge. The control variable for size, measured by the gross written premiums of direct business, exhibits a positive relationship with the loss ratio across all lines. This finding suggests a negative association between firm size and profitability, which is consistent with the observations of Choi and Weiss (2005) and Moro and Anderloni (2014).

The relationship between CPI inflation and the loss ratio varies across lines of business. For instance, the motor line shows a positive association, which may be attributable to the fact that premium adjustments in response to inflationary pressures tend to occur with a lag. More broadly, however, the heterogeneity of results raises the question of the extent to which CPI inflation can adequately capture claims inflation in individual lines. In lines such as legal expenses or personal accident, for example, the cost dynamics driven by legal representation or medical inflation may diverge substantially from general consumer price developments.

The control variable GDP growth exhibits a negative relationship with the loss ratio in almost all lines. This may be explained by the fact that higher GDP growth is typically associated with rising incomes and increased demand for insurance, which in turn can enhance underwriting profitability. Overall, the observed positive association between GDP growth and profitability aligns with prior empirical evidence (e.g., Batool and Sahi, 2019; Chen et al., 1999; Dorofti and Jakubik, 2015; Zinyoroa and Aziakpono, 2024).

The variable NatCats shows a statistically significant positive association with loss ratios, which is unsurprising given that insured catastrophe losses are covered by insurers and thus directly increase the loss ratio.

The time trend control exhibits a significantly negative coefficient in nearly all lines. This likely reflects that, during the low-interest-rate period under study, declining investment returns constrained cash flow underwriting, thereby shifting the strategic focus more strongly toward underwriting profitability.

Table 2.5 reports the regression results on the effects of the COVID-19 pandemic years on expense ratios. Across all lines, the inclusion of the lagged dependent variable ER_{t-1} in specifications (3) and (4) substantially increases the R^2, indicating strong persistence of the expense ratio. With regard to the impact of the COVID-19 years 2020 and 2021, the results show that the maximum deviation of expense ratios relative to the reference years does not exceed 1 percentage point, both for the overall business and for each individual line. Deviations are mixed in sign, with some lines showing slight increases (e.g., motor in 2021) and others slight decreases (e.g., legal expenses in 2020), but in all cases the magnitude remains small. This limited variation supports hypothesis H7, which posits that the pandemic years did not materially affect expense ratios.

Table 2.6 shows the regression results for the combined ratio. The estimates closely mirror those for the loss ratio, reflecting the fact that the loss ratio accounts for most of the variation in the combined ratio. Moreover, the regressions for the expense ratio reveal no material deviations during the COVID-19 years relative to the reference period. Overall, the evidence indicates that the unusual volatility in underwriting profitability during the pandemic was driven by claims dynamics rather than by expense changes, thereby supporting hypothesis H8.

2.6 Discussion

Table 2.7 summarizes the eight hypotheses and the corresponding findings. In short, premium growth across business lines showed little change, while underwriting profitability improved, most clearly in the motor line and, to a lesser extent, in household contents and personal accident insurance.

Table 2.7 Summary of hypothesis and results

	Hypothesis	Expected effect	Result
H1	The COVID-19 pandemic years are not associated with substantial changes in premium growth, either at the aggregate market level or across individual lines of business.	No notable effect	Supported
H2	The COVID-19 pandemic years are associated with a reduction in the loss ratio of the motor line.	↓LR	Supported
H3	The COVID-19 pandemic years are associated with an increase in the loss ratio of the legal expenses line.	↑LR	Weak support (only in 2020 and in two of four model specifications)
H4	The COVID-19 pandemic years are associated with a reduction in the loss ratio of the household contents line.	↓LR	Partially supported (only in 2020)
H5	The COVID-19 pandemic years are associated with a reduction in the loss ratio of the personal accident line.	↓LR	Partially supported (only in 2021)
H6	The COVID-19 pandemic years are associated with a reduction in the loss ratio of the liability line.	↓LR	Weak support (only in 2020 and in two of four model specifications)
H7	The COVID-19 pandemic years are not associated with substantial changes in the expense ratio, either at the aggregate market level or across individual lines of business.	No notable effect	Supported
H8	The impact of the COVID-19 pandemic years on underwriting profitability, as measured by the combined ratio, is primarily driven by loss ratios rather than expenses.	LR dominates CR	Supported

Note: Overview of all eight hypotheses, the expected effects, and the corresponding results.

In general, the results are consistent with observations from practice as well as with findings reported in the broader academic literature on COVID-19 across various disciplines. For example, the observed premium stability during the COVID-19 years (H1) is confirmed in industry reports by the German Insurance Association (GDV, 2021b).

With regard to the motor line, the decline in the loss ratio during the COVID-19 years (H2) aligns with evidence from the literature, which attributes this development to the pandemic itself, in particular to behavioral adjustments and policy interventions. Bönisch et al. (2020) demonstrate that both lockdown measures and voluntary precautionary behavior during the pandemic led to a decline in overall mobility in Germany in 2020. While Anke et al. (2021) and Kolarova et al. (2021) show that the car gained relative importance over public transport during COVID-19, the absolute level of car use nevertheless declined substantially (Aravindakshan et al., 2020; Ecke et al., 2021). Wegman and Katrakazas (2021) estimate that vehicle kilometers driven in Germany decreased by more than 10% in 2020 compared to the average of previous years, which also contributed to a reduction in road fatalities. Official statistics confirm comparable reductions in police-recorded accidents, both those involving personal injury and those involving only property damage, for 2020 and 2021 (Destatis, 2025b). Taken together, this evidence suggests that lower mileage translated into reduced claim frequency and, ultimately, lower losses.

Whereas the motor line exhibits a robust decline in the loss ratio across both COVID-19 years, the results for the other lines are more nuanced and less consistent. For household contents (H4) and personal accident (H5), COVID-19 effects are observed consistently across model specifications, but only in one of the two years, while legal expenses (H3) and liability (H6) show weaker patterns.

The reduction in the household contents loss ratio in 2020 can partly be explained by shifts in key peril categories. Burglary-related claims, which account for roughly one third of total household contents losses, declined by about 20% in both 2020 and 2021, consistent with criminological evidence of fewer residential burglaries during COVID-19 due to increased home occupancy (GDV, 2024a; Habermann and Zech, 2022; Wollinger et al., 2021). In addition, NatCat claims were comparatively low in 2020 but exceptionally high in 2021 following the Rhine valley floods. Although not directly related to COVID-19, this likely reinforced the decline in 2020 while offsetting it in 2021, a pattern also captured in regression specifications controlling for NatCat effects.

The decline in the personal accident loss ratio in 2021 can largely be explained by the exceptional reduction in trauma accidents during the COVID-19 period. Health studies using data from German emergency departments report a general decrease in trauma patients in 2020 and 2021, with particularly sharp reductions during lockdown phases: up to 80% in sports injuries, 40% in leisure-time injuries, and 30% in traffic accidents. Despite the shift of daily life into the home, household accidents did not show a substantial increase and, in some cases, even declined (Frink et al., 2023; Hegenberg et al., 2023; Maleitzke et al., 2021; Messler et al., 2023; Schappacher et al., 2022). Given that the personal accident line represents a classic long-tail business, it is plausible that COVID-19 effects from 2020 only became visible in the loss ratios of 2021 due to time lags in claims settlement and reserve adjustments.

While the regression results provide only weak evidence for an increase in the legal expenses loss ratio, industry data suggest a potential COVID-19-related rise. In 2020, the number of initial telephone consultations rose by more than 20%, primarily driven by inquiries regarding cost reimbursement for cancelled trips and issues related to labor law (GDV, 2021a). By contrast, there is little evidence in the liability line to explain a reduction in loss ratios, and the regression results are also weakest for this line across all model specifications. Only a few insurers mention the reduction in social contacts due to contact restrictions as a potential influencing factor for the liability line in their 2020 annual reports.

With respect to expenses and overall underwriting profitability (H7 and H8), the results confirm that expense ratios did not undergo substantial changes during the COVID-19 years. This suggests that insurers' cost structures remained largely unaffected by the pandemic. At the same time, developments in underwriting profitability were primarily driven by shifts in loss ratios rather than expenses. Hence, the evidence indicates that the impact of COVID-19 on insurers materialized predominantly on the claims side, while operating expenses remained stable.

A comparison with previously studied P&C insurance markets reveals notable differences in premium stability. While the German market remained relatively stable, developing economies and markets with low insurance penetration experienced a substantial decline in premium volumes in 2020 (Babuna et al., 2020; Haque et al., 2021; Stojkoski et al., 2021; Wang et al., 2020). This may be explained by the structural stability of the German market, characterized by long-term contractual relationships, in contrast to many developing countries where insurance is often seen as a luxury good and thus more vulnerable to cancellations in times of crisis. In addition, extensive government support measures during the pandemic (e.g., short-time work schemes, subsidized loans) likely helped to reduce policy cancellation rates in Germany.

As with any empirical analysis, this study is subject to certain limitations that should be considered when interpreting the results. First, the investigation cannot disentangle whether the behavioral changes and their effects on losses are primarily attributable to fear of the virus itself or to government-imposed lockdown measures. Furthermore, the reliance on annual financial statement data necessitates the use of COVID-19 year dummies, which constrains the precision of the analysis. Consequently, while it appears unlikely, it cannot be entirely ruled out that factors other than COVID-19 and NatCats may have contributed to substantial changes during the two observed years. In addition, it remains uncertain whether the profitability increases observed in specific business lines, such as motor insurance, will provide an enduring advantage for insurers. These additional gains, resulting from temporarily reduced losses, may ultimately be transferred back to policyholders through refunds or lower premiums in subsequent periods. Finally, given that the analysis is limited to Germany, the findings may not be fully generalizable to other countries, as the scope, design, and enforcement of lockdown measures varied substantially across countries.

2.7 Conclusion

The findings suggest that COVID-19 had a measurable impact on underwriting profitability in the German P&C insurance industry, both overall and across individual business lines. While premium volume was largely unaffected, underwriting profitability improved, driven mainly by reduced claims in the motor line due to lower traffic volumes and fewer accidents. Additional gains were observed in household contents and personal accident insurance, reflecting declines in burglaries and trauma-related accidents. Overall, the improvements in underwriting profitability were primarily loss-driven rather than expense-driven.

Taken together, the results indicate that the German P&C insurance industry, operating in a market with high penetration and density, showed resilience to pandemic related shocks. In fact, underwriting profitability benefited from behavioral changes among policyholders, with certain lines, such as motor insurance, profiting particularly from lockdown related reductions in losses.

2.8 Appendix

Table 2.8 Main insured perils and losses by line of business

Line of business	Main insured perils and losses
Fire	Buildings or movable property destroyed or damaged by fire, lightning, or explosion
Homeowners Building	Residential buildings destroyed or damaged by fire, lightning, explosion, escape of water from pipes, or natural catastrophes
Household Contents	Entire household contents destroyed or damaged by fire, lightning, explosion, burglary, escape of water from pipes, or natural catastrophes
Legal Expenses	Legal expenses related to the pursuit of legal interests (main areas: private, commercial, and traffic legal protection)
Liability	Event directly causing damage to a third party (bodily injury, property damage, or resulting financial loss) for which the insured may be held legally liable (main areas: personal, pet owner's, property owner's, business/professional, and product/environmental liability)
Motor	Motor liability: Bodily injury, property damage, or resulting financial loss to a third party caused by the insured vehicle Comprehensive motor: Damage, destruction, total loss, or loss of the insured vehicle caused by fire, explosion, theft, natural catastrophes, or accident
Personal Accident	Accident or involuntary impairment of health of the insured person

Note: Overview of the principal lines of business in the German P&C insurance industry, including the associated main insured perils and losses in accordance with the model policy conditions of the German Insurance Association (GDV, 2025). The lines of business are presented in alphabetical order.

Table 2.9 Description and sources of determinants

Variable name	Variable description, and source
Δln_dGWP	Direct gross written premium growth rate; calculated as the log difference of direct gross written premiums. Source: KIVI GmbH
LR	Loss ratio; ratio of losses incurred (gross claims payments + change in gross loss reserve) to earned premiums. Source: KIVI GmbH
ER	Expense ratio; ratio of expenses (gross acquisition costs + gross administrative expenses) to earned premiums. Source: KIVI GmbH
CR	Combined ratio; ratio of losses incurred and expenses to earned premiums. Source: KIVI GmbH
COV20	COVID-19 year dummy 2020.
COV21	COVID-19 year dummy 2021.
ln_dGWP	Natural logarithm of direct gross written premiums. Source: KIVI GmbH
CPI Infl.	German consumer price inflation rate. Source: Destatis
GDPG	German gross domestic product (GDP) growth rate. Source: Destatis
NatCat	Natural catastrophe losses by line, including storm, hail, and other elemental perils. Source: German Insurance Association (GDV)
t	Linear time trend ranging from 0 (2004) to 19 (2023).

Table 2.10 Estimated effects of the COVID-19 period (2020-2021) on premium growth in the fire and homeowners building line

	Fire		Homeowners Building	
	(1)	(2)	(1)	(2)
COV20	-0.019	-0.031	-0.016***	-0.027***
	(0.015)	(0.023)	(0.005)	(0.008)
COV21	0.033	0.049	-0.010	0.011
	(0.040)	(0.041)	(0.017)	(0.024)
CPI Infl.		0.007*		0.004*
		(0.004)		(0.002)
GDPG		-0.005***		-0.004***
		(0.001)		(0.001)
NatCat				-0.000
				(0.000)
t	0.007***	0.006***	0.004***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-0.040***	-0.034***	0.037***	0.048***
	(0.009)	(0.008)	(0.008)	(0.007)
Company FE	Yes	Yes	Yes	Yes
R^2 (within)	0.148	0.167	0.045	0.056
N	542	542	950	950

Note: All regressions are estimated using panel fixed effects. Robust standard errors are clustered at the company level. The dependent variable is premium growth (Δln_dGWP); the key independent variables are the COVID-19 year dummies (COV20 and COV21). Variant (1) includes only the COVID-19 dummies for 2020 and 2021 together with a time trend, while variant (2) additionally incorporates further control variables. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 2.11 Estimated effects of the COVID-19 period (2020-2021) on loss ratios (LR) in the fire and homeowners building line

	Fire				Homeowners Building			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
LR_{t-1}			-0.050	-0.077			0.008	0.029
			(0.070)	(0.063)			(0.030)	(0.027)
COV20	-8.109	-14.467*	-10.140*	-16.511**	-12.157***	-2.880**	-11.523***	-2.634*
	(5.974)	(7.108)	(5.567)	(6.808)	(0.875)	(1.416)	(1.100)	(1.475)
COV21	-4.556	-5.207	-5.387	-6.731*	31.238***	-9.262	32.157***	-9.847
	(4.236)	(4.146)	(3.981)	(3.922)	(4.052)	(5.956)	(4.330)	(6.035)
ln_dGWP		10.368**		13.736**		-2.751		-0.962
		(4.647)		(5.459)		(3.392)		(2.595)
CPI Infl.		-1.309		-1.346		1.139***		1.107***
		(1.042)		(1.167)		(0.247)		(0.247)
GDPG		-0.438		-0.411		-0.152		-0.236
		(0.528)		(0.511)		(0.193)		(0.196)
NatCat						0.008***		0.009***
						(0.001)		(0.001)
t	0.813***	0.767***	0.726**	0.605*	-0.477***	-0.356	-0.656***	-0.570**
	(0.244)	(0.261)	(0.283)	(0.331)	(0.078)	(0.258)	(0.083)	(0.220)
Constant	55.784***	26.264*	60.241***	22.084	82.243***	69.132***	83.815***	61.728***
	(2.231)	(14.227)	(4.918)	(17.132)	(0.775)	(10.749)	(2.635)	(7.980)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.026	0.043	0.021	0.047	0.173	0.420	0.187	0.442
N	582	582	542	542	1,012	1,012	950	950

Note: All regressions are estimated using panel fixed effects. Robust standard errors are clustered at the company level. The dependent variable is loss ratio (LR); the key independent variables are the COVID-19 year dummies (COV20 and COV21). The four model variants are specified as follows: (1) COVID-19 dummies plus a time trend; (2) as in (1) plus economic controls; (3) lagged LR (LR_{t-1}) plus COVID-19 dummies and a time trend; and (4) as in (3) plus economic controls. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 2.12 Estimated effects of the COVID-19 period (2020-2021) on expense ratios (ER) in the fire and homeowners building line

