Essays on the Impact of Natural Disasters on Insurance Stock Value and the Performance of Mutual Insurance in Germany

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Contents

Introduction

Natural disasters pose significant economic and financial challenges globally, with impacts that resonate through various sectors. The insurance industry plays a critical role in managing natural hazard risks by providing financial protection against losses incurred from natural disasters. However, the occurrence of such events can strain insurers' financial stability, influence their stock performance, and alter investor perceptions. The interplay between natural catastrophes and the insurance industry is complex, as insurers are simultaneously affected by immediate financial losses and long-term market perceptions. Among the various forms of insurance providers, mutual insurance companies hold a unique position. These entities, owned by policyholders rather than shareholders, prioritize member benefits and long-term stability over short-term profits. Understanding the performance of mutual insurers is particularly pertinent given the increasing volatility in global natural hazard risks, driven by factors such as climate change. This thesis aims to provide a comprehensive analysis of how mutual and stock insurers navigate financial challenges, manage risk, and sustain growth, thereby offering insights that could inform regulatory frameworks, and strategic decision-making within the insurance sector. The multifaceted relationship between natural catastrophe risks and insurance performance is explored within the context of the stock value. Additionally, the thesis delves into the performance of mutual insurance companies in Germany.

The first essay, written and published together with Tanja Jäckle (responsible for data curation and the formal analysis), investigates the impact of hurricanes on US insurance stocks. Hurricanes are among the most expensive catastrophic events and both the severity and frequency of natural disasters have increased significantly in recent decades. Climate change is leading to a higher probability of hurricanes. The development of coastal areas, especially the increase in population in these areas, allows hurricanes to cause more damage. Given the frequency and intensity of hurricanes in the US, particularly on the East Coast and in the Gulf of Mexico, understanding the US stock market's response to such natural disasters is instructive about the financial stability and risk management practices of insurance companies. Our study examines how hurricanes affect the stock returns of insurance companies in the property-casualty line of business in the United States. Previous studies focus either on the impact of individual hurricanes on the stock market, such as Hurricane Katrina or Andrew, or on the impact of a data sample with

different types of catastrophes. This research gap is filled by our quantitative analysis, which answers the research question of how US insurers' share prices reacted to the most expensive hurricanes since 2004. At first glance, it seems obvious that severe hurricane events pose a threat to insurers and therefore have a significant negative impact on the stock value of insurance companies. However, reinsurance solutions and demand effects associated with the foreseeable losses of a hurricane could also have a positive impact on insurance stocks. The data sample of our event study consists of the 13 most expensive hurricanes that have hit the US since 2004 and 32 P&L insurance companies listed on the US stock exchange. Stock returns are examined in multiple event windows around the hurricane landfall to capture immediate and short-term market reactions. Further, the regression model in this paper examines the impact of several independent variables, namely hurricane category, hurricane losses, and S&P 500 membership, on the observed cumulative abnormal return. The study highlights the financial vulnerability of insurance stocks to hurricanes, with significant negative returns observed after major hurricanes. The results suggest that the market differentiates by the severity of the hurricane and the resulting losses, with higher category hurricanes leading to more pronounced negative stock market reactions. Interestingly, lower category hurricanes can sometimes show a positive correlation with cumulative abnormal returns. The hypothesis that S&P 500 membership has a significant impact on abnormal returns cannot be confirmed. Although statistically significant negative abnormal returns prevail, the effects are rather moderate in a time window of 2 weeks around the event. The insurance sector seems to be able to cope with the uncertainty of hurricane risks as the market does not make extreme price jumps. Since the negative abnormal returns are mainly concentrated on days 1 and 2 after the hurricane's arrival, we conclude that the insurance market responds efficiently to new information generated by hurricanes. Our study can serve as a starting point for further research. A promising approach would be to use exposure-weighted indicators such as the proportion of home insurance premiums written in hurricane-exposed states.

The second essay, written and published with Lukas Michael Noth (responsible for data curation and formal analysis), investigates the influence of ownership structures on the risk behavior of German property-liability insurance companies. The German insurance industry is characterized by the coexistence of different organizational forms of insurance companies. Two organizational forms, which differ in terms of organization and the derived business implications, dominate the German insurance market, with over 96% of gross written premiums in the German non-life insurance market. Our paper addresses

the question of how ownership structures, in particular the distinction between stock and mutual insurers, influence risk-taking behavior in the German non-life insurance market. We hypothesize that the different organizational implications of the stock and mutual forms manifest themselves in a significant difference in risk management approaches. The influence of investors on management as well as the easier possibility of refinancing could encourage riskier behavior in stock companies. We investigate whether the legal form of an insurance company in the German non-life insurance market influences the way it deals with risk in the two business dimensions of underwriting and investment. We first show that there is a significant difference between the strategic behavior of stock insurance companies and mutual insurance companies. Furthermore, we analyse the risk preferences of the two organizational forms. To determine the different risk preferences of the two organizational forms, we use three main methods. First, we define volatility-based risk indicators and divide the investment instruments and business areas into riskier and less risky classes. Second, we observe the average composition of the underwriting and investment behavior of mutual or stock insurers over time. Third, we conduct logistic regressions using the maximum likelihood model to identify the differences in risk preferences between the two organizational forms. The study analyzes 62 German non-life insurers over the period from 2000 to 2019. Underwriting risk is measured by the volatility of loss ratios, while investment risk is captured by the standard deviation of investment returns. Variables such as company size, market share and economic conditions are controlled for. The study provides evidence that ownership structure significantly influences risk behavior in the German non-life insurance market. Our results suggest that stock insurers are riskier than mutual insurers. On the investment side, equities show a proportionally higher investment in more volatile asset classes, but this difference can be explained by size effects. In the underwriting dimension, mutuals write more business in less risky lines, which is reflected in the volatility of claims payments. Stock insurers write proportionally more business in riskier lines.

The third essay investigate the success of stock and mutual insurers in the dimensions, growth, costs, and solvency combined with a survey on perception of mutual insurers in the German market. Mutual insurance in Germany has its roots in the 19th century with the primary aim of providing affordable and accessible insurance services. A mutual insurance association initially aims to provide its members with adequate insurance cover and charges favorable premiums, as the insured members also own the association. The mutual form can serve the interests of its members as the form is independent of profit-

oriented capital providers. Over time, mutual insurance companies have contributed significantly to the development of the German insurance market. In recent years, however, the relevance of this form has declined worldwide as more and more mutual insurance companies have been converted into stock corporations. Nevertheless, mutual insurance continues to play an important role: in 2020, 240 mutuals were active in Germany with a market share of around 14%. Historically, academic literature in Germany has emphasized the disadvantages of mutuals. This paper provides a comprehensive analysis of the historical development, current performance and future prospects of these member-owned insurers. I use an extensive data set to analyze the performance of stock and mutual insurers in various dimensions, such as growth, costs and solvency. The empirical results show that mutual insurers have higher growth rates and lower expense ratios than stock insurers. Mutual groups have gained market share from stock companies over the last 25 years. In terms of investment returns, there is no clear difference between shares and mutuals. The yield disadvantage of mutuals has narrowed over time. Mutuals have a cost advantage in the areas of health and property insurance. In life insurance, mutuals have lower acquisition costs than stock companies. The success and growth of mutuals is not achieved at the expense of substance or security. Mutuals cover higher solvency ratios. In a second step, I examine how the organizational form of an insurance company is assessed by customers. The survey shows that many policyholders attach little importance to the legal form. Customers often do not understand the concept of mutual insurance and do not know whether they have an insurance contract with a mutual insurance group. My combination of performance analysis and a survey shows a clear contradiction between the performance and perception of mutual insurance. Despite the measurably strong performance of mutual insurance, mutuality does not play a decisive role in the decision to buy insurance. A stronger emphasis on the special features of mutual insurance and educating customers about them could be a promising marketing approach for mutual insurers.