	Fire				Homeowners Building			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
ER_{t-1}			0.855***	0.844***			0.506***	0.507***
			(0.043)	(0.051)			(0.155)	(0.157)
COV20	-1.414	-1.030	-0.415	-0.260	-0.311	-0.472	-0.114	-0.442
	(0.947)	(0.876)	(0.352)	(0.450)	(0.306)	(0.427)	(0.202)	(0.294)
COV21	-1.249*	0.163	0.469	0.638	0.446	0.232	0.660**	0.454
	(0.735)	(0.648)	(0.411)	(0.450)	(0.311)	(0.496)	(0.250)	(0.399)
ln_dGWP		-7.199**		-0.525		-0.719		-0.351
		(3.501)		(0.628)		(1.555)		(0.786)
CPI Infl.		0.231		0.117*		0.047		0.035
		(0.225)		(0.064)		(0.128)		(0.079)
GDPG		-0.122*		-0.032		-0.065		-0.093**
		(0.066)		(0.051)		(0.044)		(0.040)
NatCat						0.000		0.000
						(0.000)		(0.000)
t	-0.095	0.029	-0.047**	-0.056*	-0.147***	-0.105	-0.074***	-0.057
	(0.092)	(0.098)	(0.020)	(0.030)	(0.054)	(0.105)	(0.028)	(0.042)
Constant	34.205***	55.847***	5.142***	7.076**	30.624***	32.769***	14.996***	15.968**
	(0.925)	(10.530)	(1.472)	(3.096)	(0.539)	(5.026)	(4.656)	(6.361)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.023	0.216	0.760	0.762	0.056	0.060	0.293	0.297
N	582	582	542	542	1,012	1,012	950	950

Note: All regressions are estimated using panel fixed effects. Robust standard errors are clustered at the company level. The dependent variable is expense ratio (ER); the key independent variables are the COVID-19 year dummies (COV20 and COV21). The four model variants are specified as follows: (1) COVID-19 dummies plus a time trend; (2) as in (1) plus economic controls; (3) lagged ER (ER_{t-1}) plus COVID-19 dummies and a time trend; and (4) as in (3) plus economic controls. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 2.13 Estimated effects of the COVID-19 period (2020-2021) on combined ratios (CR) in the fire and homeowners building line

	Fire				Homeowners Building			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CR_{t-1}			-0.086	-0.095			0.032	0.056**
			(0.057)	(0.061)			(0.030)	(0.026)
COV20	-9.523*	-15.497**	-11.543**	-17.632***	-12.468***	-3.352**	-11.453***	-2.953*
	(5.576)	(6.775)	(5.026)	(6.373)	(0.974)	(1.539)	(1.212)	(1.591)
COV21	-5.804	-5.044	-6.687*	-6.658	31.685***	-9.030	33.115***	-9.238
	(4.015)	(4.128)	(3.688)	(3.936)	(4.100)	(6.056)	(4.358)	(6.077)
ln_dGWP		3.169		6.361**		-3.470		-1.228
		(2.265)		(2.856)		(4.366)		(3.228)
CPI Infl.		-1.078		-1.176		1.186***		1.043***
		(1.035)		(1.171)		(0.292)		(0.276)
GDPG		-0.560		-0.505		-0.217		-0.300
		(0.539)		(0.521)		(0.194)		(0.210)
NatCat						0.008***		0.009***
						(0.001)		(0.001)
t	0.718***	0.797***	0.629**	0.655**	-0.623***	-0.461	-0.800***	-0.680**
	(0.236)	(0.250)	(0.280)	(0.311)	(0.092)	(0.338)	(0.094)	(0.276)
Constant	89.989***	82.111***	99.588***	82.796***	112.867***	101.900***	111.410***	89.067***
	(2.104)	(7.369)	(5.789)	(8.926)	(0.930)	(13.642)	(3.529)	(9.824)
Company FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.022	0.028	0.023	0.032	0.176	0.416	0.192	0.438
N	582	582	542	542	1,012	1,012	950	950

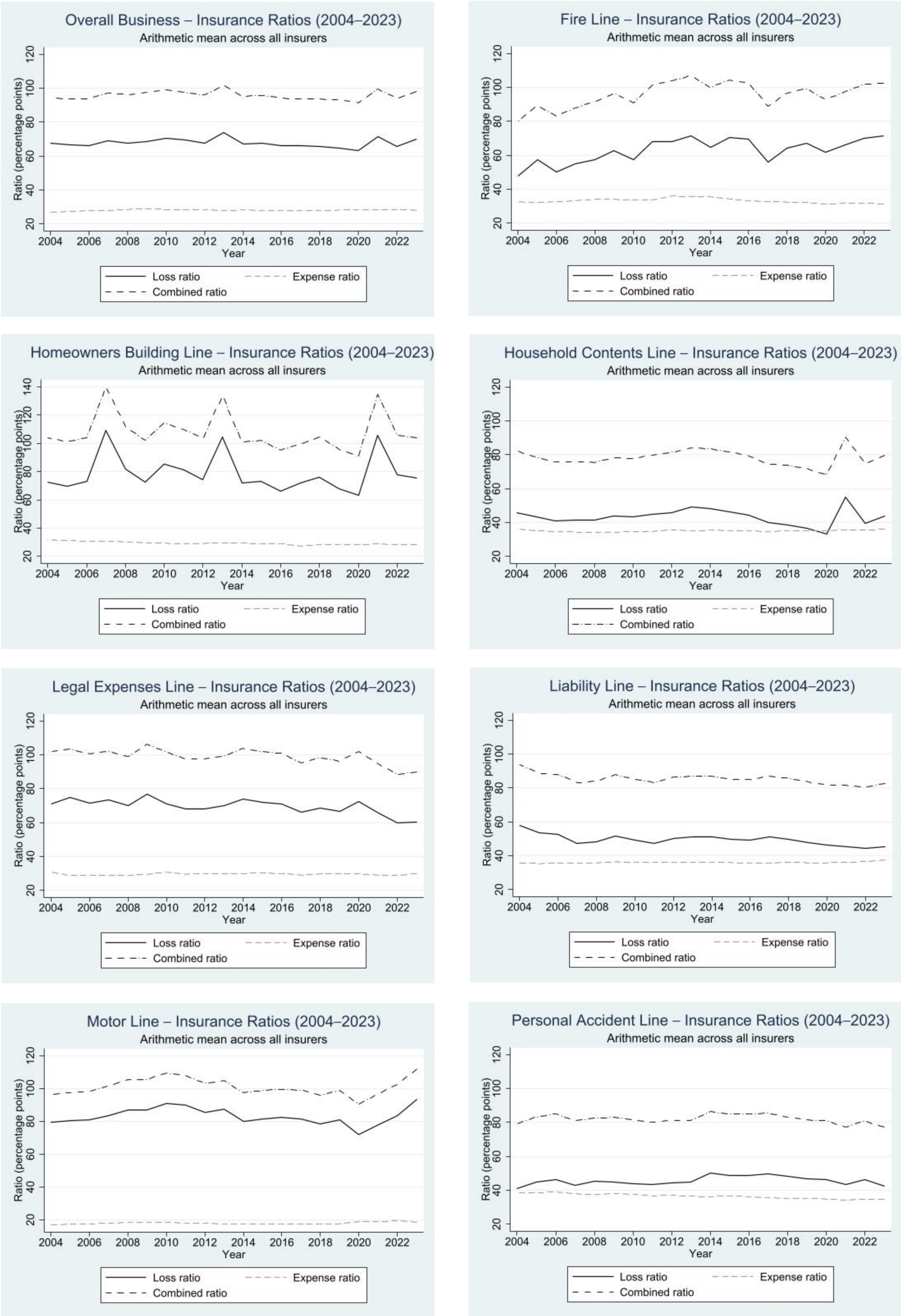
Note: All regressions are estimated using panel fixed effects. Robust standard errors are clustered at the company level. The dependent variable is combined ratio (CR); the key independent variables are the COVID-19 year dummies (COV20 and COV21). The four model variants are specified as follows: (1) COVID-19 dummies plus a time trend; (2) as in (1) plus economic controls; (3) lagged CR (CR_{t-1}) plus COVID-19 dummies and a time trend; and (4) as in (3) plus economic controls. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 2.14 Share of total market premium volume covered by the sample, by line of business and year

	Overall business	Fire	Homeowners Building	Household Contents	Legal Expenses	Liability	Motor	Personal Accident
2023	75.81	55.78	93.25	91.75	92.79	61.01	89.13	92.45
2022	75.22	52.35	94.16	90.33	92.78	60.27	88.21	92.87
2021	77.12	53.44	94.81	91.53	93.56	62.48	88.75	93.36
2020	75.21	50.04	89.76	88.35	93.84	63.71	86.73	91.81
2019	75.99	54.45	89.53	88.15	92.98	66.03	86.57	91.85
2018	76.15	55.94	87.79	85.40	92.30	67.26	85.48	89.14
2017	76.27	55.96	87.25	84.61	92.70	68.26	85.52	88.69
2016	79.00	60.08	86.84	85.51	94.43	70.26	88.57	88.59
2015	76.91	58.71	85.11	83.76	91.94	68.73	87.65	87.95
2014	77.55	64.15	84.80	84.45	81.31	70.63	87.28	88.43
2013	76.66	64.63	84.02	83.85	80.72	72.07	87.60	88.34
2012	76.33	67.23	83.19	83.70	80.18	73.06	87.29	87.46
2011	74.82	64.36	82.29	82.00	73.64	70.11	86.53	87.03
2010	74.90	65.20	82.10	82.23	69.77	70.55	86.63	86.74
2009	69.40	63.90	78.36	77.54	66.78	67.16	82.83	77.16
2008	69.99	64.20	77.03	75.92	66.18	65.31	81.03	75.03
2007	68.51	61.09	76.79	76.10	63.83	64.06	81.29	74.85
2006	69.12	61.82	76.58	75.03	63.38	62.43	81.53	74.37
2005	65.21	60.27	73.35	70.53	63.39	60.98	76.22	66.25
2004	62.40	61.13	72.17	68.18	62.16	57.82	70.26	65.79
Ø	73.63	59.74	83.96	82.45	80.43	66.11	84.75	84.41

Note: Market coverage of the sample across lines of business and years, calculated relative to the official market volume (gross written premiums in direct business) reported by the German supervisory authority BaFin (Bundesanstalt für Finanzdienstleistungsaufsicht, 2025). Values represent percentages.

Table 2.15 Development of insurance ratios over time by line of business



Note: Graphical illustration of the development of insurance ratios (loss ratio, expense ratio, combined ratio) for all insurers in the sample (arithmetic mean) over the observation period 2004-2023, disaggregated by line of business.

3. Essay 3: The Cyber-ILS market two years on: Status quo, learnings, and future developments

Abstract

With the issuance of the first pure Cyber CAT bond in 2023, a new market for Cyber-ILS has emerged, reaching a total volume of over $900 million in issued bonds within just over two years. To develop a holistic understanding of this still nascent market, we conducted semi-structured interviews with Cyber-ILS experts from the sponsor side and systematically analyzed the collected data. Our results show that the market launch is primarily attributable to capacity shortages in the cyber reinsurance sector, rising reinsurance prices, improvements in cyber risk modeling, and enhanced cyber risk education among investors. Moreover, there is broad consensus among sponsors regarding the preferred short duration of Cyber-ILS instruments, whereas opinions diverge significantly on the structuring of triggers and the appropriate level of diversification. The insights are relevant not only from a theoretical perspective but also for practitioners, as they help identify starting points to further develop the market.

Keywords: Cyber-ILS, Cyber-ILS market, Cyber CAT bond, cyber risk, ILS

3.1 Introduction

Looking at the long-term developments in the insurance-linked securities (ILS) market, it becomes apparent that, first, the market has shown a positive growth trend over the past 20 years in terms of annual issuance volume (from \$2.5 billion in 2005 to \$17.7 billion in 2024), and second, that the overall ILS market is heavily dominated by Property catastrophe (CAT) bonds (Artemis, 2025c). However, a closer analysis of more recent developments indicates a growing trend toward the securitization of pure cyber risk, which has rapidly given rise to a novel segment within the ILS market: the Cyber-ILS market. Since the issuance of the first pure Cyber CAT bond in early 2023, a total of 11 Cyber CAT bonds with a combined volume of over \$900 million have been placed on the market by March 2025. In particular, the sudden emergence of the market combined with its rapid growth raises the question of what is driving this development, especially considering that the primary cyber insurance market has already been showing high growth rates and, compared to other lines of business, exceptionally high cession rates for several years prior to the launch of the Cyber-ILS market (Eling et al., 2024).

To take a comprehensive view of the current Cyber-ILS market, this paper will not only examine the question of market drivers, but also address the following issues: What are the specific characteristics of the underlying cyber risks in Cyber-ILS? And how do these particular features of cyber risks influence the concrete product design of Cyber-ILS instruments? And finally: What specific potential does the Cyber-ILS market hold in terms of its economic impact on the broader cyber risk landscape, its growth prospects, and overall market size?

To answer these questions, we conducted semi-structured interviews with 12 high-level Cyber-ILS experts from the sponsor side. These interviews were guided by four key research dimensions: market dynamics and demand drivers, risk assessment and modeling, product development, and economic impact and future trends, which were developed based on current Cyber-ILS and cyber risk research literature as well as publicly known developments in the Cyber-ILS market. The goal is to gain comprehensive and exclusive insights and assessments from the sponsor side regarding the current dynamics of the Cyber-ILS market.

The analysis of our results can be summarized in these key points: Main drivers behind the sudden emergence of the Cyber-ILS market include capacity shortages in the reinsurance sector, increasing reinsurance costs, progress in cyber risk modeling, and enhanced investor awareness and education. The identified challenges in cyber risk assessment and modeling are consistent with insights from the existing literature and center around the dynamic nature of cyber risk, the lack of historical data, and the absence of standardized definitions. Controversial findings emerged primarily in relation to the specific structuring of Cyber-ILS products: Whereas there is a strong consensus among experts on the preference for short durations, two fundamentally opposing perspectives exist concerning the design of triggers and the extent of diversification. In contrast, assessments regarding future trends are relatively unambiguous: Experts expect steady, linear growth, but view the potential of the Cyber-ILS market as significantly more limited than that of the leading ILS class, Property CAT bonds.

The rest of the paper is structured as follows: The Literature review discusses existing research on Cyber-ILS and highlights the research gap. The section Market for Cyber-ILS outlines the key developments in the Cyber-ILS market to date. In the section Key research dimensions, we derive four central analytical dimensions based on the current literature and market trends. The Methodology section explains our research design, with a focus on expert interviews as the primary data collection method. In the Results section, we present the analysis of the interview data. We then interpret our findings in the Discussion section and the paper concludes with a summary in Conclusion.

3.2 Literature review

This literature review examines the current research landscape surrounding Cyber-ILS, emphasizing that academic studies in this area remain limited due to the emerging nature of the topic. The first publications explicitly focusing on ILS in the context of cyber risks only began to appear in 2021.

A more general overview of Cyber-ILS can be found in the publications by Ehling et al. (2021) and Woods and Wolff (2025). Their papers examine cyber risk management or cyber risk transfer from a historical perspective, each dedicating a brief subchapter to the topic of Cyber-ILS, particularly in light of recent developments. A significant portion of the additional publications focus on the theoretical modeling and pricing of Cyber-ILS, particularly Cyber CAT bonds. Xu and Zhang (2021) develop a multiperiod pricing model for Data Breach CAT bonds, while Mastroeni et al. (2022) concentrate on pricing models for Cloud Service Fail CAT bonds. Kolesnikov et al. (2022) and Pal and Nag (2024) also address the pricing of Cyber CAT bonds; however, their work takes a broader approach, not focusing on a specific cyber risk. Braun et al. (2023) take it a step further by illustrating what a functional market for Cyber-ILS could look like. To achieve this, they estimate key parameters for both investors and cedents, highlighting the situations and conditions under which Cyber-ILS can work well for both sides.

A less theoretical and more practical approach is taken in three publications by Johansmeyer and Mican (2022) and Johansmeyer (2024a, 2024b), which are based on qualitative interviews with ILS fund managers and cyber model vendors. The first paper analyzes the perspective of the investor side regarding potential Cyber-ILS investments at a time when only a few small transactions were publicly known. It highlights that the interest of potential investors is growing, suggesting that the market could gain momentum in the foreseeable future. The second paper by Johansmeyer (2024a) explores the perspective of cyber model vendors for cyber re/insurance and Cyber-ILS, particularly regarding their perceived challenges in modeling cyber risks. In the third paper, Johansmeyer (2024b) examines how the investor side assesses the correlation between Cyber CAT bonds and financial markets. He concludes that most ILS managers consider Cyber CAT bonds to be investable, despite a certain degree of correlation with financial markets. In contrast to the publications by Johansmeyer, the study by Cremer et al. (2024), which is also based on qualitative interviews, focuses on the sponsor side and examines how reinsurers organize their cyber risk accumulation. As part of their analysis of alternative risk transfer approaches, the authors explicitly discuss the role of Cyber-ILS in addition to public-private partnerships (PPPs) and captives.

The literature review suggests that the body of Cyber-ILS literature is generally still limited. Although Cremer et al. (2024) is one of the first studies to explore the perspective of sponsors on Cyber-ILS, several important aspects remain unexamined. This particularly applies to the specific design of Cyber-ILS product features, especially in light of sponsors' experiences and lessons learned well after the market launch. Furthermore, a more in-depth analysis of the reasons behind the sudden market launch and the future development prospects of the Cyber-ILS market would also be valuable. To address these topics, we conducted qualitative interviews with 12 high-level Cyber-ILS experts from the sponsor side (eight reinsurance experts, two primary insurance experts, and two modeling specialists), with the goal of gaining exclusive insights into our four key research dimensions: market dynamics and demand drivers, risk assessment and modeling, product development, and economic impact and future trends.

3.3 Market for Cyber-ILS

When examining the evolution of the relatively young Cyber-ILS market over the past few years, the year 2023 stands out as something of a perceived market launch. However, research by Johansmeyer and Mican (2022) and Braun et al. (2023) indicates that Cyber risks had already been sporadically placed in capital markets before 2023. For instance, Credit Suisse issued an Operational Risk CAT bond with a volume over $220 million in 2016 that also covered cyber risks. What makes 2023 particularly notable is not only the primary focus on cyber risk within the issued Cyber-ILS (first full Cyber CAT bonds) but also the relatively high number of transactions completed within a single year.

In terms of the specific form of Cyber-ILS, it becomes evident that the majority of known transactions to date have been executed through Cyber CAT bonds. The ILS-focused news platform Artemis records a total of only two specific cyber transactions in the form of Industry Loss Warranties (ILW), in addition to the eleven Cyber CAT bond transactions (Artemis, 2024a; Artemis, 2024d; Artemis, 2025b). This also aligns with the most commonly used form of securitization in the ILS market, the securitization of natural risks, where Property CAT bonds are typically the preferred instrument (Artemis, 2023c; Artemis, 2025a). In light of these factors, this section will focus exclusively on Cyber CAT bond transactions in relation to the securitization of cyber risks. Similarly, in the subsequent chapters on Cyber-ILS, Cyber CAT bonds remain the central focus of this study, as they represent the dominant instrument in the Cyber-ILS market. Table 3.1 shows all Cyber CAT bond transactions since 2023, as reported by Artemis. In early 2023, the UK specialist insurer Beazley issued the world's first pure Cyber CAT bond, a privately listed $45 million Cyber CAT bond designed to provide additional capacity for covering a range of cyber risks as well as tech errors and omissions catastrophe risks (Artemis, 2023a; Artemis, 2023b). This placement was followed by others; by April 2025, a total of eleven Cyber CAT bonds had been issued, with a combined volume of $900.25 million, of which $805 million remain outstanding.

Table 3.1 Cyber CAT bond transactions

Issue Name	Sponsor	Insured Risk	Modeling	Trigger	Size (M)	Mat.	Issuance	
Cumulus Re (Series 2025-1)	Hannover Re	Cloud Outage	Parametrix	Parametric	$20.00	1 yr	Mar 25	Private
PoleStar Re Ltd. (2024-3)	Beazley	Cyber Risks	RMS	Indemnity	$210.00	3 yr	Sep 24	Public
PoleStar Re Ltd. (2024-2)	Beazley	Cyber Risks	RMS	Indemnity	$160.00	2.5 yrs	May 24	Public
Cumulus Re (Series 2024-1)	Hannover Re	Cloud Outage	Parametrix	Parametric	$13.75	1 yr	Apr 24	Private
Matterhorn Re Ltd. (2023-1)	Swiss Re	Cyber Risks	CyberCube	Loss Index	$50.00	2 yr	Dec 23	Public
East Lane Re VII Ltd. (2024-1)	Chubb	Cyber Risks	CyberCube	Indemnity	$150.00	2 yr	Dec 23	Public
PoleStar Re Ltd. (2024-1)	Beazley	Cyber Risks	RMS	Indemnity	$140.00	2 yr	Dec 23	Public
Long Walk Re Ltd. (2024-1)	AXIS Capital	Cyber Risks	CyberCube	Indemnity	$75.00	2 yr	Nov 23	Public
Beazley cyber cat bond (Cairney III)	Beazley	Cyber Risks	CyberCube	Indemnity	$16.50	1 yr	Sep 23	Private
Beazley cyber cat bond (Cairney II)	Beazley	Cyber Risks	CyberCube	Indemnity	$20.00	1 yr	May 23	Private
Beazley cyber cat bond (Cairney)	Beazley	Cyber Risks	CyberCube	Indemnity	$45.00	1 yr	Jan 23	Private

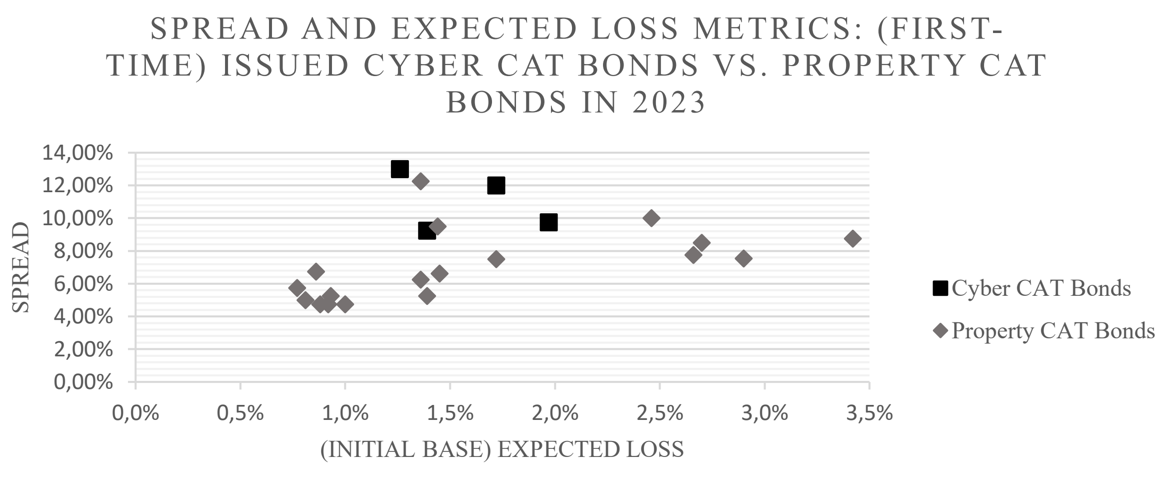
Note: Listing of all publicly known pure Cyber CAT bond transactions, sorted by issuance date, as of April 2025 (Artemis, 2025b; Geneva, 2024).

If the total volume of Cyber CAT bonds is differentiated by type of placement, approximately 87% ($785 million) are public bonds issued under Regulation Rule 144A, while about 13%

($115.25 million) are private bonds (so-called CAT bonds light).[34] This proportional distribution does not seem unusual, as the overall CAT bond market, and especially the Property CAT bond market, is also heavily dominated by public bonds. The comparison between the total issued Cyber CAT bond volume in 2023 ($496.5 million) and the public Property CAT bond issuance in 2023 ($15 billion) reveals that, despite the increase in transactions, the Cyber CAT bond market currently remains a niche, accounting for approximately 3.3% of the public Property CAT bond issuance in 2023 (Artemis, 2023c).

With regard to the triggers used in Cyber CAT bonds, the following can be observed: Measured by the total volume of all eleven Cyber CAT bonds, the vast majority of the bonds (90,7%) are based on an indemnity trigger.[35] Only 5.6% of the total volume is linked to an industry loss index, and just 3.7% is parametric. Comparing these figures with the overall ILS issuance in 2023 and 2024 reveals a similar hierarchy among the three main trigger types, though with slightly different proportions. The indemnity trigger is also the most common mechanism (approximately 70%), followed by the industry loss index (approximately 15%), parametric triggers (approximately 5%) and other types (Artemis, 2023c; Artemis, 2025a).

Figure 3.1 Spread and expected loss metrics



Note: Spread-expected loss allocation of the Public Cyber CAT bonds issued in 2023 and the Property CAT bonds issuances from first-time sponsors and returning sponsors in 2023 (Artemis, 2025b; Swiss Re, 2024).

Figure 3.1 illustrates the spread-expected loss allocation of the four public Cyber CAT bonds issued in 2023 and compares them with the public Property CAT bond issuances from first-time

[34] Public CAT bonds are regulated under the (resale) Rule 144A, which typically has a positive effect on the liquidity of these securities. In contrast, CAT bond lights are less regulated, are usually privately placed, and are therefore less liquid. For further information, see: Ammar et al. (2015) and Artemis (2024e).

[35] While the indemnity trigger refers to the actual losses incurred by the specific sponsor, the industry loss index trigger is based on certain aggregated losses of the whole insurance industry. In contrast, the parametric trigger operates independently of insured losses and is tied to specific objective event parameters of an occurrence (Ammar et al., 2015).

sponsors and returning sponsors in 2023.[36] It is noticeable that, compared to the public Property CAT bonds, the spreads of the Cyber CAT bonds tend to be at the upper end of their corresponding expected losses. This is also reflected in the comparison of the corresponding multiples (spread-expected loss ratio) of the bonds. The average multiple and weighted average multiple of the Cyber CAT bonds, at 7.22 and 7.62 respectively, exceed the average multiple and weighted average multiple of the Property CAT bonds, which stand at 5.04 and 4.99 respectively. Since the comparison of Property CAT bonds only considers first-time sponsors and returning sponsors, there is considerable indication that the significant difference in multiples is unlikely to be attributed to direct distortions related to the sponsors. Rather, the sponsors seem to be paying a sort of novelty premium to compensate for the still relatively novel nature of cyber risks, the lack of a track record for Cyber CAT bonds, and to make the new bonds more attractive to investors.

3.4 Key research dimensions

Based on the publicly known developments in the Cyber-ILS market over the past two years and insights from the current Cyber-ILS and cyber risk research literature, the following four research dimensions have been identified.

Market dynamics and demand drivers

The content of the first dimension is primarily based on the observed developments in the Cyber-ILS market and the question of how these are assessed from the perspective of the sponsors. Specifically, it focuses on the evaluation of the general demand for Cyber-ILS solutions and the reasons behind the sudden market launch. Moreover, cyber risks possess heavy tails (Eling et al., 2024; He et al., 2024; Malavasi et al., 2022; Shevchenko et al., 2023), particularly due to the potential impact of major cyber events. For example, Eling et al. (2023a) estimate the potential losses of an extreme cyber risk scenario at up to $35 billion. Given these circumstances, the possible consequences of a major cyber event on the demand for Cyber-ILS should also be addressed.

Risk assessment and modeling

Since the valuation of Cyber-ILS primarily depends on the underlying cyber risks, the challenges in assessment and modeling of cyber risks in general should also be considered. The aim

[36] The four public Cyber CAT bonds issued in 2023 are: Long Walk Reinsurance Ltd. (2024-1), PoleStar Re Ltd. (2024-1), East Lane Re VII Ltd. (2024-1), Matterhorn Re Ltd. (2023-1).

of this key research dimension is to determine, from the sponsors' perspective, whether and to what extent these challenges also impact the risk modeling of Cyber-ILS. Given that traditional insurance coverage for cyber risks has been available for years, several publications exist that discuss the main difficulties associated with the assessment and modeling of these risks. In addition to the already mentioned heavy-tail issue, the modeling of cyber risks is further complicated by the following characteristics: Cyber risks are considered dynamic, particularly with regard to the number of attacks, shifting proportions of different attack types, and the development of new forms of attacks (Awiszus et al., 2023; Eling et al., 2023b; Shevchenko et al., 2023). Moreover, the authors Biener et al. (2015) and Awiszus et al. (2023), along with the literature reviews by Eling (2020) and Cremer et al. (2022), highlight the frequent lack of a historical data foundation for cyber losses, further complicating the modeling and risk-adequate pricing of cyber risks. Another challenge is the heterogeneity regarding a unified understanding of cyber risk. There is no consistent and widely accepted definition of cyber risk, for example, in terms of its type or impact (Awiszus et al., 2023; Strupczewski, 2021). Additionally, there is no general standard for how cyber risks are assessed and modeled (Eling et al., 2023b).

Product development

While the research dimension Risk Assessment and Modeling addresses the impact of specific characteristics of cyber risks on the risk modeling of Cyber-ILS, this dimension aims to explore how the previously described unique attributes of cyber risks (heavy tailed losses, dynamic nature of cyber risk, lack of a historical data, lack of uniform definitions) influence the concrete product design of Cyber-ILS (e.g. choice of a specific trigger or duration) from the sponsors' perspective. The central focus is particularly on the question of how a certain level of flexibility and adaptability in Cyber-ILS products can be achieved to effectively address these unique characteristics of cyber risks.

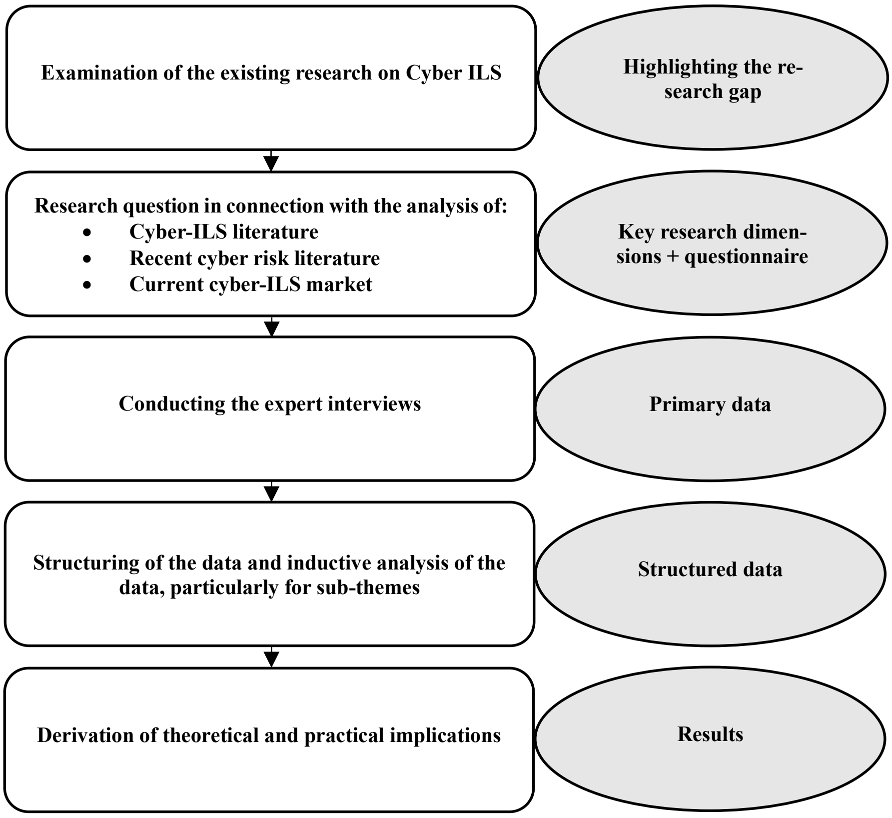
Economic impact and future trends

The last of the four research dimensions examines the sponsors' perspective on whether and how Cyber-ILS can contribute to strengthening the resilience of the financial ecosystem against cyber threats. Additionally, it explores the sponsors' assessments regarding the future market development and potential adoption of Cyber-ILS. In this context, the relatively young Cyber-ILS market is also compared to the Property CAT bond market, which, with an issuance volume of $16.6 billion in 2024, represents by far the largest segment within the entire ILS market (Artemis, 2025a).