The fourth essay, written together with Dr. Jannes Rauch (responsible for the formal analysis), examines the relation between ownership structures and earnings quality in the German non-life insurance market. Financial reports are critical to assessing a company's financial performance, with higher quality reports providing better information to decision makers. However, managers can manipulate earnings to meet certain thresholds. The organizational form of a company, such as a stock corporation or a mutual insurance

company, can influence the quality of financial reporting through governance and demand effects. International research suggests that mutual companies tend to have higher quality financial reporting due to lower incentives for manipulation. The integration of the roles of customers and investors in mutuals reduces agency problems and aligns management incentives with policyholder interests. In contrast, stock insurers are under constant pressure from external investors to meet financial benchmarks, leading to a higher tendency to manipulate earnings. Previous studies suggest that mutual insurers have better financial reporting quality than stock insurers. We analyze whether the organizational form of an insurance company influences the quality of reporting in the German non-life insurance industry. Using a dataset of 1,856 company observations for the years 2001-2021 and regression analyses, we examine differences in the quality of financial reporting between mutual and stock insurers. The influence of organizational form on the management of reported figures is analyzed using OLS regression models. The study analyzes data from 124 German non-life insurance companies over two decades (2001-2021), comprising 1,856 company-year observations. Three measures of financial reporting quality are used for a comprehensive analysis. We analyze using three measures: standard deviation of return on equity (SD(ROE)), loss reserve error and profit ratio. These ratios assess the variability of profitability, the accuracy of loss reserves and the discrepancy between profit on ordinary activities and retained earnings. The study also controls for additional company-level factors and macroeconomic developments to ensure robust results. The results consistently show that mutual insurers have a higher quality of financial reporting compared to stock insurers on all three measures. This result supports the opportunistic behavior hypothesis, which states that managers in stock companies have stronger incentives to manipulate earnings due to external investor pressure and stock-linked compensation. The internalized incentive conflicts of mutuals lead to fewer agency problems and higher quality of financial reporting. This result is consistent across different measures and holds regardless of additional firm-level factors or macroeconomic conditions.

Essay 1: The Impact of Hurricanes on US Insurance Stocks

Schuh, F. & Jaeckle, T. (2022).
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Abstract:

This paper analyzes the impact of hurricanes on insurance stock returns in the United States. The objective is to assess the reaction of insurance stock prices caused by hurricanes using an extensive data sample consisting of the costliest hurricanes since 2004. We aim to understand the insurance stock price reactions and provide possible explanations for the observed results. The main outcome is a negative abnormal return for all examined time windows. Analyses of impact factors show that high-category hurricanes have more negative abnormal returns in comparison to low-category hurricanes. The latter category is even positively correlated with the cumulative abnormal return. The regression model indicates a statistically significant negative correlation between the cumulative abnormal return and the damage caused by the hurricane.

Keywords: Insurance, hurricane, stock price, event study

1.1. Introduction

1.1.1. Background

One of the most threatening extreme weather phenomena is hurricanes, tropical cyclones that typically threaten the US east coast and the Caribbean (World Economic Forum, 2019, p. 5). Hurricanes are also among the costliest catastrophic events. Hurricane Katrina, one of the worst hurricanes in history, caused more than 100 billion USD of damage (Howerton and Bacon, 2017, p. 12). For individuals and companies, insurance might be salvation after hurricanes, whereas the requirement to pay resulting claims might turn into a challenge for insurers. Claim requests after natural disasters especially affect property and liability (P&L) insurers as homeowner's insurance policies typically include the coverage of wind as one type of peril (Insurance Information Institute, n.d.). In the case of Hurricane Katrina: about 62 billion USD of its damage was insured (Munich Re, n.d.).

Throughout the last decades, both the severity and frequency of natural disasters increased significantly. The risk of extreme weather events interconnects with the failure of climate change adaptation and mitigation (World Economic Forum, 2019, p. 15). Climate change leads to a higher likelihood of hurricanes (Holland and Bruyère, 2014, p. 625). The coastal development, especially an increased population living in these areas, enables hurricanes to cause more damage (Congressional Budget Office, 2016, pp. 5-6). These increases in frequency and severity could evolve into a major negative financial impact on insurance companies. Although the hurricane season is recurring and predictable, the occurrence and impact of individual hurricanes are still not fully predictable. There is a great concern among investors about whether insurance companies will be able to cope with catastrophic weather events in the future (Born and Viscusi, 2006, p. 56). Insurance firms should be able to effectively and efficiently absorb losses after catastrophes to sustain their long-term value. Therefore, understanding the implications of hurricanes and possible impact factors is of great importance for insurance companies and investors. At first glance, it seems obvious that severe hurricane events are a threat to insurers and should therefore also have a clear negative influence on the stock value of insurance companies. But diving deeper into the topic, reinsurance solutions and demand effects linked to the foreseeable damages of a hurricane could also have positive effects on insurance stocks.

1.1.2. Research objective

Previous studies focus either on stock market implications of individual hurricanes, such as hurricane Katrina or Andrew (Howerton & Bacon, 2017, p. 13; Angbazo & Narayanan, 1996, p. 622), or on the effects that a data sample with diverse catastrophe types imply (Hagendorff, Hagendorff, and Keasey, 2015, pp. 159; Born & Viscusi, 2006, p. 57). An identified research gap is how insurance companies react to a group of hurricanes as one type of natural disaster because most previous studies focus on discrete analyses of single events or various catastrophe types. This paper focuses on hurricanes solely and includes a more extensive data sample, consisting of the costliest and most recent hurricanes[1] in the US. Our goal is to answer the following research question:

How do stock prices of US insurers react to the costliest hurricanes since 2004?

We aim to ascertain the general reaction of insurance stock prices triggered by hurricanes. Additionally, the goal is to better understand the drivers of abnormal returns. Thus, the cross-sectional regression model of this paper investigates the impact of various independent variables, namely the hurricane category, hurricane damage and S&P 500 (Standard & Poor's index) membership, on the observed cumulative abnormal return. To sum up, this paper contributes to understanding the insurance stock price reactions due to hurricanes and provides possible explanations for the observed results.

1.1.3. Paper structure

The remainder of this paper is organized as follows: Section 2 discusses the theoretical foundations of the implications of hurricanes on insurance companies before hypotheses concerning the corresponding stock price reactions are derived. Next, Section 3 describes the underlying data set before Section 4 outlines the applied event study methodology and linear regression model. Section 5 illustrates our event study and regression results. Section 6 discusses the empirical findings and possible explanations. The last section gives a short conclusion and outlines limitations, implications and suggestions for further research.

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[1] This paper includes hurricanes since 2004 as most previous literature focused on earlier hurricanes. Additionally, adjusted costs (based on 2020 Consumer price index) from the database with the costliest tropical cyclones in the United States (NCEI & NHC, 2020, p. 2) have to be over 10 billion USD.

1.2. Literature review and hypotheses

The following literature review focuses on existing studies that investigate the financial impact of hurricanes. Angbazo and Narayanan (1996, p. 628) identify a statistically significant negative reaction of P&L insurers on and after the day of hurricane Andrew's landfall. Their observation shows, that the negative reaction includes a positive and counteracting effect for an anticipated premium increase (Angbazo and Narayanan 1996, p. 628).

Hurricane Katrina made landfall in August 2005 and caused more than 100 billion USD of damage (Howerton and Bacon, 2017, p. 12). The study of ten P&L insurers with coverage in the affected areas shows a semi-strong market efficiency as the stock prices react fast to public information around the event. Statistically significant negative risk-adjusted returns of -0.02% prevail in the [-30;+30] day period around the event (Howerton & Bacon, 2017, p. 14, p. 16).

The dataset of Born and Viscusi (2006, p. 71) comprises natural catastrophic events (floods, storms, fires, earthquakes) and every firm that writes homeowners' insurance coverage in the US from 1984 to 2004 classified by state. They examine the twenty most devastating events, including twelve hurricanes, with the conjecture that the insurers did not fully anticipate these catastrophes and their severity (Born & Viscusi, 2006, pp. 57-59). The regression analysis includes (among others) three independent variables regarding unexpected catastrophes[2], which have a statistically significant positive effect on the probability of insurance firms terminating business after catastrophes (Born & Viscusi, 2006, p. 69). The paper clarifies that catastrophic events hit insurers hard and lead to an increase in losses as a response to catastrophic events (Born & Viscusi, 2006, p. 69-71).

Lamb (1995, p.116) demonstrates that investors efficiently access the information generated by Hurricane Andrew in 1992, as the market response is concentrated on days 0 and +1 after the hurricane struck Florida's coast. Additionally, investors can distinguish P&L insurers according to their number and volume of written insurance policies. Firms with business in the most exposed states (Florida and Louisiana) obtain significant negative

[2] The variable "unexpected catastrophe" is defined by Born and Viscusi (2006, p. 61) as "the difference between the number of actual catastrophic events in a given year and the average number of catastrophic events in that state over the 1984-2004 period". The regression model includes this variable not only in the year of the dependent variable, but also for the two previous years.

returns (-0.05%) over the two days on and after landfall (Lamb, 1995, p. 117, p. 120). Three years later, Lamb again examines hurricane Andrew to compare it with hurricane Hugo, concluding that Andrew caused approximately three times the damage of Hugo. Hurricane Hugo and Andrew led to different market reactions for P&L firms, providing evidence that the market can discriminate by hurricane magnitude (Lamb, 1998, p. 168, p. 171).

The study of Hagendorff *et al.* (2015, pp. 159-160) investigates the effect of mega-catastrophes in the US on 57 publicly traded P&L insurers in the period from 1996 to 2010. Nine of the nineteen catastrophes in the sample are hurricanes. The analysis from Hagendorff *et al.* reveals negative performance implications of -0.28% (1% significance level) for the time window [0;+1] (2015, p. 162). The researchers conducted a multivariate regression analysis to identify factors that determine the observed market reactions of insurers in the [0;+15] period. A significant negative relationship exists between catastrophe size, measured as total insured loss in constant 2010 USD terms and insurers' stock price reaction, as anticipated by the researchers. As an additional dummy variable, Hagendorff *et al.* (2015, p. 167) study the relationship between the insurance company's Standard and Poor's rating and abnormal returns. They find a positive (between 0.014 and 0.034) correlation. Insurers with a rating of AA or better would have less negative abnormal returns. However, this result is non-significant.

Lanfear, Lioui, and Siebert (2017) investigate how stock price reactions after hurricanes vary for different decile portfolios. They use a sample of 34 hurricanes making landfall between 1990 and 2014 in the US. The database includes stock data of NYSE and NASDAQ listed companies, sorted into decile portfolios regarding market equity (Panel A) and book-to-market equity (Panel B). The main finding of Panel A is that abnormal returns due to hurricanes are negatively related to firms' size. Firms of smaller size face more negative abnormal returns than firms of a bigger size. The magnitude of the negative effect is generally decreasing when moving from smaller to larger stock-size portfolios (Lanfear *et al.*, 2017, p. 15). Results for the book-to-market equity ratio (Panel B) indicate that growth stocks (low book equity/market equity) and value stocks (high book equity/market equity) suffer larger negative abnormal returns compared to portfolios in the middle of the decile range.

Likewise, Gangopadhyay, Haley, and Zhang (2010, p. 147) find empirical evidence for an efficient adjustment of stock prices concerning the new information from hurricanes

Katrina and Rita. The observed negative abnormal returns of hurricane Katrina align closely with the press releases (Gangopadhyay *et al.*, 2010, p. 142). Both exposed and unexposed insurers react in the same direction, indicating that contagion effects on unexposed firms exist (Gangopadhyay *et al.*, 2010, p. 148). Nevertheless, for the [0;+1] time window on and after landfall, exposed insurers react more severely with a stock price reaction of -1.55% compared to unexposed insurers with -0.98%, both at a 5% significance level (Gangopadhyay *et al.*, 2010, p. 145). The regression indicates that market capitalization has no significant impact on the cumulated abnormal return in the [-1;+1] window (Gangopadhyay *et al.*, 2010, p. 143).

The evaluation of US insurance stock reactions after individual catastrophes reveals manifold insights. First, hurricanes mostly lead to negative stock price reactions. Second, when examining various hurricanes, the magnitude and timing of the reactions differ, although a tendency to observe negative stock price reactions persists. In this paper, several hypotheses are set up to analyze the research question, how stock prices of US insurers react to the costliest hurricanes since 2004. The goal is to extend knowledge of the empirically varying results in previous literature with a more extensive data set.

Shelor, Anderson, and Cross (1992, p. 477) published one of the first papers that refers to the "damage" and "revenue" hypothesis[3] to explain the impact of catastrophes on insurance firms' value. Further studies that examine the effect of catastrophes on stock prices, for example, Gangopadhyay, Haley and Zhang (2010, p. 143), similarly refer to the opposing damage and revenue hypotheses. The "damage" hypothesis represents the theory that catastrophes have a negative impact on the firm value of insurers because insurers need to handle claim payments for damages to policyholders. This expectation of losses can lead to a decline in insurance stock prices. Contrary, the "revenue" hypothesis states that catastrophes lead to an increase in stock prices because insurance firms may benefit from catastrophes via demand effects or premium increases.[4] The positive effect of the revenue hypothesis counterbalances the negative effect of the damage hypothesis (Shelor *et al.*, 1992, p. 477). Although previous literature is consistent with the

[3] This paper defines the hypotheses from Shelor *et al.* (1992) as "revenue" and "damage" hypothesis.
[4] In early 2007, Florida enacted legislation that sought to increase regulatory control over insurance rates and claims adjustment. This pressures insurers to lower their prices, which reduces the effect of premium increases. At the same time, especially relevant in the context of catastrophe risk, regulators may pressure insurers to make more generous claims payments and pay claims more quickly, which increases the demand effect (Grace & Klein, 2009, pp. 107-109).

two hypotheses, the results about the dominating effect after disasters are still inconsistent. Our first hypothesis investigates which of the counteracting effects dominates and leads to positive/negative abnormal returns.

H_1: Hurricanes generate a negative abnormal return for insurance stocks.