3.5 Methodology

The study primarily draws on the perspectives of experts from the sponsor side of the Cyber-ILS market. Given that the Cyber-ILS market is still in its early stages and reliable data sources, such as advanced datasets, are scarce, this paper employs a qualitative approach within an exploratory research strategy. This approach is particularly well-suited for research areas where the theoretical framework has not yet been fully established and where the research subjects are still evolving (Miles and Huberman, 1994). In the context of Cyber-ILS, such a strategy enables the researcher to delve deeper into the subject by exploring and discussing emerging findings, challenges, and trends that were not initially apparent. As the foundation of our study, we have derived the following four key research dimensions from insights in the Cyber-ILS and current cyber risk literature, as well as from publicly available information on recent developments in the Cyber-ILS market: (1) Market dynamics and demand drivers, (2) Risk assessment and modeling, (3) Product development, and (4) Economic impact and future trends (see figure 3.2).

Figure 3.2 Elements of the research design



Note: Key steps of the research process and the outcomes of each step.

Based on these four key research dimensions as a starting point and interview agenda, the paper's primary data was collected through semi-structured interviews with industry experts. Semi-structured interviews were chosen here because they offer the interviewees the opportunity to share their insights and experiences in their own words while still retaining the greatest possible flexibility to focus on certain facets or elements within the agenda and beyond if required. In addition, this format provides strategic added value in the field of explanatory research, as it allows the interviewer to spontaneously address questions that arise during the course of the interview, thereby contributing to a more balanced understanding of the topic (Adams, 2015). In addition, the method of semi-structured interviews has already been successfully employed in research on cyber risk and Cyber-ILS, for instance by Cremer et al. (2022, 2024) and Johansmeyer (2024a), which underscores the effectiveness and practicality of this approach. The planning and execution of the interviews, as well as the analysis of the collected primary data, were carried out based on common guidelines such as Adams (2015), Harrell and Bradley (2009) and Kaiser (2014).

With regard to the selection of Cyber-ILS experts to be interviewed, the focus was primarily on experts from the reinsurance industry. This is based on the assumption that the largest share of cyber premium volume lies with reinsurers. In fact, the share of globally written cyber insurance premiums ceded to reinsurers was as high as 60% in 2022 (S&P Global, 2023). Furthermore, the analysis of the Cyber-ILS market shows that all previous pure Cyber CAT bonds have been issued either by reinsurers or by specialty insurers that also engage in reinsurance business. Nevertheless, primary insurers and modeling experts are also a central part of the sponsor side, which is why their perspectives have also been included.

Concerning the specific sample size, we follow the recommendations of Sandelowski (1995) and Boddy (2016) and limit the number of interviewed experts to 12. This decision is based on the fact that the Cyber-ILS market is still a highly specialized niche (to date, only five different sponsors have entered the Cyber CAT bond market) and that Cyber-ILS experts therefore represent a specific and homogeneous target group. The intended allocation is as follows: eight experts from the reinsurance industry (target group), two experts from the primary insurance industry (as potential future sponsors), and two modeling experts (as modeling experts have been actively involved in each of the previous eleven Cyber CAT bond issuances). For this purpose, a total of 38 potential Cyber-ILS experts were identified using the Marketview database from Artemis (2024b), LinkedIn, and additional contacts through the Cologne Research Centre for Reinsurance. Particular attention was paid to ensuring that the experts possess a certain level of Cyber-ILS know-how and have work experience with an international reinsurer and/or international primary/specialty insurer and/or in the risk modeling industry. The interview partners were selected based on the first 12 experts who provided a firm commitment. In accordance with our intended allocation, the final sample also reflects the planned distribution of eight reinsurance experts, two primary insurance experts, and two modeling specialists (see Table 3.2). The sample includes experts from Germany, Switzerland, the United Kingdom, the United States, and Israel, thus providing a differentiated and balanced perspective on the topic. This diversification aligns with the recommendation by Kaiser (2014), who emphasizes the importance of a differentiated approach in order to present the most comprehensive picture possible.

Table 3.2 Overview of the Cyber-ILS experts

Group	Industry	Position
A	Reinsurer	Vice President
A	Reinsurer	Senior Underwriter Retrocessions & Capital Markets
A	Reinsurer	Vice President
A	Reinsurer	Portfolio Underwriter Cyber
A	Reinsurer	Global Head of Index Classes
A	Reinsurer	Managing Director Retrocessions & Capital Markets
A	Reinsurer	Cyber-ILS Expert
A	Reinsurer	Vice President
B	Primary insurer	(Re)Insurance Expert
B	Primary insurer	Chief Risk Officer
C	Modeling Expert	Senior Cyber Modeling Specialist
C	Modeling Expert	Chief Commercial Officer

Ahead of the scheduled interview, each expert received a briefing document, including the 12 questions, approximately one week in advance (see Table 3.3). The interviews themselves were all conducted online via Microsoft Teams. At the beginning of each interview, both parties introduced themselves, followed by a description of the interviewee's role in the field of Cyber-ILS, as well as general explanations of the research project.

Finally, participants were asked for permission to use the collected content anonymously. Due to the sensitive nature of the data and strict company guidelines, no recording device was used during the interview. Instead, notes were taken during the interviews, and the content of the interviews was reconstructed in the form of a structured and systematic protocol. This protocol was then sent to the interview partners for confirmation for reasons of traceability and legitimacy. Additionally, this approach aims to ensure the accuracy of the presented results. All expert interviews took place between June and July 2024.

The data obtained from the semi-structured interviews was systematically analyzed according to the guidelines of Kaiser (2014). The applied coding process serves to capture and model central themes and patterns among the various interviewees. In this way, the data can be categorized, and the findings of the different interview partners can be compared and differentiated from one another. The focus is on an inductive analysis, with the goal that, aside from the four research dimensions, a large part of the findings comes directly from the raw data itself. At the beginning of the coding process, the core themes were identified and assigned to the respective research dimensions (e.g., degree of diversification to the dimension of product development). In the next step, sub-themes were identified (e.g., product diversification vs. geographical diversification) and assigned to the respective core theme. This systematic approach ensures that, on the one hand, the consistency of the analysis is guaranteed, but on the other hand, marginal opinions and outliers can also be recorded and discussed appropriately (Kaiser, 2014).

Table 3.3 Questionnaire

Research Dimension	Question
Market dynamics and demand drivers	• Do you think there is a need for reinsurance in cyber insurance, especially for alternative risk transfer solutions? • What trends are contributing to the growing interest in Cyber-ILS? • How could a major cyber event influence the demand for Cyber-ILS in the market?
Risk assessment and modeling	• How could existing cyber risk models assess the dynamic and evolving nature of cyber threats? • What are the main challenges in developing accurate and reliable Cyber-ILS models? • What challenges do you see in the creation of Cyber-ILS due to the heterogeneity of the definition of "cyber"?
Product development	• What characteristics must be incorporated into Cyber-ILS products to address the unique challenges of cyber risk? • How do Cyber-ILS products differ from traditional ILS in terms of risk mitigation • What measures can be taken to assure the flexibility and adaptability of Cyber-ILS products?
Economic impact and future trends	• How could Cyber-ILS products contribute to the broader financial ecosystem's resilience against cyber threats? • What future trends do you foresee in the development and adoption of Cyber-ILS, considering the evolving nature of cyber threats? • Do you think that Cyber-ILS might attract more investors than natural ILS?

Note: Overview of all 12 interview questions, categorized by research dimension.

3.6 Results

3.6.1 Market dynamics and demand drivers

Fundamentally, all experts agree that there is a need and a clear justification for the existence of traditional reinsurance solutions as well as alternative risk transfer solutions in the context of cyber insurance. Only the reasoning behind the demand differs slightly. The need for traditional reinsurance in the context of cyber insurance is particularly justified by half of the experts due to the required protection of insurers against large-scale cyber events. Additionally, some experts point to the currently high cession and retrocession rates in the field of cyber insurance, which in itself indicates a high demand for traditional reinsurance solutions. In contrast, the general need for Cyber-ILS is justified by almost all experts with the provision of additional capacity.

When asked which trends specifically drive the growing interest in Cyber-ILS, the majority of experts identify the rapidly increasing demand for cyber insurance in the primary insurance markets over the past years as the main driver. This has increasingly resulted in capacity constraints in the traditional reinsurance market, especially for non-proportional reinsurance aimed at covering large-scale cyber events. As a result, the capacity constraints are driving up reinsurance prices, making the underwriting of cyber risks in the form of Cyber-ILS even more attractive to investors. Additionally, some experts see advancements in the modeling of cyber risks, as well as improved investor education regarding cyber risks and cyber insurance, as demand drivers.

Regarding the potential impact of a major cyber event on the Cyber-ILS market, most experts distinguish between the reactions of the sponsor and investor sides, as well as potential short-term and long-term effects on the demand for Cyber-ILS products. In the short term, most experts anticipate reduced investor interest or capital outflows in Cyber-ILS investments, particularly in the event of a major cyber incident where losses significantly exceed investor expectations. On the other hand, some experts highlight that such an event could lead to a rise in spreads, which, in turn, may attract new investors. In the long term, experts expect that a major cyber event will primarily lead to increased demand for insurance coverage in the primary market. Consequently, from the sponsors' perspective, this is likely to result in higher demand for reinsurance coverage and alternative risk transfer solutions, such as Cyber-ILS products. Some experts emphasize that if the losses from a major cyber event align with expectations and confirm the accuracy of risk models (proof of concept), this could also drive greater investor demand for Cyber-ILS investments.

3.6.2 Risk assessment and modeling

Regarding the experts' assessments of the difficulties in developing accurate and reliable Cyber-ILS models, three main challenges can be identified: the dynamic and evolving nature of cyber risks, the lack of historical data on cyber events, and the absence of standardized definitions. There is generally a broad consensus among experts regarding the three main issues. Differences in the fundamental assessment of the difficulties are rare, although the specific elaboration may vary slightly depending on the expert.

The first issue, the dynamic and evolving nature of cyber risk, is considered essential by the majority of experts. Some experts particularly emphasize the fundamentally man-made nature of cyber risks compared to natural disaster risks. In addition to human failure, this often involves human behavior with malicious intent, characterized by changing attack strategies, tactics, motivations, and methods. Due to these characteristics, cyber risks, especially in comparison to natural disaster risks, will always be a bit more dynamic and unpredictable, making it difficult to establish predictive models. Moreover, according to some experts, this fundamental dynamic is further amplified by additional factors. The economic impact also varies when a scenario has already occurred. The exact extent of the damage depends, for example, on the duration of the outage, the specific security measures implemented by the company, and ultimately, the precise structure of the respective insurance coverage. Additionally, regulatory changes are possible, such as the introduction of new laws on ransomware payments. Moreover, the involvement of state actors in cyber attacks is often unclear, making predictability even more difficult.

The second issue, the lack of historical data, is viewed as relevant by nearly half of the experts. According to the experts, this is partly due to the fact that clients are generally reluctant to share their data, as the data is seen as highly valuable and confidential. Additionally, the loss history with regard to cyber events, both in general and in specific cases, is limited. For example, one expert sees a solid data foundation for cloud risks, while the data on malware events (such as NotPetya, WannaCry, and SolarWinds) is limited, as these types of events occur too infrequently.

The third issue, the absence of standard definitions, is seen as important by almost all interviewed experts. By systematizing the experts' responses, three different levels can be identified where an absence of standard definitions exists. While some of the interviewed experts miss clear definitions on all three levels, others consider the lack of definitions critical only on two or just one of these levels. The first level relates to cyber insurance products in the primary insurance market. These cyber policies are often very broadly defined and, depending on their design, cover a wide range of risks such as cloud outages, data breaches, system failures, and ransomware attacks, making precise differentiation fundamentally challenging. The second and third levels relate to the specific design of Cyber-ILS. First, similar to the cyber policies in the primary insurance market, there are significant differences between Cyber-ILS in terms of the scope of covered risks. Second, there are no uniform and clear event definitions. For example, it remains unclear whether the exploitation of the same vulnerability by different hacking groups should be considered a single event or multiple events. There is also no consistent methodology for event aggregation, which is crucial for developing reliable indices. In contrast to the first two issues (dynamic and evolving nature of cyber risk, lack of historical data), most experts also present possible solutions for this issue, which apply to all three levels: the development and application of recognized, clear, and precise definitions in order to establish more standardized Cyber-ILS products.

Considering the experts' assessments of the fundamental modeling quality and the specific implementation of current risk models for Cyber-ILS, their opinions tend to diverge more compared to the generally broad consensus on the three main issues. While some experts criticize the strong dependence of sponsors and investors on the few main modeling agencies, others see the issue more in the varied outcomes of the models. According to experts, there are substantial differences between the models in terms of the probabilities for certain events or impacts, as each model operates with different methodologies and assumptions. Other experts, however, identify the problems elsewhere. They argue that the models focus too heavily on doomsday scenarios. For example, a cloud outage scenario, due to fragmentation, is more likely to result in a failure within a single region rather than a global shutdown. Nevertheless, there are also some voices that assess the predictive quality of the current models as generally positive, considering the challenging circumstances.

3.6.3 Product development

By analyzing the experts' views on how specific Cyber-ILS products should be designed to adequately reflect the previously described unique attributes of cyber risks, the following four key areas can be identified: the structuring of triggers, duration, the degree of diversification (both at the product level and geographically), and the handling of the long-tail issue regarding the settlement period of losses. While there is a certain consensus among experts regarding duration, opinions differ on the structuring of triggers and the degree of diversification and the resolution of the long-tail issue.

The design of the duration of Cyber-ILS is addressed by around half of the experts. All of them advocate for relatively short terms of approximately 1-2 years to remain flexible in response to the rapidly evolving nature of cyber risks.

The structuring of the triggers is discussed by the majority of the experts surveyed, with opinions being divided compared to the duration issue. Some experts advocate for equipping Cyber-ILS, particularly Cyber CAT bonds, primarily with parametric triggers. One argument is their easier applicability for sponsors and investors, as they allow for a clearer understanding and management of risks without having to account for the complexities of individual policies. Additionally, the objectivity of parametric triggers is emphasized, such as a specific trigger based on a clearly measurable event, like the duration of a system outage. However, there is also the view that sees indemnity triggers as unproblematic. The current indemnity triggers for Cyber CAT bonds typically attach at relatively high levels, meaning that a major cyber event is usually required to trigger them. The high attachment point also provides a certain level of protection for investors, as sponsors must first bear substantial losses below this threshold, creating a general incentive to underwrite fewer high-risk policies. One expert also explicitly highlights the challenges associated with standardized and simplified parametric trigger solutions and points out that there is generally a trade-off between the degree of standardization and the consideration of portfolio diversity, including the specific needs of sponsors and compliance with regulatory standards. Regardless of the preference for parametric or indemnity triggers, some other experts generally call for the establishment of more adaptive triggers for Cyber CAT bonds. The use of flexible and scenario-based triggers could enable better consideration of changes in the cyber threat landscape, such as new types of cyber attacks, as well as potential regulatory changes.

The degree of diversification is also addressed by the majority of the interviewed experts, again with differing opinions. However, most of these experts advocate for increased diversification at the product level to reduce the inherent correlation of cyber risks. They suggest that Cyber-ILS should securitize different types of cyber risks by distinguishing, for example, between company size, industry sector, and the specific cyber risks covered, such as the risk of systemic cloud outage, as well as attack types like ransomware or malware. This approach is intended to enable investors to achieve a certain level of diversification within their Cyber-ILS investment portfolios by strategically selecting different Cyber-ILS products. Some of these experts, in addition to diversification at the product level, see the need for more geographical diversification opportunities by ensuring that individual ILS products cover cyber risks from specific regions only. There are also some experts who view diversification at the product level or an overly specific cyber risk cover of a Cyber-ILS rather critically. These Cyber-ILS are considered unsustainable, as they ultimately provide only minimal protection for sponsors despite their high costs. Consequently, it is also suspected that the current Cyber-ILS with limited coverage have been issued more for reputational reasons rather than strategic ones, and it is considered unlikely that this type of deal will establish itself permanently. In the long run, Cyber-ILS covering entire portfolios should prevail, as they offer real added value to sponsors. In addition to sponsors, investors should also benefit from this type of Cyber-ILS, as they enable repeated transactions, fostering a more robust market for Cyber-ILS.