In this study, hurricanes are differentiated into five categories according to their strength[5]. The second hypothesis investigates whether a difference in abnormal return generation occurs depending on the respective hurricane category. To test this hypothesis, hurricanes from the two highest categories (4 or 5), the middle (3) and the two lowest categories (1 or 2) are compared. One would expect that hurricanes from a higher category, thus with higher wind speeds, lead to more negative stock returns due to possibly higher resulting claims. This expectation is in line with the damage hypothesis. More negative abnormal returns for higher-category hurricanes can result if either the damage hypothesis increases or the revenue hypothesis decreases. The analysis of the hurricane category helps to achieve the goal to shed light on the influencing factors for stock price reactions to anticipated hurricanes, as the hurricane category is observable before the event date. To understand this effect, the following hypothesis is tested:

H_2: High-category hurricanes have more negative abnormal returns than low-category hurricanes.

A related question to the hurricane category (hypothesis 2) is whether the financial damage a hurricane causes correlates with abnormal returns. For this examination, firstly, the three most impactful hurricanes with respect to their damage (measured in billion USD based on the 2020 consumer price index) are compared with the remaining hurricanes in the sample. Secondly, the regression analysis investigates the prevalence of a correlation between hurricane damage and cumulative abnormal return. In contrast to hypothesis 2, the damage caused by the hurricane is only observable after the hurricane event. Hagendorff *et al.* study the impact of the catastrophe size, measured by the total insured loss (2015, p. 167). This paper seizes that suggestion and wants to fill the gap of missing research regarding the overall hurricane damage costs. Insured as well as uninsured costs are considered in the damage estimate. The tested hypothesis is:

[5] The hurricane category is derived from the Saffir-Simpson Hurricane Wind Scale. A hurricane is classified in the respective category based on the sustained winds (see section “hurricane data”)

H_3: More damaging hurricanes have more negative abnormal returns.

Lanfear *et al.* (2017, p. 15) and Gangopadhyay *et al.* (2010, p. 146) investigate the impact of extreme weather events on stocks, controlled by various capitalization and income variables. Lanfear *et al.* (2017, p. 15) state that micro stocks have more negative abnormal returns on hurricanes compared to larger stocks. This paper uses the S&P 500 index membership during the assessed period of this event study as market capitalization indicator. The following hypothesis has the goal to clarify the controversial findings from previous studies regarding the significance level of a capitalization approximation on abnormal returns:

H_4: The S&P 500 membership has a positive impact on abnormal returns after hurricanes.

1.3. Data

1.3.1. Hurricane data

This paper restricts the sample of hurricanes to the US as geographic region because this country is susceptible to hurricanes. Hurricanes occur not only frequently but also devastatingly (NHC & CPHC, n.d.). Additionally, this paper narrows down the scope to the costliest hurricanes with adjusted costs of over 10 billion USD. The database of "costliest tropical cyclones to impact the United States" from the National Oceanic and Atmospheric Administration (NCEI & NHC, 2020) provides hurricane data. In this sample, 16 out of the 21 costliest US hurricanes occurred between 2004 and 2018 (NCEI & NHC, 2020, p. 2). Thus, the focus of this paper is set on the 16 most recent and costliest hurricanes from the initial database. Table 1 shows the selected hurricanes with their date of landfall, hurricane category and adjusted costs based on the 2020 consumer price index. The date of landfall is retrieved from the National Weather Service website (weather.gov) and sets the day when the hurricane made its first continental landfall in the US (Puerto Rico for hurricane Maria).

As hurricane Ike occurred during the financial crisis in 2008, a time of unique market conditions, it is reasonable to exclude this hurricane from the analysis to prevent distortion of the results. Due to partly overlapping event windows, hurricanes Ivan and Irma are eliminated to ensure a spread of more than 10 trading days between the events. Thus, the final sample consists of 13 hurricanes since 2004.

Table 1: List of the costliest hurricanes since 2004

Hurricane	**Adjusted damage costs** (based on 2020 Consumer Price Index)	**Date of landfall** (as reported by weather.gov)	**Hurricane Category**
Katrina	170.0 bn USD	25.08.2005	3
Harvey	131.3 bn USD	25.08.2017	4
Maria	94.5 bn USD	20.09.2017	4
Sandy	74.1 bn USD	29.10.2012	1
Irma	52.5 bn USD	10.09.2017	4
Ike	36.9 bn USD	13.09.2008	2
Ivan	28.7 bn USD	16.09.2004	3
Wilma	25.8 bn USD	24.10.2005	3
Michael	25.5 bn USD	10.10.2018	5
Rita	25.2 bn USD	24.09.2005	3
Florence	24.5 bn USD	14.09.2018	1
Charley	22.4 bn USD	13.08.2004	4
Irene	15.8 bn USD	27.08.2011	1
Frances	13.7 bn USD	05.09.2004	2
Matthew	10.9 bn USD	08.10.2016	1
Jeanne	10.5 bn USD	26.09.2004	3

Source: based on NCEI & NHC (2020, p. 2)

To accomplish a precise analysis, the event date (day of landfall) has to be adjusted for hurricanes Katrina, Harvey and Sandy to the day after the actual landfall. This is necessary as hurricane landfall occurred in the late evening when the stock market was already closed (trading hours: 9:30 a.m. until 4:00 p.m. ET). Furthermore, if the day of landfall falls on a non-trading day (for example weekend or public holiday), the event date is shifted to the first following trading day after the actual (reported) day of landfall.

A further distinction between the events is the hurricane category, which is derived from the Saffir-Simpson Hurricane Wind Scale. The categories range from 1 to 5, based on a hurricane's sustained wind speed (NHC & CPHC, n.d.). Table 2 presents the categories and their respective potential property damage. For the regression model, hurricanes of categories 1 and 2 are summarized as independent variable *Category_low*. Catastrophic hurricanes of categories 4 and 5 are summarized as variable *Category_high*.

Table 2: Hurricane category

Category	Sustained Winds	Hurricane damage
1	119 – 153 km/h	Very dangerous winds produce some damage
2	154 – 177 km/h	Extremely dangerous wind causes extensive damage
3	178 – 208 km/h	Devastating damage occurs
4	209 – 251 km/h	Catastrophic damage occurs
5	252 km/h or higher	Catastrophic damage occurs

Source: based on NHC & CPHC (n.d.)

1.3.2. Stock data

Besides event data, the second pillar to conduct an event study analysis is the daily prices of the sample stocks and chosen index. Stock and index prices are extracted from Thomson Reuters Datastream. The selection of insurance companies is based on the sample from Hagendorff *et al.* (2015, p. 170), including 57 publicly traded P&L insurers that earned positive premiums in the homeowners' business line from 1996 until 2010. From the original sample, 34 insurers provide stock data for the assessed period of this event study (end of 2003 until 2018). Two more companies are excluded due to their illiquid stocks. To ensure that all firms from the final sample are potentially exposed to the hurricanes in our analysis, the annual report of each company was reviewed with the finding that generally, all considered firms include hurricane damages in their portfolio. 32 firms represent the final company sample of this paper (Table 8 in Appendix).[6]

[6] Berkshire Hathaway and Donegal Group list class A and B stocks. Berkshire Hathaway class A stocks are excluded. Due to the ongoing high price (Datastream, 2020) they could react differently to the events. For Donegal Group, class B stocks are excluded because Donegal Mutual held approximately 85% of the outstanding class B common stocks, but only 40% of the outstanding class A common stocks (Donegal Group Inc., 2020, p. 1). Thus, due to the higher free float percentage, class A is more suitable for an analysis as they better represent the market and can react to external influences.