The last key area regarding the specific design of Cyber-ILS, the resolution of the long-tail issue, is addressed by around half of the experts. While there is general consensus among experts that long-tail claims settlement can be a challenge for Cyber-ILS, their proposed solutions vary. Fundamentally, a long-tail issue in the context of Cyber-ILS can arise simply from the fact that, for example, cyber damages may only be discovered weeks or even months after an attack, even though the Cyber-ILS term has already expired. To address this issue, experts propose various concrete design options. One approach is the consistent application of so-called claims-made clauses, meaning that only claims reported within the Cyber-ILS term are considered. Another suggestion focuses on strictly separating cyber risks into first-party and third-party coverage, treating them differently. Cyber-ILS solutions would be used for first-party coverages, which are generally settled more quickly, whereas third-party coverages are seen as more suitable for traditional reinsurance solutions. Further proposals include prioritizing parametric triggers for Cyber CAT bonds or, even more consistently, increasing the use of securitized quota shares instead of Cyber CAT bonds, thereby eliminating the need for event definitions altogether.

3.6.4 Economic impact and future trends

Almost all interviewed experts believe that Cyber-ILS can contribute to broader financial ecosystem resilience against cyber threats, at least in the long run. The main argument cited is the growing demand for cyber coverage due to the increasing global cyber exposure. A well-functioning Cyber-ILS market can help stabilize the insurance and reinsurance sectors by ensuring that sufficient capital is available in the event of a large-scale cyber incident, thereby preventing a systemic shock or at least mitigating its impact. Nearly half of the experts also explicitly point out that the current Cyber-ILS market is dominated on the sponsor side by large-sized companies such as Beazley and Chubb. They emphasize that the engagement of mid-sized insurers and reinsurers is essential to create a heterogeneous pool of participants and thereby enable a sustainable risk transfer.

Regarding the forecast for the expected growth of the Cyber-ILS market over the next few years, the majority of experts anticipate linear growth at a relatively low level rather than exponential growth. However, some experts take a more cautious view, seeing certain Cyber-ILS primarily as test cases that are unlikely to gain long-term acceptance. This particularly applies to Cyber-ILS types with highly specific cyber risk coverage, where the cost-benefit ratio for sponsors suggests they serve more as a testing and/or marketing tool rather than a strategic protection solution.

Regardless of the specific market development forecast, the experts' explanations reveal four key determinants that are expected to have a significant impact on the future market growth. In general, parts of these key determinants are closely aligned with the trends mentioned by experts regarding the growing interest in Cyber-ILS. The first factor is demonstrating the functionality and accuracy of current models under real-world conditions, particularly in the event of a major cyber incident. If these models meet market participants' expectations, they could drive increased interest and demand from both sponsors and investors. Conversely, underperformance could have the opposite effect. The second factor is significant improvements in cyber risk modeling in the future. In particular, the three main challenges previously mentioned, the dynamic and evolving nature of cyber risks, the lack of historical data on cyber events, and the absence of standardized definitions, complicate the development of accurate and reliable Cyber-ILS models. Expected progress, especially in addressing the latter two challenges, could significantly enhance cyber risk modeling, including the pricing of cyber risk. In the medium to long term, this could also lead to increased interest and demand from both sponsors and investors. The third factor concerns the extent of a possible correlation between the investment in Cyber-ILS or, respectively, the cyber risks covered and the financial market. On the one hand, some of the experts assume that a certain correlation exists between cyber risks and the financial market. Possible reasons for this assumption include potential financial market reactions to a major cyber event or the risk that an economic downturn could lead to increased cybercrime. On the other hand, some of the other experts emphasize that there is no correlation between cyber risks and the financial market, or if there is any, only a slight correlation, for example, in the case of a major cyber event. Should the view prevail that cyber risks are not or only minimally correlated with the financial market, this could particularly drive demand on the investor side, as one of the main reasons for investing in ILS in general is the low or non-existent correlation between ILS products and financial market developments. The fourth factor concerns the cyber education of existing and potential investors. The experts point out that, especially due to the dynamic and evolving nature of cyber risks, it is important to continuously and consistently inform investors about current developments in cyber threats and provide ongoing education, thereby creating an informed and prepared investor base. As a result, a deeper understanding and trust of investors in Cyber-ILS products should lead to increased demand on the investor side.

The future development of spreads is addressed by around half of all experts, with all of them expecting spreads to decline in the medium to long term. Among the four factors mentioned, increased investor confidence in cyber models, in particular, should help reduce uncertainty and consequently lead to a decline in the novelty premium.

When considering the potential market size of the Cyber-ILS market in relation to the largest ILS market, the natural catastrophe ILS market, and particularly the Property CAT bond market, about half of the experts also discuss this topic. Almost all experts assume that the Cyber-ILS market cannot reach or even surpass the size of the natural catastrophe ILS market in the foreseeable future. One of the stated reasons for this is the advantages that the natural catastrophe market currently offers over the Cyber-ILS market. The natural catastrophe market is a well-established sector, particularly in terms of risk modeling, with a proven track record that investors have relied on for over two decades. Additionally, the Cyber-ILS market has not yet met the liquidity levels demanded by many investors, compared to the natural catastrophe market. Another mentioned reason concerns the damage potential of high-profile cyber incidents, which currently appears to be more limited compared to losses from natural disasters, at least for now. For example, it is mentioned that the economic loss from the most expensive natural disaster (the 2011 earthquake and tsunami in Japan) is higher than the sum of all high-profile cyber incidents over the past 20 years.

3.7 Discussion

Comparing the experts' arguments regarding the general need for traditional reinsurance solutions and alternative risk transfer solutions in cyber insurance with recent academic and non-academic publications reveals several similarities. Thus, the reference to the high cession rates in the field of cyber insurance can also be supported by figures. S&P Global (2023) indicates that around 50-60% of worldwide cyber insurance premiums written in 2022 were transferred to reinsurers. Eling et al. (2024) report comparable values for the US market, estimating the median value of the retention ratio (the ratio of premiums retained by the insurer to total premiums) for US insurance companies in cyber insurance at 31.75% in 2022, compared to 51.19% for non-cyber insurance. Moreover, the explicit risk of large-scale cyber events, as mentioned by the half of the experts, is also confirmed in the research literature, as previously demonstrated in the section on Key research dimensions. The efforts of primary insurers to protect themselves against the risk of large-scale cyber events are also reflected in the figures regarding the reinsurance market for cyber risk solutions in recent years. Although quota share contracts remain the most commonly used reinsurance instrument, there is a noticeable shift towards more non-proportional reinsurance solutions in the cyber sector.[37] For example, the share of risk carriers using event-based reinsurance solutions has increased from 10% in 2020 to over 30% in 2024 (Howden Re, 2024). With regard to reinsurance pricing, capacity constraints and high demand in recent years have led to significant risk-adjusted rate increases for non-proportional reinsurance solutions in the cyber sector, even though the cyber reinsurance pricing environment has

[37] S&P Global (2023) estimates the share of quota share contracts at over 87% of all cyber reinsurance in 2022, based on a survey of global multiline insurers and global reinsurance groups, while Howden Re (2024) estimates the share of insurers purchasing quota share contracts at over 70% in 2024, based on an analysis of 25 risk carriers.

somewhat eased since 2024 (Gallaher Re, 2023, 2024, 2025). The risk transfer via Cyber-ILS or Cyber CAT bonds issued in 2023 and 2024 is also considered relatively expensive in relation to comparable Property CAT bonds. As highlighted in the section on Market for Cyber-ILS, sponsors also seem to be paying a novelty premium to make the new bonds more attractive to investors. The main driver for the growing interest in Cyber-ILS mentioned by the experts, the overall increasing demand for cyber insurance in general, can also be supported by data. The annual global cyber insurance gross premium volume has increased from $3.5 billion in 2017 to over $14.4 billion in 2023, representing a CAGR of 26.6%. Although the growth rate currently appears to be slowing down slightly, further growth is expected in the coming years (Howden Group, 2024; Swiss Re Group, 2024).

The classification of expert opinions regarding the impact of a major cyber event on the Cyber-ILS market will be based on two reference points: the historical development of the market for the highest-volume ILS product, the public Property CAT bonds, and the effects of relevant cyber events since the issuance of the first Cyber-ILS in 2023. When examining the historical development of the annual volume of Property CAT bond issuance, two notable trends emerge. Firstly, there is a sharp increase in 2006 and 2007 following a relatively stable volume between 1997 and 2005. The average annual volume between 1997 and 2005 was $1.2 billion, before surging to $4.9 billion in 2006 and $6.9 billion in 2007 (Artemis, 2025c). According to Polacek (2018), this increase can be largely attributed to the main event, Hurricane Katrina in 2005. In its aftermath, higher reinsurance prices and rising returns on Property CAT bonds led to increased demand from both sponsor and investor side. Secondly, after a brief decline to $2.7 billion due to the financial crisis in 2008, the annual volume of Property CAT bond issuance experienced a continuous increase, aside from a few fluctuation-related setbacks, reaching $16.6 billion in 2024 (Artemis, 2025c). Reasons for this include not only the low-yield environment over the years but also improvements in the modeling of Property CAT bonds (Polacek, 2018). Comparing the arguments of experts with the historical development of the Property CAT bond market, it seems plausible that a large-scale cyber event, followed by rising returns and a confirmation of the accuracy of cyber risk models, could also lead to increased demand for Cyber-ILS products from both sponsors and investors. With regard to past cyber events since the issuance of the first Cyber-ILS in 2023, there has been only one truly large-scale cyber event: the CrowdStrike IT outage in July 2024. The event is named after the cybersecurity company CrowdStrike, whose software caused approximately 8.5 million Microsoft Windows computers worldwide to crash due to a faulty service update (Harrison, 2024). The Geneva Association (2024) estimates the economic loss from this event at approximately $7.5 billion, while the insured losses are estimated at around $1 billion, based on various assessments from the insurance industry. Just days after the event, it became clear that it was unlikely that the trigger had been activated for any of the Cyber CAT bonds. Additionally, no direct price movements were observed on the secondary market (Artemis, 2024c). ILS investors assessed the incident differently. While some investors were unsettled by the fact that a non-hostile cyber incident could develop into a potential trigger event, others take a more positive view and see the incident as a stress test for the calibration of the models (Artemis, 2024c; The Insurer, 2024a).

The main challenges identified from the expert interviews (the dynamic and evolving nature of cyber risks, the lack of historical data on cyber events, and the absence of standardized definitions) are consistent with the findings from the scientific literature. This alignment also applies to the results of Cremer et al. (2024), although their study distinguishes between challenges and causes. Despite this general agreement, there are some individual expert opinions that are worth addressing.

Some experts see the rapid development of AI as a potential catalyst and, consequently, as a real challenge in regard to the dynamic and evolving nature of cyber risk. For example, the use of AI could significantly enhance attackers' capabilities, resulting in less accurate risk models. Regarding the lack of historical data, it is worth mentioning that some experts view the stricter data protection regulations in Europe compared to the U.S. as problematic. These regulations make it more difficult to develop comprehensive and accurate models, as these models consequently rely even more on assumptions. With respect to the issue of the absence of standardized definitions, some experts emphasize that they consider the definition problem to be overrated, particularly at the first and second levels (definition of the scope of covered risk in the primary insurance and Cyber-ILS market). One expert even regards the definition problem at the third level (event definition) as overrated and believes it can be easily resolved by simply adopting previously established definitions from the industry.

In terms of the implementation of current risk models for Cyber-ILS, the experts' description of the strong dependence of sponsors and investors on the few main modeling agencies and the varied outcomes of the models aligns with the findings from the academic literature (Johansmeyer, 2024a). For example, Johansmeyer (2024a) notes that the market for Cyber-ILS modeling is predominantly dominated by the three providers CyberCube, Cyence, and RMS. One of the interviewed experts delves deeper into the issue of strong dependence and advocates that insurers invest in training and developing in-house expertise to independently implement advanced methods for risk modeling.

As already presented in the results, there is broad consensus among experts regarding the preferred duration of 1-2 years for Cyber-ILS products. Contrasting these preferences with the durations of previously known Cyber CAT bond transactions reveals a strong alignment, as 9 out of a total of 11 Cyber CAT bonds have a maximum maturity of 2 years. When comparing the other results of the product development category with the findings of Cremer et al. (2024), there are also certain similarities. For instance, the long-tail issue is also identified as a challenge in the expert survey conducted by Cremer et al. (2024). Furthermore, there is partial agreement regarding the choice of triggers. Similar to the findings of Cremer et al. (2024), some of our interviewed experts also suggest a stronger focus on parametric triggers to enhance the attractiveness of Cyber-ILS for investors. However, some of the experts we interviewed view Cyber-ILS that are overly specialized in a certain type of cyber risk, which are often equipped with parametric triggers, as problematic. For example, the Cumulus Re Cyber CAT bond by Hannover Re, which is equipped with a parametric trigger and covers only specific cloud outage risks. As mentioned earlier in the results section, some experts view these Cyber-ILS as unsustainable because they offer limited portfolio protection for sponsors while incurring high costs, leading them to expect that this type of cyber bond will likely remain a niche product. Even though the Cumulus Re Cyber CAT bond by Hannover Re was renewed in March 2025 for one year with a volume of $20 million, Cyber CAT bonds with a parametric trigger, having a total issued volume of $33.75 million to date, still currently appear to remain a niche market, accounting for only 4% of the total issued Cyber CAT bond volume of $900.25 million.

The topic of risk mitigation in the context of Cyber-ILS product development is addressed by only a few of the interviewed experts, as it primarily pertains to the product level in the primary insurance market and the end customer. Nevertheless, experts emphasize that primary insurers should ensure policyholders implement cyber risk mitigation measures (e.g., robust systems and trained personnel) and actively monitor these efforts, for instance, through an automated scoring system. This would help ensure that the associated cyber risks are suitable for securitization.

When comparing the factors mentioned by the experts regarding future Cyber-ILS market growth, there are some similarities with the findings of Cremer et al. (2024). The authors also conclude that improvements in cyber risk modeling, increased cyber education for potential investors, as well as investors' views on the correlation between cyber risk and financial markets, play a role in the future growth of the Cyber-ILS market.

With regard to the question of whether cyber risks are correlated with the financial market, the findings of Johansmeyer (2024b) may offer some insight. Although this question was not empirically investigated, the study, based on surveys of ILS investors, concludes that the majority of respondents assume some correlation in the event of a large cyber event. However, a certain degree of correlation is deemed tolerable by the investors.

In light of the experts' arguments as to why the Cyber-ILS market is unlikely to reach the size of the natural catastrophe ILS market in the foreseeable future, additional sources can also support this view. For example, certain institutional investors seem to currently avoid investments in Cyber-ILS due to the lack of sufficient liquidity in the Cyber-ILS market (The Insurer, 2024b). The size comparison between high-profile cyber incidents over the past 20 years and the most expensive natural disaster (the 2011 earthquake and tsunami in Japan) can also be illustrated with concrete figures. The total estimated economic losses from high-profile cyber incidents exceeding $800 million (adjusted to USD 2023) from 2003 to the end of 2024 (including the CrowdStrike incident) amount to approximately $251 billion (adjusted to USD 2023), while the economic loss of the most expensive natural disaster is around $284 billion (adjusted to USD 2023). Moreover, the economic loss of the most expensive high-profile cyber incident from 2010 to the end of 2024, the NotPetya cyber incident, with an original economic loss of $10 billion, appears relatively modest when compared to the original economic losses of, for example, Hurricane Harvey in 2017 at $125 billion or Hurricane Ian in 2022 at $115 billion (FEMA, 2023; Johansmeyer, 2024b; NOAA, 2018; Swiss Re Group, 2023).

There are also some limitations to this study. These relate both to the specific research subject and to the qualitative research method of semi-structured interviews in general. Although the Cyber-ILS market under investigation has reached a notable issuance volume of nearly $1 billion in Cyber CAT bonds, it still represents a very young and niche segment. For comparison, the Property CAT bond market has existed for over 20 years and, in 2023, its issuance volume was approximately 30 times higher. As a result, the limited historical depth of the Cyber-ILS market restricts the extent of insights that can currently be derived. Moreover, the cyber risk environment is evolving rapidly, which has a direct impact on the Cyber-ILS market. Consequently, the insights derived from this study may become less relevant over time. In addition, this study is subject to limitations commonly associated with semi-structured interviews (Diefenbach, 2009; Potter and Hepburn, 2005). These include, for example, the potential influence on respondents due to the nature of the interview setting itself. Additionally, a certain degree of unconscious bias on the part of the interviewees cannot be ruled out.