1.4. Empirical model and methodology

1.4.1. Event study methodology

This paper uses the event study methodology to empirically assess the effect of hurricanes on US insurance stock prices. The event's impact is measured with abnormal stock market returns that are attributable to the hurricane events. The impact of an event can be quantified as the delta of the expected stock price that would have realized without any unanticipated events and the actual stock price after the event's appearance.

MacKinlay (1997, p. 37) states that an "important characteristic of a successful event study is the ability to identify the date of the event precisely". This clear event date definition is especially important for hurricanes as investor stock price expectations adjust as the hurricane evolves and approaches landfall. Likewise, Lamb (1998, p. 171) shows that investors incorporate the produced new information about hurricanes quickly in the market, as abnormal returns are concentrated on the two days after hurricane Andrew's landfall. Generally, hurricanes are not unexpected events as the existence of the storm is already known before landfall (Cagle, 1996, p. 60). The hurricane category can be observed before landfall. Nevertheless, the realized magnitude of the damage through the hurricane may be unexpected and different from the anticipated value. The actual damage will be revealed after landfall when the actual magnitude becomes observable and reports of damage are available (Cagle, 1996, p. 60). Thus, the date of landfall is relevant for the damage event that includes some uncertainty. This paper sets the event date t_0 (day zero) as the date of hurricane landfall in the US which is defined by the National Hurricane Center as the date when the center of a hurricane hits the coastline (NHC & CPHC, n.d.). To isolate the effect of hurricanes the event window covers two trading days, [0;+1], the day of and the day after landfall. This time window does not only capture immediate responses on the day of hurricane landfall but also incorporates slightly delayed information. This is beneficial, as costs of damage are not necessarily fully transparent on the day of landfall. At the same time, this window minimizes the amount of time in which other factors may influence the results. To include possible further delayed reactions, the regression analysis is performed with the [0;+5] time window. Additionally, the event window lengths [-5;+5], [-2;+2] and [0;+10] extend the analysis of this paper to cross-check findings with event windows besides the typical periods.

There is no clear consensus regarding the optimal length of the estimation window when conducting an event study with daily stock data. For example, Lamb (1995, p. 114; 1998, p. 166) uses a 150-day trading period as estimation window, ending 10 days before landfall to avoid contamination through anticipation of the hurricane's impact. Angbazo and Narayanan (1996, p. 623) use an estimation period of 110 days (day -120 to day -11) for their calculation. Lanfear *et al.* (2017, p. 12) define the estimation window based on the Atlantic hurricane season. This method is especially suitable when multiple hurricanes occur in the same year to avoid a confounding influence of other hurricanes in the estimation window. The Atlantic hurricane season lasts from June 1st until November 30th (NHC & CPHC, n.d.). Thus, the period outside and before the hurricane season, December 1st until May 31st, determines the estimation window.

This paper uses the framework from Lanfear *et al.* (2017) and determines its applicability. The general US hurricane season will be adjusted to ensure that all estimation windows are outside the hurricane season. Therefore, the latest landfall date of the event data set (October 29) determines the adjusted hurricane season end date. Whereas the earliest date of the data sample (August 13) sets the start date of the adjusted hurricane season. To ensure that all estimation windows are prior to and outside the adjusted hurricane season, the non-hurricane season is extended from mid-November until mid-July. As a result, the estimation window [-188;-77] includes 110 trading days. The window starts 78 days before the event date to avoid abnormal return contaminations of other hurricanes.

The normal return in the estimation window is calculated as the theoretically appropriate required rate of return in absence of the event. The comparison of the actual stock return with the expected normal stock return presents the abnormal return (MacKinlay, 1997, p.15). To measure the expected normal return, several approaches based on economic and statistical assumptions are available. This paper uses the market model event study methodology which requires stock prices for all firms and the (daily) market portfolio returns. In this study, the S&P 500 composite index represents the US stock market as it is the most widely used measure of overall stock market performance in the US.

All actual returns are computed with daily stock returns as short-term daily data can be advantageous over longer periods (Brown and Warner, 1985, p. 25). Day-end prices of stocks are based on the official day-end prices from NYSE, NASDAQ, or non-NASDAQ OTC (over-the-counter). Stock prices and market portfolio data are extracted from Thomson Reuters Datastream as all sample firms are publicly traded. As recommended by

Corrado and Truong (2008, p. 518), this paper uses logarithmic returns as they generally produce better test specifications compared to simple compounded returns. Moreover, this paper follows the approach of continuously compounded returns as mostly used in event studies (Henderson, 1990, p. 287).

To draw an overall conclusion, abnormal returns are aggregated over time and across securities (MacKinlay, 1997, p. 21). Abnormal returns are aggregated over the event window. Aggregating abnormal returns across all firms on day *t* leads to the average abnormal return (AAR). By combining aggregation for average abnormal returns through time, cumulative average abnormal return (CAAR) represents the mean abnormal returns for all companies in the event window.

1.4.2. Regression analysis methodology

An event study identifies significant abnormal returns for subsamples with certain characteristics, but it does not explain the causes of abnormal returns. Whereas a multivariate regression model determines the impact of different characteristics on the CAR. In this paper, the dependent variable of the cross-sectional regression is CAR [0;+5] to evaluate a longer period than in the subsample analyses. *Category_low*, *Category_high, Hurricane_Damage* and *S&P_Member* are explanatory variables to model the relationship with CAR. Model I investigates the influence of the hurricane category, which is identifiable before the final realization of the damage of the hurricane, on insurance stocks. The first dummy variable *Category_low* is set 1 for hurricanes defined as category 1 or 2 hurricanes and thus belong to the lower end of the hurricane category classification. Whereas *Category_high* refers to the upper end of the classification and is set 1 for hurricanes of category 4 or 5. In model II the influence of the hurricane damage, which is realized after the event, on insurance stocks is analyzed. *Hurricane_Damage* states the damage costs of a hurricane in billion USD. Data for the hurricane category and damage is provided by NCEI and NHC (2020, p. 2), illustrated in Table 2. In model III we investigate the influence of market capitalization on the stock reaction to hurricanes. We use the insurer's membership in the S&P 500 index as a dummy variable for high market capitalization. *S&P_Member* is set 1 if the company has been part of the S&P 500 index during the assessed period of this event study. Model IV combines all variables.

A series of variables is used as control factors. The control variable *Net_income* is a variable regarding the average net income of the investigated insurance companies from

2004 until 2018. It is used to check for size effects based on actuarial income. If the average net income was above 200 million USD, the dummy variable is set to 1, otherwise, it is set to 0. *Debt_Equity* depends on the capital structure of the investigated companies as it is set to 1 if the debt-to-equity ratio is higher than 25% on average during the period from 2004 until 2018. With an average debt-to-equity ratio below 25%, the dummy variable *Debt_Equity* is set to 0. The cumulated average return of the S&P 500 index is used as an indicator to constitute the overall stock market reactions around the event date. If the cumulated S&P 500 return in the period starting 5 days before and ending 5 days after the event day was positive, the dummy variable *Market* is set to 1. For a cumulated negative return, the variable is set to 0.