3.8 Conclusion

This paper explores the emergence and current developments of the still nascent Cyber-ILS market, based on semi-structured interviews with 12 Cyber-ILS experts. The study is guided by an analytical framework structured around four research dimensions (market dynamics and demand drivers, risk assessment and modeling, product development, and economic impact and future trends), which were defined in advance using publicly available developments in the Cyber-ILS market over the past two years, as well as insights from current academic literature on Cyber-ILS and cyber risk.

Our results show that, in particular, capacity constraints in the reinsurance market for cyber risks, the resulting increase in reinsurance prices, as well as advancements in cyber risk modeling and improved investor education regarding cyber risks, have been identified as driving factors behind the sudden market entry and growing interest in Cyber-ILS.

With regard to the challenges in the risk assessment and modeling of cyber risks, which form the foundation for adequate pricing of Cyber-ILS, our findings align with the results presented in the academic literature. Modeling cyber risks is significantly complicated by the dynamic and evolving nature of cyber threats, as well as the lack of historical data. Another major challenge is the absence of standard definitions, whether for cyber insurance products in the primary insurance market, for the scope of risks covered by a Cyber-ILS, or the definition of a triggering event.

Addressing the unique attributes of cyber risk in the design of Cyber-ILS has led to the identification of four key areas. There are clear findings regarding the structuring of the duration, as Cyber-ILS experts tend to prefer short maturities of around 1-2 years. It is also recognized that the long-tail issue poses a challenge for product design, though proposed solutions vary among ILS experts. In contrast, the findings regarding the structuring of triggers and the degree of diversification are inconclusive. One view is that the future of the Cyber-ILS market lies in the establishment of parametric triggers in combination with the securitization of specific cyber risk types. The reasons cited include increased objectivity, easier applicability and comprehensibility, as well as the opportunity for investors to achieve better portfolio diversification through the strategic selection of Cyber-ILS linked to specific cyber risks. On the other hand, there is the view that Cyber-ILS linked to highly specific cyber risks are not considered sustainable, as they offer only limited portfolio protection for sponsors and are therefore likely to remain a niche product in the Cyber-ILS market.

The results also highlight that, in order for Cyber-ILS to strengthen the broader financial system's resilience to cyber threats, participation from midsized insurers and reinsurers is essential in the long run. With regard to the future growth of the Cyber-ILS market, experts anticipate linear growth, with the potential market size considered limited compared to the Property CAT bond market, particularly due to the relatively lower loss potential of high-profile cyber incidents.

The objective of our study was to provide new insights and a deeper understanding of developments in the recently emerged Cyber-ILS market by applying a qualitative research approach. Our findings contribute to the existing Cyber-ILS literature in two main ways: First, the specific design of Cyber-ILS product features is examined in detail, particularly in light of sponsors' early experiences and lessons learned following the market launch. Second, the underlying drivers of the market launch and the future market potential of Cyber-ILS are extensively analyzed. In addition to its contributions to academic literature, this study also offers several implications for practice. For instance, the findings suggest that the establishment of standardized definitions would be beneficial not only for defining events but also for clearly outlining the scope of covered risks. With regard to cyber risk modeling, practitioners could critically examine the relevance and impact of overly unrealistic assumptions in so-called doomsday scenarios. Moreover, practical efforts should focus on how to reconcile the opposing views regarding the degree of diversification and the structuring of triggers in Cyber-ILS products.

In terms of further research, Cyber-ILS and the Cyber-ILS market offer considerable potential. Our literature review has shown that the body of academic work on Cyber-ILS remains limited, likely due to the relatively recent emergence of this market. A longer market history should provide a more robust data foundation. Furthermore, the dynamic and evolving nature of cyber risk is expected to continuously reshape the environment in which Cyber-ILS operate, thereby creating an ongoing need for research in this area. Specifically, with a broader data foundation, similar to the study by Hagendorff et al. (2014), which is based on the Property CAT bond market, it could be examined whether Cyber CAT bonds truly work for sponsors and contribute to a significant reduction in default risk. This could also involve distinguishing between the structuring of triggers and the degree of diversification of Cyber CAT bonds, in order to address the open question of whether Cyber CAT bonds with parametric triggers, in combination with the securitization of specific cyber risk types, can contribute to sustainable portfolio protection for sponsors. Furthermore, in the future, the open question of how major cyber events specifically impact the Cyber-ILS market could also be investigated. Additionally, exploring the influence of AI on cyber risk and, consequently, on the Cyber-ILS market also seems highly relevant.

References

Adams, W.C. (2015). Conducting Semi-Structured Interviews. In: Newcomer, K.E., Hatry, H.P. and Wholey, J.S. (eds.), *Handbook of Practical Program Evaluation* (4th ed., pp. 492-505). Wiley.

Albrecht, P. and Weinmann, H. (2015a). Zur Diskussion um die Zinszusatzreserve in der Lebensversicherung: Legaler Betrug oder mangelndes Produktverständnis? *Zeitschrift für Versicherungswesen* 66(5): 137-139.

Albrecht, P. and Weinmann, H. (2015b). 35 Jahre Kapitalanlageperformance der deutschen Lebensversicherer. *Zeitschrift für Versicherungswesen* 66(17): 544-548.

Allianz Deutschland AG (2018). *Transformation des Geschäftsmodells: Mehrwert für den Kunden* [Press release]. Allianz Deutschland AG. https://www.allianz.de/presse/mitteilungen/transformation-des-geschaeftsmodells-mehrwert-fuer-den-kunden/, accessed 23 March 2024.

Ammar, S.B., Braun, A. and Eling, M. (2015). *Alternative Risk Transfer and Insurance-Linked Securities: Trends, Challenges and New Market Opportunities*. Institute of Insurance Economics I.VW-HSG, University of St. Gallen.

Anke, J., Francke, A., Schaefer, L.-M. and Petzoldt, T. (2021). Impact of SARS-CoV-2 on the mobility behaviour in Germany. *European Transport Research Review* 13: 10.

Aravindakshan, A., Boehnke, J., Gholami, E. and Nayak, A. (2020). Preparing for a future COVID-19 wave: Insights and limitations from a data-driven evaluation of non-pharmaceutical interventions in Germany. *Scientific Reports* 10: 20084.

Artemis (2023a). *Beazley "proud" cat bond investors backed its "high quality" cyber underwriting: CEO*. Artemis. https://www.artemis.bm/news/beazley-proud-cat-bond-investors-backed-cyber-underwriting-ceo/, accessed 1 April 2025.

Artemis (2023b). *Beazley cyber cat bond (Cairney)*. Artemis. https://www.artemis.bm/deal-directory/beazley-cyber-cat-bond-cairney/, accessed 1 April 2025.

Artemis (2023c). *Q4 2023 Catastrophe Bond & ILS Market Report: An unprecedented year of new risks, records, and huge market growth*. Artemis. https://www.artemis.bm/wp-content/uploads/2023/12/catastrophe-bond-ils-market-report-q4-2023.pdf?utm_source=ReportsPage&utm_medium=Link&utm_content=Q42023Report&utm_campaign=Report, accessed 1 April 2025.

Artemis (2024a). *Swiss Re: $50m cyber ILW is "novel and complementary" retro cover*. Artemis. https://www.artemis.bm/news/swiss-re-50m-cyber-ilw-is-novel-and-complementary-retro-cover/, accessed 1 April 2025.

Artemis (2024b). *MarketView - Listings of ART, catastrophe bond and weather risk professionals*. Artemis. https://www.artemis.bm/marketview/, accessed 2 May 2024.

Artemis (2024c). *CrowdStrike outage: Cyber cat bond prices stable, uncertainty palpable*. Artemis. https://www.artemis.bm/news/crowdstrike-outage-cyber-cat-bond-price-stable-uncertainty-palpable/, accessed 1 April 2025.

Artemis (2024d). *Beazley adds $290m cyber ILW to its $510m cyber cat bonds, in $1bn cyber cat coverage*. Artemis. https://www.artemis.bm/news/beazley-adds-290m-cyber-ilw-to-its-510m-cyber-cat-bonds-in-1bn-cyber-cat-coverage/, accessed 1 April 2025.

Artemis (2024e). *Rule 144A Catastrophe Bond*. Artemis. https://www.artemis.bm/glossary/rule-144a-catastrophe-bond/, accessed 12 December 2024.

Artemis (2025a). *Q4 2024 Catastrophe Bond & ILS Market Report: Records fall once again as outstanding cat bond market nears $50bn*. Artemis. https://www.artemis.bm/wp-content/uploads/2025/01/catastrophe-bond-ils-market-report-q4-2024.pdf?utm_source=Article&utm_medium=Link&utm_content=Q42024Report&utm_campaign=Q42024Report, accessed 1 April 2025.

Artemis (2025b). *Catastrophe Bond & Insurance-Linked Securities Deal Directory: Catastrophe bond and ILS market dashboard*. Artemis. https://www.artemis.bm/deal-directory/?_sft_perils=cyber-risks, accessed 1 April 2025.

Artemis (2025c). *Catastrophe bonds & ILS issued by type and year*. Artemis. https://www.artemis.bm/dashboard/catastrophe-bonds-ils-issued-by-type-and-year/, accessed 7 April 2025.

Artz, J. (2025). *Regieren im Ausnahmezustand in Deutschland: Die Herausforderungen der RAF, des internationalen Terrors und der Pandemie*. Wiesbaden: Springer VS.

Assekurata Assekuranz Rating-Agentur GmbH (2019). *Assekurata-Marktstudie: Korridormethode zeigt deutlich Wirkung bei Zinszusatzreserve* [Press release]. Assekurata GmbH. https://www.assekuratarating.de/fileadmin/mediendatenbank/Dokumente/Presse/Pressemitteilungen/2019/Zinszusatzreserve/Assekurata_PM_14_02_2019_Zinszusatzreserve.pdf, accessed 23 March 2024.

Assekurata Assekuranz Rating-Agentur GmbH (2021a). *Einmalbeiträge - berechtigter Wachstumstreiber im Lebensversicherungsgeschäft?* Assekurata GmbH. https://www.assekurata.de/2021/02/15/einmalbeitraege-berechtigter-wachstumstreiber-im-lebensversicherungsgeschaeft/, accessed 23 March 2024.

Assekurata Assekuranz Rating-Agentur GmbH (2021b). *Assekurata-Studie: Run-off in der Lebensversicherung 2021* [Press release]. Assekurata GmbH. https://www.assekurata-rating.de/wp-content/uploads/2021/09/Assekurata_PM_16_11_2021_Assekurata_Run-off-Studie.pdf, accessed 23 March 2024.

Assekurata Assekuranz Rating-Agentur GmbH (2022). *Run-off in der Lebensversicherung 2022: Empirische Kennzahlenuntersuchung von externen Run-off-Gesellschaften*. Assekurata GmbH. https://www.experten.de/2022/12/assekurata-studie-run-off-in-der-lebensversicherung-2022/, accessed 31 January 2023.

Assekurata Assekuranz Rating-Agentur GmbH (2023a). *Überschussdeklaration*. Assekurata GmbH. https://www.assekurata-rating.de/, accessed 31 January 2023.

Assekurata Assekuranz Rating-Agentur GmbH (2023b). *Assekurata-Marktstudie: Zinswende sorgt für erste Rückflüsse aus der Zinszusatzreserve* [Press release]. Assekurata GmbH. https://www.assekurata rating.de/wpcontent/uploads/2021/09/Assekurata_PM_28_02_2023_Assekurata_Ueberschussstudie_Garantien.pdf, accessed 23 March 2024.

Awiszus, K., Knispel, T., Penner, I., Svindland, G., Voß, A. and Weber, S. (2023). Modeling and pricing cyber insurance. *European Actuarial Journal* 13: 1-53.

Babuna, P., Yang, X., Gyilbag, A., Awudi, D.A., Ngmenbelle, D. and Bian, D. (2020). The impact of COVID-19 on the insurance industry. *International Journal of Environmental Research and Public Health* 17(16): 5766.

Batool, A. and Sahi, A. (2019). Determinants of financial performance of insurance companies of USA and UK during global financial crisis (2007-2016). *International Journal of Accounting Research* 7(1): 1-9.

Beenken, M. (2022). *So teuer ist der Lebensversicherungs-Vertrieb*. Versicherungsmagazin. https://www.versicherungsmagazin.de/rubriken/branche/so-teuer-ist-der-lebensversicherungs-vertrieb-3273782.html, accessed 23 March 2024.

Biener, C., Eling, M. and Wirfs, J.H. (2015). Insurability of Cyber Risk: An Empirical Analysis. *The Geneva Papers on Risk and Insurance - Issues and Practice* 40: 131-158.

Bierth, C., Friedrich, K., Linderkamp, T., Lohse, U. and Schröder, M. (2018). Zukunft der Versicherung - Versicherung der Zukunft. *Zeitschrift für die gesamte Versicherungswissenschaft* 107: 127-141.

Billmeyer, A. (2022a). *Finanzielle Leistungsfähigkeit: Kapitalanlage als Hebel*. Lebensversicherung von 1871 a. G.. https://www.lv1871.de/lv/partner/blog/finanzielle-leistungsfaehigkeit-kapitalanlage-als-hebel/, accessed 25 March 2024.

Billmeyer, A. (2022b). *Finanzielle Leistungsfähigkeit beurteilen: Kostenquoten*. Lebensversicherung von 1871 a. G.. https://www.lv1871.de/lv/partner/blog/finanzielle-leistungsfaehigkeit-beurteilen-kostenquoten/, accessed 23 March 2024.

Boddy, C.R. (2016). Sample size for qualitative research. *Qualitative Market Research* 19(4): 426-432.

Bönisch, S., Wegscheider, K., Krause, L., Sehner, S., Wiegel, S., Zapf, A., Moser, S. and Becher, H. (2020). Effects of coronavirus disease (COVID-19) related contact restrictions in Germany, March to May 2020, on the mobility and relation to infection patterns. *Front Public Health* 8: 568287.

Braun, A., Eling, M. and Jaenicke, C. (2023). Cyber insurance-linked securities. *ASTIN Bulletin: The journal of the IAA* 53(3): 684-705.

Breuer, C. and Breuer W. (2005). Öffentliche versus privatwirtschaftliche Versicherer - Ein Effizienzvergleich auf Basis der Prinzipal-Agenten-Theorie. In: Keuper F. and Schaefer C. (eds.) *Führung und Steuerung öffentlicher Unternehmen: Probleme, Politiken und Perspektiven entlang des Privatisierungsprozesses*. Berlin: Logos Verlag, pp. 1-19.

Bürger, C. (2019). Wertschöpfung im Retailgeschäft der Bancassurance durch Kundenbeziehungsmanagement. In: Wagner, F. (ed.) *Leipziger Schriften zur Versicherungswissenschaft*. Karlsruhe: VVW Verlag.

Bundesanstalt für Finanzdienstleistungsaufsicht (2004). *Veröffentlichungen der Bundesanstalt für Finanzdienstleistungsaufsicht: Anordnung und Verwaltungsgrundsätze: Hinweis zur Wahrung des Gleichbehandlungsgrundsatzes gemäß § 11 Abs. 2 VAG bei der Verteilung der Überschüsse an die Versicherungsnehmer*. 53. Jahrgang, Nr. 7, Bonn.

Bundesanstalt für Finanzdienstleistungsaufsicht (2010). *Rundschreiben 8/2010 (VA) - Hinweise zu Lebensversicherungen gegen Einmalbeitrag und zu Kapitalisierungsgeschäften (Geschäftszeichen VA 21-I 4209-2010/0002)*. Bonn.

Bundesanstalt für Finanzdienstleistungsaufsicht (2012). *Was bedeutet Überschussbeteiligung bei Kapitallebensversicherungen? Wie unterscheidet sich die "laufende Überschussbeteiligung" vom "Schlussüberschussanteil"?* Bundesanstalt für Finanzdienstleistungsaufsicht. https://www.bafin.de/SharedDocs/FAQs/DE/Verbraucher/Versicherung/Produkte/Kapital/03_ueberschussbeteiligung.html, accessed 31 January 2023.