The significance of the multiple linear regression is tested with the standard two-sided-t-test. Estimated parameters in combination with the test statistic help to infer a correlation between a respective variable of interest and the CAR [0;+5].

1.5. Empirical results

1.5.1. Event study

The following section outlines the empirical results of the conducted event study that investigates changes in stock prices as a reaction to hurricanes. First, results for the full sample are shown, including abnormal and cumulated abnormal returns for different periods around the day of landfall. Second, this paper evaluates subsamples, regarding the hurricane category, damage impact and S&P 500 membership. Last, the findings of the regression analysis are presented to explain the identified CAR effects. Statistical significance is tested at levels of 1%, 5% and 10% respectively.

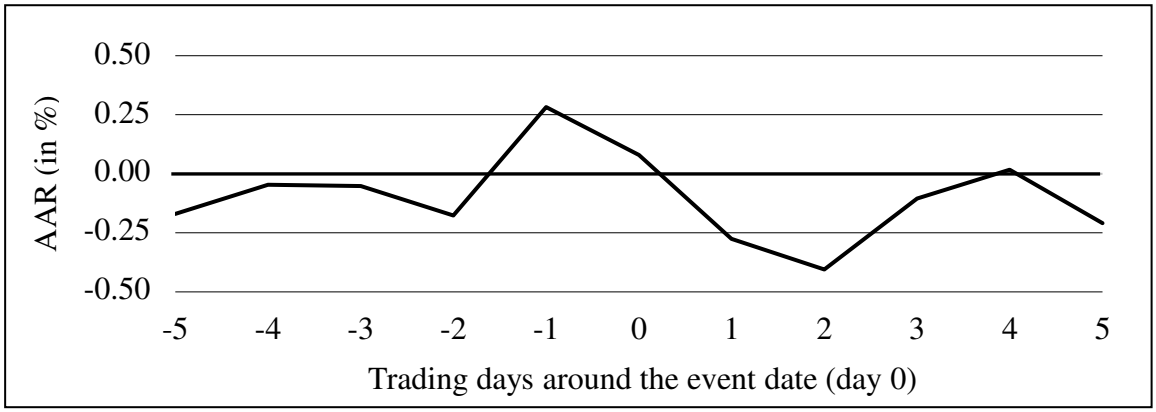
1.5.1.1. Entire sample

This first section examines the changes in stock prices when considering the full sample set, including 13 events and 32 companies.

Figure **1** represents the average abnormal return (AAR) results linked to the hurricanes in the [-5;+5] period around the day of landfall. A statistically significant (1% level) positive AAR of +0.28% is identified on the day before the event, but no statistically significant average abnormal return prevails on the day of hurricane landfall (t_0). A negative and statistically significant AAR is observed before hurricane landfall on day t_{-2} with a mean

of -0.18%. Additionally, the two days after landfall reveal statistically significant negative AARs. The AAR on t_1 with a mean of -0.28% exactly offsets the positive AAR on the day before landfall. AAR on t_2 is -0.41%, the most negative value within the examined two-week period around landfall.

Figure 1: Average abnormal returns for the whole sample in [-5;+5] days period



Note: The figure depicts the average abnormal returns (AAR) for the whole data sample (N=416) around the event date (day of hurricane landfall).

Generally, observable patterns are decreasing AARs in the [-1;+2] time window and negative AARs for the [-5;-2] and [+1;+5] time windows before and after hurricane landfall. Whereas, the second time frame has a slightly positive (but insignificant) AAR on day 4. Detailed daily AARs and the respective test statistics (t-test and Wilcoxon signed-rank test) for the [-10;+10] period are presented in Table 9 (Appendix).

As negative abnormal return patterns predominate, this paper analyzes additional test statistics for different time windows around the day of hurricane landfall. Table 3 represents the observed mean CAARs for different time windows and their respective significance tests (t-test and Wilcoxon signed-rank test). Each tested period shows statistically significant CAARs with a significance level of at least 5% for both conducted test methods. All mean CAARs are negative and range between -0.2% for the [0;+1] time window and -1.06% for the [-5;+5] time window. Even the longest post-event window, including ten trading days after hurricane landfall, shows a negative CAAR of -0.78% at a statistical significance level of 1% for the t-test and 5% for the Wilcoxon signed-rank test.

Table 3: Value effects for different periods

Time window	Sample size	Mean (CAAR)	t-test	Wilcoxon signed-rank test
[0;+1]	416	-0.20%	-1.69 ** (0.046)	-2.96 *** (0.003)
[-5;+5]	416	-1.06%	-4.04 *** (0.000)	-3.77 *** (0.000)
[-2;+2]	416	-0.50%	-2.73 *** (0.003)	-2.31 ** (0.021)
[0;+5]	416	-0.90%	-4.21 *** (0.000)	-3.37 *** (0.001)
[0;+10]	416	-0.78%	-3.19 *** (0.001)	-2.57 ** (0.010)

Significance: * p < 0.1, ** p < 0.05, *** p < 0.01

To summarize, hurricanes generate statistically significant negative CAARs for each analyzed time window, ranging between -0.2% and -1.06%. The AAR analysis shows the pattern of decreasing AARs, starting on the day before hurricane landfall. After hurricane landfall, mainly negative AARs prevail. These outcomes help to evaluate hypothesis 1 which assumes that hurricanes generate negative abnormal returns for insurance stocks.

1.5.1.2. Subsamples by hurricane or firm criteria

This article presents results from different subsamples to extend the full sample analysis (N=416) and examine the additional hypotheses. Therefore, the following analyses include subsamples regarding the hurricane category, resulting damage and the S&P 500 membership. Subsample analyses are based on the [0;+1] time window as this period includes the most direct effects related to the hurricane landfall.

Panel A: Hurricane category

To test hypothesis 2, the sample of events is split up into various subsamples. The first subsample analysis refers to the hurricane category. “Category low” subsumes hurricanes with an indicated category 1 or 2 according to the Saffir-Simpson Hurricane Wind Scale. Hurricanes of category 3 represent “Category middle” and “Category high” subsumes hurricanes with category 4 or 5. This subsample is evaluated in Table 4.

Table 4: Value effects for Panel A: Hurricane category

Criteria specification	Sample size	CAAR [0;+1] Mean	t-test	Wilcoxon signed-rank test
Category low	160	0.37%	2.28 **	3.20 ***
			(0.012)	(0.001)
Category middle	128	-0.44%	-1.81 **	-4.48 ***
			(0.037)	(0.000)
Category high	128	-0.66%	-3.40 ***	-4.53 ***
			(0.001)	(0.000)

Significance: * p < 0.1, ** p < 0.05, *** p < 0.01
Note: "Category low" includes hurricanes with the indicated category 1 or 2, "Category middle" includes hurricanes of category 3, "Category high" includes hurricanes of category 4 or 5.

The results indicate, that for the [0;+1] time window the mean CAAR has a more negative value for category high hurricanes compared to category middle hurricanes. Additionally, category middle hurricanes have a more negative mean CAAR than category low hurricanes. All identified abnormal returns are statistically significant at the 5% level at least. At the same time, the CAAR associated with category low hurricanes is positive at 0.37%, whereas category middle hurricanes lead to a negative CAAR of -0.44% and high category hurricanes result in a CAAR of -0.66%. This leads to an overall mean CAAR difference of approximately 1%-point between hurricanes from category low and category high.

Panel B: Hurricane damage

Hypothesis 3 aims to find out whether the actual hurricane impact, measured in adjusted damage costs based on the 2020 Consumer Price Index, makes a difference in the observed abnormal returns. As Welch's t-test requires a dummy variable, this paper constructs a subsample with the three most damaging hurricanes which are hurricanes Katrina, Harvey and Maria. These three hurricanes are compared to the remaining ten hurricanes in the sample. Table 5 represents the results of the hurricane damage study. The CAAR of both, the top three and the remaining hurricanes, is negative. To be more precise, the CAAR of the three most damaging hurricanes amounts to -0.56% and is thus 0.47%-point more negative than the CAAR of the remaining hurricanes in the sample. This difference in CAAR is confirmed with Welch's t-test at a 5% significance level.

Table 5: Welch's t-test for Panel B and C

Criteria specification	Sample size	CAAR [0;+1] Mean	Std. dev. (standard deviation)	Welch's t-test	p-value
Panel B: Hurricane damage					
Non-Top 3	320	-0.09%	2.47		
Top 3	96	-0.56%	1.95		
Difference		0.47%		1.95 **	(0.027)
Panel C: S&P 500					
Non-S&P 500	299	-0.10%	2.58		
S&P 500	117	-0.44%	1.69		
		0.34%		1.57*	(0.059)

Significance: * p < 0.1, ** p < 0.05, *** p < 0.01
Note: Panel B refers to the adjusted damage costs based on the 2020 consumer price index in billion USD (Table 1). The 3 most damaging hurricanes are subsumed and compared to the remaining hurricanes in the data sample. The dummy variable in Panel C is set 1 if a sample firm has been part of the S&P 500 index during the assessed period of this event study.

Panel C: S&P 500

The last panel refers to the dummy variable *S&P_Member* which is set 1 for companies that have been part of the S&P 500 index during the assessed period of this event study. Otherwise, the variable is set to zero. Welch's t-test (Table 5) shows a positive difference in CAAR (10% significance level) whether a company belongs to the S&P 500 subset or not. Thus, companies that belong to the S&P 500 have a 0.34%-point more negative CAAR than companies that did not belong to the index during the assessed period of this event study. This observation helps to evaluate hypothesis 4.

To summarize, hurricanes generate significant negative CAARs, ranging for different periods between -0.2% and -1.06%, at least with a 5% significance level. A decreasing AAR pattern starts on the day before landfall until two days after landfall. The first subsample investigates different hurricane categories. Hurricanes classified with a high hurricane category reveal more negative CAARs compared to middle-category hurricanes. The same applies to hurricanes from the middle and low hurricane classifications. Hurricanes with a middle category reveal a (more) negative CAAR, as low-category hurricanes even lead to a positive CAAR. Next, the top three hurricanes in terms of damage indicate more negative CAARs than the remaining hurricanes. Lastly, Welch's t-test results show a more negative CAAR for companies that have been part of the S&P 500 index during the assessed period, however at a significance level of 10%.

1.5.2. Regression analysis

As the preceding step for valid multiple regression analysis, it must be ensured that all necessary assumptions are met. Eventually, the assumptions for the OLS regression are tested and adjusted before the presentation of regression results. Regression Model I to IV analyze different constellations of predictor variables of interest: *Category_low*, *Category_high*, *Hurricane_Damage, S&P_Member*, *Net_income*, *Debt_Equity* and *Market*. Table 10 (Appendix) shows descriptive statistics for all variables in the conducted regression model with the dependent variable CAR of the [0;+5] time window.

1.5.2.1. Regression assumptions

As a prerequisite to obtaining valid results from the regression analysis, several assumptions have to be fulfilled. As the first pretest, outliers are identified and afterward excluded. Figure 2 (Appendix) provides a graphical overview of all variables in a scatterplot to identify outliers and hence exclude data point number 386. Following, pairwise correlation is calculated for all variables, presented in Table 11 (Appendix). Although the variables indicate further correlations, none of the variables of interest has to be dropped, as values from 0.3 to 0.7 indicate a moderate linear relationship (Ratner, 2009, p. 140). Next, the normality of residuals is both numerically and graphically checked. Although the calculated results from the Shapiro-Wilk test (Table 12 in Appendix) reject the null hypothesis of normal distribution, residuals illustrated in Figure 3 (Appendix) appear to be close enough to the straight line to justify a normal distribution. In conclusion, the normality assumption is confirmed, however, with reservations.

The next prerequisite for a valid multiple regression is heteroscedasticity ("same variance"). The evaluation in Figure 4 (Appendix) indicates that the assumption of heteroscedasticity is not violated as the absolute variance of error terms tends to be constant and no systematic effects are identifiable. Additionally, the regression model requires no multicollinearity among predictor variables. This is examined by the variance inflation factor (VIF) analysis (Figure 5 in Appendix) which reveals only values below three. Thus, one can expect uncorrelated independent variables (Hoffmann, 2016, p. 15). Partial residual plots in Figure 6 (Appendix) are used to test linearity for variables of the regression models. The graphs show that the independent variables fulfill the assumptions of linearity sufficiently as the regression lines fit the data adequately. Hence, all necessary assumptions are met at a satisfactory level.

1.5.2.2. Regression results

The results of regression Models I to IV are shown in Table 6. Model I, II and IV have an F-significance at a 1% level, however, Model III reveals no significance. Thus, we can conclude that models I, II and IV offer useful insights. The coefficient of determination, adjusted R-squared, suggests that between 0.60% (Model III) and 10.41% (Model IV) of the variance of the dependent variable CAR [0;+5] can be explained to a certain extent by the investigated models.

Model I illustrates the impact analysis of the hurricane category and reveals that the dummy variable *Category_low* is positively correlated with abnormal returns due to hurricanes. Whereas *Category_high* (dummy variable) correlates negatively with abnormal returns. Thus, the dependent variable CAR [0;+5] increases for low-category hurricanes, whereas decreases for high-category hurricanes. Model IV confirms the sign of correlation for these independent variables at different significance levels.

Table 6: Linear regression results

	Dependent variable: CAR [0;+5]			
Independent variable:	I	II	III	IV
Category_low	0.95**			0.37
	(0.046)			(0.442)
Category_high	-1.29**			-0.96*
	(0.011)			(0.054)
Hurricane_Damage		-0.03***		-0.02***
		(0.000)		(0.000)
S&P_Member			-0.02	-0.02
			(0.971)	(0.967)
Net_income	0.21	0.21	0.22	0.22
	(0.585)	(0.586)	(0.631)	(0.618)
Debt_Equity	-0.04	-0.03	-0.03	-0.03
	(0.926)	(0.933)	(0.934)	(0.938)
Market	1.28***	0.56	1.03**	0.81**
	(0.002)	(0.163)	(0.013)	(0.048)
Constant	-1.67***	-0.03	-1.54***	-0.23
	(0.001)	(0.944)	(0.001)	(0.688)
N	415	415	415	415
Significance F	0.0000	0.0000	0.1659	0.0000
R-squared	0.0663	0.1031	0.0157	0.1192
Adjusted R-squared	0.0549	0.0944	0.0060	0.1041

Significance: * p < 0.1, ** p < 0.05, *** p < 0.01

Note: Reported results are OLS regression coefficients, p-values are stated in parenthesis. The independent variables are *Category_low* (dummy variable) which is set 1 for hurricanes of category 1 and 2, the dummy variable *Category_high* is set 1 for hurricanes of category 4 and 5, *Hurricane_Damage* refers to the adjusted damage costs in billion USD, the dummy variable *S&P_Membe*r is 1 for firms that have been part of the S&P 500 index during the assessed period of this event study. The control variable *Net_income* is a dummy variable, set 1 if the average net income of the firm from 2004 to 2018 was above 200 million USD. The control variable *Debt_Equity* (dummy variable) is set 1 if the average debt-to-equity ratio of a firm from 2004 to 2018 is higher than 25%. The dummy control variable *Market* is set 1 if the cumulated S&P 500 return was positive in the period 5 days before and 5 days after the event day.