Bundesanstalt für Finanzdienstleistungsaufsicht (2021a). *Statistik der BaFin 2020 - Erstversicherungsunternehmen (Tabelle 160)*. Bundesanstalt für Finanzdienstleistungsaufsicht. https://www.bafin.de/SharedDocs/Downloads/DE/Statistik/Erstversicherer/dl_st_20_erstvu_lv_va_xls.xlsm, accessed 23 March 2024.

Bundesanstalt für Finanzdienstleistungsaufsicht (2021b). *Statistik der BaFin 2011-2020 - Erstversicherungsunternehmen (Tabelle 6), (Tabelle geb. BB)*. Bundesanstalt für Finanzdienstleistungsaufsicht. https://www.bafin.de/DE/PublikationenDaten/Statistiken/Erstversicherung/erstversicherung_node.html, accessed 23 March 2024.

Bundesanstalt für Finanzdienstleistungsaufsicht (2025). *Statistik der BaFin - Erstversicherungsunternehmen*. Bundesanstalt für Finanzdienstleistungsaufsicht. https://www.bafin.de/DE/PublikationenDaten/Statistiken/Erstversicherung/erstversicherung_artikel.html, accessed 26 July 2025.

Bundesregierung (2021a). *Videoschaltkonferenz der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder am 5. Januar 2021*. Bundesregierung. https://www.bundesregierung.de/resource/blob/997532/1834306/75346aa9bba1050fec8025b18a4bb1a3/2021-01-05-beschluss-mpk-data.pdf, accessed 15 July 2025.

Bundesregierung (2021b). *Videoschaltkonferenz der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder am 19. Januar 2021*. Bundesregierung. https://www.bundesregierung.de/resource/blob/974430/1840868/8e190fafc4ac9395b058bf1a4294ac0e/2021-01-19-mpk-data.pdf?download=1, accessed 15 July 2025.

Bundesregierung (2021c). *Videoschaltkonferenz der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder am 10. Februar 2021*. Bundesregierung. https://www.bundesregierung.de/resource/blob/974430/1860078/a6cf07859f87555d0e9483ddcf15fde1/2021-02-10-mpk-barrierefrei-data.pdf, accessed 15 July 2025.

Bundesregierung (2021d). *Videoschaltkonferenz der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder am 3. März 2021*. Bundesregierung. https://www.bundesregierung.de/resource/blob/974430/1872054/66dba48b5b63d8817615d11edaaed849/2021-03-03-mpk-data.pdf?download=1, accessed 15 July 2025.

Bundesregierung (2021e). *Videoschaltkonferenz der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder am 10. August 2021*. Bundesregierung. https://www.bundesregierung.de/resource/blob/974430/1949532/d3f1da493b643492b6313e8e6ac64966/2021-08-10-mpk-data.pdf, accessed 15 July 2025.

Bundesregierung (2021f). *Videoschaltkonferenz der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder am 18. November 2021*. Bundesregierung. https://www.bundesregierung.de/resource/blob/974430/1982598/defbdff47daf5f177586a5d34e8677e8/2021-11-18-mpk-data.pdf, accessed 15 July 2025.

Bundesregierung (2021g). *Videoschaltkonferenz der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder am 2. Dezember 2021*. Bundesregierung. https://www.bundesregierung.de/resource/blob/974430/1986142/5873aa09c3896444d247b356b5df4315/2021-12-02-mpk-bund-laender-data.pdf, accessed 15 July 2025.

Cash. Media Group GmbH (2023). *Überschussbeteiligung*. Cash. Media Group GmbH. https://www.cash-online.de/, accessed 31 January 2023.

cecu.de GmbH (2023). *Überschussbeteiligung bei Lebensversicherung im Vergleich*. Cecu.de GmbH. https://www.cecu.de/ueberschussbeteiligung-lebensversicherung.html, accessed 31 January 2023.

Chen, R., Wong, K.A. and Lee, H.C. (1999). Underwriting cycles in Asia. *Journal of Risk and Insurance* 66(1): 29-47.

Choi, B.P. and Weiss, M.A. (2005). An empirical investigation of market structure, efficiency, and performance in property-liability insurance. *Journal of Risk and Insurance* 72(4): 635-673.

Corona Datenplattform (2021). *Themenreport 02: Homeoffice im Verlauf der Corona-Pandemie*. Bundesministerium für Wirtschaft und Energie. https://www.bundeswirtschaftsministerium.de/Redaktion/DE/Downloads/I/infas-corona-datenplattform-homeoffice.pdf?__blob=publicationFile&v=4, accessed 15 July 2025.

Costa, M., Gonçalves, R., Lopes da Costa, R., Pereira, L. and Dias, Á. (2022). Health public crisis impact on non-life insurance: The case of COVID-19. *International Journal of Electronic Healthcare* 12(4): 338-368.

Cremer, F., Sheehan, B., Fortmann, M., Kia, A.N., Mullins, M., Murphy, F. and Materne, S. (2022). Cyber risk and cybersecurity: a systematic review of data availability. *The Geneva Papers on Risk and Insurance - Issues and Practice* 47: 698-736.

Cremer, F., Sheehan, B., Mullins, M., Fortmann, M., Materne, S. and Murphy, F. (2024). Enhancing cyber insurance strategies: exploring reinsurance and alternative risk transfer approaches. *Journal of Cybersecurity* 10(1): 1-17.

Dennstedt, N., Johannsen, O. and Papadatos, G. (2021). Der Akquisitionsprozess - von der Kontaktaufnahme über die Due Diligence, die BaFin-Genehmigung bis zum Closing. In: Krause, D. and Wolfsdorf, K. (eds.) *Run-off in der Lebensversicherung: Besonderheiten von Bestandsversicherern*. Karlsruhe: VVW Verlag, pp. 235-255.

Destatis (2025a). *Verbraucherpreisindex: Deutschland, Jahre*. Destatis. https://www-genesis.destatis.de/datenbank/online/statistic/61111/table/61111-0001, accessed 26 July 2025.

Destatis (2025b). *Verkehrsunfälle Zeitreihen. Statistischer Bericht 5462403, jährliche Veröffentlichung 2015-2024*. Destatis. https://www.destatis.de/DE/Service/Bibliothek/Veroeffentlichungsverzeichnis/_inhalt.html#651008, accessed 26 July 2025.

Destatis (2025c). *VGR Monitor Deutschland: Bruttoinlandsprodukt*. Destatis. https://service.destatis.de/DE/vgr-monitor-deutschland/bip.html, accessed 26 July 2025.

Deutsche Aktuarvereinigung e.V. (2017a). Die Überschussbeteiligung in der Lebensversicherung. *Aktuar Aktuell* 39: 8-9.

Deutsche Aktuarvereinigung e.V. (2017b). *Aktuarielle Anmerkungen zur Differenzierung der Überschussbeteiligung*. Köln.

Deutsche Aktuarvereinigung e.V. (2018). Run-off in der deutschen Lebensversicherung. *Aktuar Aktuell* 44: 8-9.

Deutsche Bundesbank (2023). *Umlaufsrenditen inländischer Inhaberschuldverschreibungen / Insgesamt / Monatswerte (Zeitreihe: BBSIS.M.I.UMR.RD.EUR.A.B.A.A.R.A.A._Z._Z.A)*. Deutsche Bundesbank. https://www.bundesbank.de/dynamic/action/de/statistiken/zeitreihen-datenbanken/zeitreihen-datenbank/759778/759778?listId=www_skms_it01&treeAnchor=GELD, accessed 31 January 2023.

Diboky, F. and Ubl, E. (2007). Effizienz und Eigentümerstruktur: Eine empirische Analyse des deutschen Lebensversicherungsmarktes. *Zeitschrift für die gesamte Versicherungswissenschaft* 96: 21-38.

Diefenbach, T. (2009). Are case studies more than sophisticated storytelling?: Methodological problems of qualitative empirical research mainly based on semi-structured interviews. *Quality & Quantity* 43: 875-894.

Dorofti, C. and Jakubik, P. (2015). *Insurance sector profitability and the macroeconomic environment. In: EIOPA Financial Stability Report - December 2015*, EIOPA. https://www.eiopa.europa.eu/system/files/2020-03/fsr-december-2015.pdf, accessed 26 July 2025.

Ecke, L., Magdolen, M., Chlond, B. and Vortisch, P. (2021). Tracing the effects of the COVID-19 pandemic on car usage in Germany - An analysis of the German Mobility Panel. *European Journal of Transport and Infrastructure Research* 21(3): 65-82.

Eling, M. and Luhnen, M. (2010). Efficiency in the international insurance industry: A cross-country comparison. *Journal of Banking & Finance* 34: 1497-1509.

Eling, M. (2020). Cyber risk research in business and actuarial science. *European Actuarial Journal* 10: 303-333.

Eling, M., McShane, M. and Nguyen, T. (2021). Cyber risk management: History and future research directions. *Journal of Risk and Insurance* 24(1): 93-125.

Eling, M., Elvedi, M. and Falco, G. (2023a). The Economic Impact of Extreme Cyber Risk Scenarios. *North American Actuarial Journal* 27(3): 429-443.

Eling, M., Ibragimov, R. and Ning, D. (2023b). *Time dynamics of cyber risk*. SSRN, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4497621, accessed 1 April 2025.

Eling, M., Kartasheva, A. and Ning, D. (2024). *The supply of cyber risk insurance*. Swiss Finance Institute Research Paper No. 23-118, SSRN, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4497405, accessed 1 April 2025.

Farooq, U., Nasir, A., Bilal, and Quddoos, M.U. (2021). The impact of COVID-19 pandemic on abnormal returns of insurance firms: A cross-country evidence. *Applied Economics* 53(31): 3658-3678.

FEMA (Federal Emergency Management Agency) (2023). *One Year Later, Hurricane Ian Recovery Continues with Nearly $8.7 Billion in Federal Support* [Press release]. FEMA. https://www.fema.gov/press-release/20230928/one-year-later-hurricane-ian-recovery-continues-nearly-87-billion-federal, accessed 7 April 2025.

Frink, M., Ketter, V., Klama, N., Knauf, T., Betz, S., Ruchholtz, S. and Aigner, R. (2023). Effect of coronavirus (COVID-19) pandemic on orthopedic trauma patients presenting in the emergency department of a maximum care hospital and level 1 trauma center. *Archives of Orthopaedic and Trauma Surgery* 143: 1231-1236.

Fung, D.W.H., Lee, W.Y., Yang, C.C. and Yeh, J.J.H. (2024). Risk taking, performance, and resilience to the COVID-19 pandemic: Evidence from public property-casualty insurers. *International Review of Financial Analysis* 91: 102942.

Fung, D.W.H., Lee, W.Y. and Yang, C.C. (2025). Surviving the storm: Evaluating the role of enterprise risk management in property and liability insurers' performance during the COVID-19 pandemic. *Journal of Corporate Finance* 91: 102751.

Gallagher Re (2023). *1st View: Market Turns*. Gallagher Re. https://www.ajg.com/gallagherre/-/media/files/gallagher/gallagherre/1st-view-market-turns-jan-2023.pdf, accessed 7 April 2025.

Gallagher Re (2024). *1st View: What a Difference a Year Makes*. Gallagher Re. https://www.ajg.com/gallagherre/-/media/files/gallagher/gallagherre/news-and-insights/2024/january/what-a-difference-a-year-makes.pdf, accessed 7 April 2025.

Gallagher Re (2025). *1st View: Differentiation Rewarded*. Gallagher Re. https://www.ajg.com/gallagherre/-/media/files/gallagher/gallagherre/news-and-insights/2025/gallagherre-1st-view-differentiation-rewarded-jan-25.pdf, accessed 7 April 2025.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2021a). *Nachfrage nach telefonischer Rechtsberatung ungebrochen hoch*. GDV. https://www.gdv.de/gdv/medien/medieninformationen/nachfrage-nach-telefonischer-rechtsberatung-ungebrochen-hoch-66016, accessed 26 July 2025.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2021b). *Versicherer blicken „vorsichtig optimistisch nach vorn“ - mit leichtem Wachstum 2020 „sehr zufrieden“*. GDV. https://www.gdv.de/gdv/medien/medieninformationen/versicherer-blicken-vorsichtig-optimistisch-nach-vorn-mit-leichtem-wachstum-2020-sehr-zufrieden--65340, accessed 26 July 2025.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2021c). *Kennzahlen zur Kapitalanlage der Lebensversicherer und Erstversicherer 2021*. Berlin.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2022). *Die deutsche Lebensversicherung in Zahlen 2022*. Berlin.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2023). *Die deutsche Lebensversicherung in Zahlen 2023*. Berlin.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2024a). *Hausratversicherung: Schäden je Gefahr*. GDV. https://www.gdv.de/gdv/statistik/statistiken-zur-deutschen-versicherungswirtschaft-uebersicht/schaden-und-unfallversicherung/einzelgefahren-verbundenen-hausratversicherung-schadenentwicklung-151992, accessed 26 July 2025.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2024b). *Naturgefahrenreport 2024*. GDV. https://www.gdv.de/resource/blob/183526/d871a7bed27d5c99e20ab387ee393370/naturgefahrenreport-2024-download-data.pdf, accessed 26 July 2025.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2024c). *Sachversicherung. Sturm/Hagel nach Segmenten*. GDV. https://www.gdv.de/gdv/statistik/datenservice-zum-naturgefahrenreport/sachversicherung-sturm-hagel, accessed 26 July 2025.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2024d). *Sachversicherung. Weitere Naturgefahren (Elementar) nach Segmenten*. GDV. https://www.gdv.de/gdv/statistik/datenservice-zum-naturgefahrenreport/sachversicherung-elementar, accessed 26 July 2025.

GDV (Gesamtverband der Versicherer) (2024e). *Statistiken zur deutschen Versicherungswirtschaft*. GDV. https://www.gdv.de/resource/blob/152652/4a475238113e764d7dcfb9fd0f54dff1/statistiken-zur-deutschen-versicherungswirtschaft-2024-taschenbuch-data.pdf, accessed 24 July 2025.

GDV (Gesamtverband der Deutschen Versicherungswirtschaft) (2025). *Musterbedingungen*. GDV. https://www.gdv.de/gdv/service/musterbedingungen, accessed 26 July 2025.

Geneva Association (2024). *Catalysing Cyber Risk Transfer to Capital Markets: Catastrophe bonds and beyond*. Author: Darren Pain. Geneva Association. https://www.genevaassociation.org/sites/default/files/2024-12/cyber_ils_report_1213.pdf, accessed 1 April 2025.

Habermann, J. and Zech, L. (2022). The COVID-19 pandemic in Germany: Prevention measures, protest and the impact on crime rates. In: Siegel, D., Dobryninas, A. and Becucci, S. (eds.), *COVID-19, Society and Crime in Europe. Studies of Organized Crime*. Cham: Springer, pp. 197-220.

Hagendorff, B., Hagendorff, J., Keasey, K. and Gonzalez, A. (2014). The risk implications of insurance securitization: The case of catastrophe bonds. *Journal of Corporate Finance* 25: 387-402.

Haque, A., Mohona, N.T., Sultana, S. and Kulsum, U. (2021). The impact of COVID-19 on the insurance industry of Bangladesh. *Indian Journal of Finance and Banking* 6(1): 73-85.

Harrell, M.C. and Bradley M.A. (2009). *Data Collection Methods: Semi-Structured Interviews and Focus Groups*. National Defense Research Institute, https://www.rand.org/content/dam/rand/pubs/technical_reports/2009/RAND_TR718.pdf, accessed 6 April 2025.

Harrison, A. (2024). Crowdstrike and Kernel-Level Access. *ITNOW* 66(4): 58-59.

Hartwig, R., Niehaus, G. and Qiu, J. (2020). Insurance for economic losses caused by pandemics. *The Geneva Risk and Insurance Review* 45: 134-170.

He, R., Jin, Z. and Li, J.S. (2024). Modeling and management of cyber risk: a cross-disciplinary review. *Annals of Actuarial Science* 18(2): 270-309.

Hegenberg, K., Althammer, A., Gehring, C., Prueckner, S. and Trentzsch, H. (2023). Pre-hospital emergency medical services utilization amid COVID-19 in 2020: Descriptive study based on routinely collected dispatch data in Bavaria, Germany. *Healthcare* 11(14): 1983.

Howden Group (2024). *Cyber insurance: Risk, resilience and relevance*. Howden Group. https://www.howdengroupholdings.com/sites/default/files/2024-06/howden-2024-cyber-report.pdf, accessed 7 April 2025.

Howden Re (2024). *Reframing cyber risk: Navigating threats and embracing opportunities*. Howden Re. https://www.howdenre.com/sites/howdenre.howdenprod.com/files/2024-11/10503-cyber-report-2024_v9_digital-final.pdf, accessed 7 April 2025.

Johansmeyer, T. and Mican, A. (2022). Cyber ILS: How Acute Demand Could Drive a Scalable Retrocession Market. *The Journal of Risk Management and Insurance* 26(1): 40-59.

Johansmeyer, T. (2024a). How Cyber Model Vendors See Their Role in Closing the Cyber Insurance Protection Gap. *Journal of Insurance Issues* 47(1): 118-134.

Johansmeyer, T. (2024b). Perception Shapes Reality: How Views on Financial Market Correlation Affect Capital Availability for Cyber Insurance. *The Journal of Risk Management and Insurance* 28(1): 1-25.

Jost, T., Römer, F., Wilde, C. and Wagner, F. (2020). *Run-offs bei Bestandsverträgen zur Altersvorsorge: Bestandsaufnahme zur aktuellen Diskussion und empirische Analyse*. Deutsches Institut für Altersvorsorge GmbH, Berlin.

Judson, R.A. and Owen, A.L. (1999). Estimating dynamic panel data models: A guide for macroeconomists. *Economics Letters* 65: 9-15.

Kaiser, R. (2014). *Qualitative Experteninterviews: Konzeptionelle Grundlagen und praktische Durchführung* (2nd ed.). Springer VS.

Kholghi Finanz- & Vermögensplanung (2023). *Laufende Verzinsung der Rürup Versicherer*. Kholghi Finanz- & Vermögensplanung. https://rürup-renten-vergleich.de/laufende-verzinsung, accessed 31 January 2023.

Kipp, D. and Franck, P. (2021). Chancen eines externen Run-offs aus betriebswirtschaftlicher Sicht. In: Krause, D. and Wolfsdorf, K. (eds.) *Run-off in der Lebensversicherung: Besonderheiten von Bestandsversicherern*. Karlsruhe: VVW Verlag, pp. 43-54.

KIVI GmbH Kölner Institut für Versicherungsinformation und Wirtschaftsdienste (2004-2023). *Geschäftsergebnisse der Schadenversicherung, Zahlenband 2004-2023*. Köln.

KIVI GmbH Kölner Institut für Versicherungsinformation und Wirtschaftsdienste (2011-2020). *Geschäftsergebnisse der Lebensversicherung, Zahlenband 2011-2020*. Köln.

Kleinlein, A. (2015). Aktuarielle Hintergründe zur Novellierung der Mindestzuführungsverordnung. In: Wissenschaftlicher Beirat beim Bund der Versicherten (eds.) *Mindestzuführungsverordnung und Revision - Berichte aus der Anwaltspraxis*. Baden-Baden: Nomos, pp. 47-62.

Klotz, M. (2024). *Lebensversicherung kündigen: Wer vorzeitig kündigt verschenkt Geld*. Finanztip Verbraucherinformation GmbH. https://www.finanztip.de/lebensversicherung/lebensversicherung-kuendigen/, accessed 24 March 2024.

Kolarova, V., Eisenmann, C., Nobis, C., Winkler, C. and Lenz, B. (2021). Analysing the impact of the COVID-19 outbreak on everyday travel behaviour in Germany and potential implications for future travel patterns. *European Transport Research Review* 13: 27.

Kolesnikov, O., Markov, A., Samagulov, D. and Solovjovs, S. (2022). Cyber Loss Distribution Fitting: A General Framework towards Cyber Bonds and Their Pricing Models. *International Journal of Mathematics and Mathematical Science* 2022(1): 1-20.

Kuhlmann, S. and Franzke, J. (2022). Multi-level responses to COVID-19: Crisis coordination in Germany from an intergovernmental perspective. *Local Government Studies* 48(2): 312-334.

Kuhlmann, S., Franzke, J., Dumas, B.P. and Heuberger, M. (2023). *Regierungs- und Verwaltungshandeln in der Coronakrise: Fallstudie Deutschland*. Potsdam: Universitätsverlag Potsdam.

Lang, O. (2017). Bewertungsreserven als Indikator der Unternehmensstärke. *Zeitschrift für Versicherungswesen* 68(5): 154-156.

Liebwein, P. (2006). Risk Models for Capital Adequacy: Applications in the Context of Solvency II and Beyond. *The Geneva Papers on Risk and Insurance - Issues and Practice* 31: 528-550.

Malavasi, M., Peters, G.W., Shevchenko, P.V., Trück, S., Jang, J. and Sofronov, G. (2022). Cyber risk frequency, severity and insurance viability. *Insurance: Mathematics and Economics* 106: 90-114.

Maleitzke, T., Pumberger, M., Gerlach, U.A., Herrmann, C., Slagman, A., Henriksen, L.S., von Mauchenheim, F., Hüttermann, N., Santos, A.N., Fleckenstein, F.N., Rauch, G., Märdian, S., Perka, C., Stöckle, U., Möckel, M., Lindner, T. and Winkler, T. (2021). Impact of the COVID-19 shutdown on orthopedic trauma numbers and patterns in an academic Level I Trauma Center in Berlin, Germany. *PLoS ONE* 16(2): e0246956.

Mastroeni, L., Mazzoccoli, A. and Naldi, M. (2022). Pricing Cat Bonds for Cloud Service Failures. *Journal of Risk and Financial Management* 15(10): 1-18.

Messler, V., Leschinger, T., Ott, N., Rausch, V., Burst, V., Eysel, P., Müller, L.P. and Hackl, M. (2023). The impact of the SARS-CoV-2 pandemic-related lockdowns on orthopedic trauma emergencies at a level-one trauma center. *Archives of Orthopaedic and Trauma Surgery* 143: 6201-6208.

Miles, M.B. and Huberman, A.M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook* (2nd ed.). Sage Publications.

Moro, O. and Anderloni, L. (2014). Non-life insurance economic performances - an empirical investigation. *Journal of Economics & Management* 18: 160-177.

Naseer, S., Khalid, S., Parveen, S., Abbass, K., Song, H. and Achim, M.V. (2023). COVID-19 outbreak: Impact on global economy. *Frontiers in Public Health* 10: 270-309. 1009393.

Nayak, J., Mishra, M., Naik, B., Swapnarekha, H., Cengiz, K., Shanmuganathan, V. (2021). An impact study of COVID-19 on six different industries: Automobile, energy and power, agriculture, education, travel and tourism and consumer electronics. *Expert Systems* 39(3): e12677.

NOAA (National Oceanic and Atmospheric Administration) (2018). *Service Assessment: August/September 2017 Hurricane Harvey*. NOAA. https://www.weather.gov/media/publications/assessments/harvey6-18.pdf, accessed 7 April 2025.

Pal, R. and Nag, B. (2024). A Mathematical Theory to Price Cyber-Cat Bonds Boosting IT/OT Security. *WSC '23: Winter Simulation Conference*, pp. 648-659.

Polacek, A. (2018). Catastrophe Bonds: A Primer and Retrospective. *Chicago Fed Letter*, no. 405. Federal Reserve Bank of Chicago, https://www.chicagofed.org/publications/chicago-fed-letter/2018/405?trk=public_post_comment-text, accessed 7 April 2025.

Policen Direkt Versicherungsvermittlung GmbH (2023). *Gewinnbeteiligung aller Lebensversicherungen*. Policen Direkt Versicherungsvermittlung GmbH. https://www.policendirekt.de/ratgeber/gewinnbeteiligung-aller-lebensversicherungen/, accessed 31 January 2023.

Potter, J. and Hepburn, A. (2005). Qualitative interviews in psychology: problems and possibilities. *Qualitative Research in Psychology* 2(4): 281-307.

Pulawska, K. (2021). Financial stability of European insurance companies during the COVID-19 pandemic. *Journal of Risk and Financial Management* 14(6): 266.

Richter, A. and Wilson, T.C. (2020). COVID-19: Implications for insurer risk management and the insurability of pandemic risk. *The Geneva Risk and Insurance Review* 45: 171-199.

S&P Global (2023). *Global Cyber Insurance: Reinsurance Remains Key To Growth*. S&P Global. https://www.spglobal.com/ratings/en/research/articles/230829-global-cyber-insurance-reinsurance-remains-key-to-growth-12813411, accessed 1 April 2025.

Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2015). *Zukunftsfähigkeit in den Mittelpunkt: Risiken durch Niedrigzinsen, Chancen durch die Kapitalmarktunion. Jahresgutachten 2015/2016*, Wiesbaden.

Sandelowski, M. (1995). Sample size in qualitative research. *Research in Nursing & Health* 18(2): 179-183.

Schappacher, R., Rapp, M., Muth, C.-M., Amrehn, L., Schön, M., Liener, U., Bökeler, U., Sander, S., Dinse-Lambracht, A. and Fillies, T. (2022). Einfluss der COVID-19-Krise im Frühjahr 2020 auf traumatologische Fallzahlen eines akademischen Lehrkrankenhauses in Stuttgart - Trauma während einer Pandemie. *Unfallchirurg* 125: 959-966.

Schaumlöffel, K. (2020). Welche Kosten tragen die Kunden deutscher Lebensversicherer? *Zeitschrift für Versicherungswesen* 71(1): 11-16.

Schradin, H. (2005*). Beteiligung der Versicherungsnehmer an den stillen Reserven in der Lebensversicherung?* Institut für Versicherungswissenschaft an der Universität zu Köln, Köln.

Schröder, J. and Krause, J. (2021). Analyse der Kritik an den Bestandsversicherern. In: Krause, D. and Wolfsdorf, K. (eds.) *Run-off in der Lebensversicherung: Besonderheiten von Bestandsversicherern*. Karlsruhe: VVW Verlag, pp. 115-133.

Schwenke, D. and Taube, U. (2016). *Lebensversicherung: Kommentar zu den Allgemeinen Bedingungen der Lebens- und der Rentenversicherung*. In: Präve, P. (ed.) München: C.H. Beck Verlag.

Shevchenko, P.V., Jang, J., Malavasi, M, Peters, G.W., Sofronov, G. and Trück, S. (2023). The nature of losses from cyber-related events: risk categories and business sectors. *Journal of Cybersecurity* 9(1): 1-12.

Stojkoski, V., Jolakoski, P. and Ivanovski, I. (2021). The short-run impact of COVID-19 on the activity in the insurance industry in the Republic of North Macedonia. *Risk Management and Insurance Review* 24(3): 221-242.

Strupczewski, G. (2021). Defining cyber risk. *Safety Science* 135: 1-10.

Surminski, M. (2022). Einmalbeiträge: Die goldenen Jahre sind vorbei. *Zeitschrift für Versicherungswesen* 73(10): 284-285.

Swiss Re (2024). *Insurance-Linked Securities Market Insights: Edition XXXV*. Swiss Re. https://www.swissre.com/dam/jcr:bb189e59-a15f-49df-a250-07b2c6b2d9bd/2024-02-sr-ILS-market-insights-feb-2024.pdf, accessed 1 April 2025.

Swiss Re Group (2023). *Natural catastrophes in focus: Earthquakes*. Swiss Re Group. https://www.swissre.com/risk-knowledge/mitigating-climate-risk/earthquakes.html, accessed 7 April 2025.

Swiss Re Group (2024). *Reality check on the future of the cyber insurance market*. Swiss Re Group. https://www.swissre.com/risk-knowledge/advancing-societal-benefits-digitalisation/about-cyber-insurance-market.html, accessed 7 April 2025.

Swiss Re Institute (2024). *World insurance: strengthening global resilience with a new lease of life. Sigma No 3/2024*. Swiss Re Institute. https://www.swissre.com/institute/research/sigma-research/sigma-2024-03-world-insurance-global-resilience.html, accessed 12 September 2025.

The Insurer (2024a). *Aon's Schultz: Cyber ILS poised for growth in wake of CrowdStrike outage*. The Insurer. https://www.theinsurer.com/tv/news-in-focus/aons-schultz-cyber-ils-poised-for-growth-in-wake-of-crowdstrike-outage/, accessed 7 April 2025.

The Insurer (2024b). *Institutional investors remain cautious on cyber cat bonds*. The Insurer. https://www.theinsurer.com/tv/reinsurancemonth/institutional-investors-remain-cautious-on-cyber-cat-bonds/, accessed 7 April 2025.

Versicherungsbote GmbH (2023). *Überschussbeteiligung*. Versicherungsbote GmbH. https://www.versicherungsbote.de/, accessed 31 January 2023.

VersicherungsJournal Verlag GmbH (2023). *Überschussbeteiligung*. VersicherungsJournal Verlag GmbH. https://www.versicherungsjournal.de/, accessed 31 January 2023.

VorsorgeWiki e.K. (2023). *Der Versicherungsblog – LV Überschussbeteiligungen*. VorsorgeWiki. https://www.pkv-vorteile.de/blog/lv-ueberschussbeteiligungen-gesamt/, accessed 31 January 2023.

Wagner, F. (ed.) (2017). *Gabler Versicherungslexikon* (2nd ed.). Wiesbaden: Springer Gabler Verlag.

Wang, Y., Zhang, D., Wang, X. and Fu, Q. (2020). How does COVID-19 affect China's insurance market. *Emerging Markets Finance and Trade* 56(10): 2350-2362.

Wegman, F. and Katrakazas, C. (2021). Did the COVID-19 pandemic influence traffic fatalities in 2020? A presentation of first findings. *IATSS Research* 45: 469-484.

Weinmann, H. (2018). Zwischen Genugtuung und Run-off: Die Top 12-Lebensversicherer im Vergleich. *Zeitschrift für Versicherungswesen* 69(19): 586-594.

Weinmann, H. (2019). Erleichterung für die "Königsdisziplin": Die Top 12-Lebensversicherer im Vergleich (II). *Zeitschrift für Versicherungswesen* 70(19): 590-597.

WHO (World Health Organization) (2020). *Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. WHO Speeches*. WHO. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020, accessed 12 September 2025.

Williamson, O.E. (1963). Managerial Discretion and Business Behavior. *The American Economic Review* 53(5): 1032-1057.

Wolfsdorf, K. (2021). Lebensversicherung - Quo Vadis? In: Krause, D. and Wolfsdorf, K. (eds.) *Run-off in der Lebensversicherung: Besonderheiten von Bestandsversicherern*. Karlsruhe: VVW Verlag, pp. 1-42.

Wollinger, G.R., Werner, A. and Bode, F. (2021). Auswirkungen der Pandemie auf die Kriminalitätsentwicklung. In: Beck, J. and Stember, J. (eds.) *Managing Corona. Eine verwaltungswissenschaftliche Zwischenbilanz.* Baden-Baden: Nomos, pp. 321-333.

Woods, D.W. and Wolff, J. (2025). A History of Cyber Risk Transfer. *Journal of Cybersecurity* 11(1): 1-16.

World Bank (2022). *World development report 2022: Finance for an equitable recovery*. World Bank. https://documents1.worldbank.org/curated/en/408661644986413472/pdf/World-Development-Report-2022-Finance-for-an-Equitable-Recovery.pdf, accessed 12 September 2025.

Xu M. and Zhang Y. (2021). Data Breach CAT Bonds: Modeling and Pricing. *North American Actuarial Journal* 25(4): 543-561.

Zielke, C. (2021). *Ergebnisse der Untersuchung der SFCR-Berichte Deutscher Lebensversicherer 2020*. Bund der Versicherten. https://www.bundderversicherten.de/downloads/stellungnahmen/stellungnahmen-2021/1Kommentartabelle-D-01072021.pdf, accessed 31 January 2023.

Zimmermann, J., Chevtchenko, G. and Schweinberger, S. (2006). Der Einfluss des Versicherungskapitalanlagen-Bewertungsgesetzes (VersKapAG) auf Überschüsse und Überschussbeteiligung in der Lebensversicherung - Eine empirische Untersuchung. *Zeitschrift für die gesamte Versicherungswissenschaft* 95: 91-124.

Zimmermann, J. and Schramm, J. (2015). Solvenzregulierung, Kapitalanlage und Überschussverteilung - Ein größenabhängiger Vergleich des Marktverhaltens deutscher Lebensversicherer. *Zeitschrift für die gesamte Versicherungswissenschaft* 104: 427-457.

Zinyoro, T. and Aziakpono, M.J. (2024). Performance determinants of non-life insurance firms: A systematic review of the literature. *Cogent Business & Management* 11(1): 2345045.