Model II analyzes the independent variable *Hurricane_Damage*. It reveals a negative and statistically significant (1% level) correlation with CAR [0;+5]. Model III focuses on the independent dummy variable *S&P_Member*, which is set 1 if a company has been part of the S&P 500 index during the assessed period of this event study. The model reveals a slightly negative, however statistically insignificant, correlation between the S&P membership and CAR [0;+5]. Model IV combines all the independent variables and confirms the sign of correlation in Models I to III which analyze the input factors individually. To

summarize, the regression analysis confirms a positive correlation between low-category hurricanes and abnormal returns. Whereas high category hurricanes are negatively correlated with CAR. The caused hurricane damage similarly reveals a negative correlation with abnormal stock returns. The correlation between the S&P 500 membership and CAR is not statistically significant.

1.6. Discussion

The goal of this paper is to analyze how stock prices of US insurers react to the costliest hurricanes since 2004. Overall, the event study results reveal statistically significant negative returns as a reaction to hurricanes. The full sample analysis indicates for the [0;+1] time window a mean CAAR of -0.2% and a mean CAAR of -0.9% for the week after landfall, [0;+5]. Both results are statistically significant, at a 5% level. Table 7 provides a summarized overview of the findings for all hypotheses.

Table 7: Hypotheses results overview

Hypotheses	Test
H_1: **Negative abnormal returns** for insurance stocks due to hurricanes	✓
H_2: More negative abnormal returns for higher **hurricane category**	✓
H_3: More negative abnormal returns for more **damaging hurricanes**	✓
H_4: **S&P 500** membership has a positive impact on abnormal returns	✗

Note: ✓ = confirmed, ✗ = rejected

Overall, the results indicate slightly negative and statistically significant, abnormal returns of insurance stocks for all examined event windows, [0;+1], [-5;+5], [-2;+2], [0;+5] and [0;+10], with a CAAR between -0.2% and -1.06% (Table 3). This confirms hypothesis 1 that hurricanes can create statistically significant negative abnormal returns. The daily AARs in the two weeks around hurricane landfall reveal the most negative mean of -0.41% two days after the day of landfall. This observation might prove that the occurred damage is not immediately observable on the day of hurricane landfall. Rather, the actual damage becomes entirely revealed through damage reports on the days following landfall. This publicly available new information about the extent of destruction might then result

in negative abnormal returns. Considering the theoretical explanations, the expected negative abnormal return from the damage hypothesis exceeds the expected positive abnormal return from the revenue hypothesis.

Nevertheless, the observed abnormal returns are not disruptive as most of the assessed event windows report a CAAR of less than -1%. These rather low negative abnormal returns are in line with the findings of Hagendorff *et al.* (2015, p. 162). The market seems to react efficiently to new information provided by a hurricane and its landfall, as abnormal returns are quickly incorporated. Also, the relatively low level of negative abnormal returns shows that insurance companies can cope with hurricanes efficiently because investors incorporate hurricane impacts continuously in the fair price assessment. Therefore, the concerns of investors about whether insurance companies can manage hurricane risks in the future are historically not given.

Different subsamples are studied to meet the second objective of this paper and provide possible drivers for the observed abnormal returns. The following hypotheses H_2 - H_4 analyze underlying reasons for the observed negative abnormal returns. Empirical findings support hypothesis 2 that hurricanes with a higher category have more negative abnormal returns. Subsamples of the event study compare resulting abnormal returns after high-category hurricanes (category 4 or 5) with middle (category 3) and low-category hurricanes (category 1 or 2). The analysis shows that hurricanes with a high category have a more negative impact on insurance stock prices than middle-category hurricanes. Furthermore, middle-category hurricanes have a negative impact on stock returns, whereas low-category hurricanes show a positive cumulative abnormal return for the [0;+1] period. Overall, hurricanes in the test sample of a high category lead to an approximately 1%-point more negative abnormal return than hurricanes of a low category. The linear regression model confirms these results and similarly reveals that the dummy variable for hurricanes of a low category is positively correlated with CAR [0;+5], whereas hurricanes with a high category negatively correlate with CAR. These results show that the hurricane category is a potential driver for the sign and strength of abnormal returns on insurance stocks. The stock price reaction is especially strong for high-category hurricanes, which is important for investors as the hurricane category can be anticipated by the market before landfall.

The damage and revenue hypotheses illustrate the main impact factors for positive or negative reactions of insurance firms after catastrophes. The damage hypothesis emphasizes claim payments having a negative impact on insures' firm value. Whereas the revenue hypothesis mentions the demand increase for insurance coverage and an increase in premiums as beneficial for insurance companies after catastrophes. Concerning these drivers, positive abnormal returns for insurers after low-category hurricanes might imply that either the claim payments are lower than expected, or the increase in demand or premiums are higher than anticipated by the stock market. The same reasoning applies to negative abnormal returns after high-category hurricanes. The resulting claim obligations for insurance companies could be higher than excepted, or the demand or premium increase might be lower than anticipated. The net abnormal return of insurance stocks on hurricanes depends on the strength of these opposing factors.

The next hypothesis examines the relationship between hurricane damage and its financial effect on insurance stock returns. Both, the results from Welch's t-test and the regression model confirm hypothesis 3, stating that more damaging hurricanes generate more negative abnormal returns. Welch's t-test confirms that the three most damaging hurricanes generate a statistically significant more negative CAAR for the [0;+1] time window compared to the remaining less damaging hurricanes of the sample. Similarly, regression results confirm a negative correlation (-0.02/-0.03) between hurricane damage (measured in billion USD) and the CAR [0;+5] at a 1% significance level. The observed abnormal returns might arise from unpredicted damages or unexpectedly severe damages that become observable just after hurricane landfall. These results are in line with the assumption that hurricanes with especially high damage generate higher loss claims for insurance companies. Claim handling is (according to the damage hypothesis) a reason to explain the negative impact of catastrophes on insurance firms' value. Comparing these results with previous research, Hagendorff *et al.* (2015, p. 168) similarly find a significant negative correlation between the variable catastrophe size, measured by insured losses, and CAR [0;+15]. Lamb (1998, p. 171) also concludes that the market discriminates against hurricanes Hugo and Andrew by their magnitude. The subsample demonstrates that the top three hurricanes in terms of damage have an almost 0.5%-point more negative abnormal return compared to the remaining hurricanes of the sample, which is confirmed by a negative correlation in the regression analysis. This verifies that investors incorporate information regarding the incurred hurricane damage in the stock prices of insurance

companies. It assumes that the hurricane impact is not fully foreseeable by the hurricane category.

Hypothesis 4, stating that the S&P 500 membership has a positive impact on abnormal returns is rejected. Empirical findings are ambiguous. The findings are also not or only at a level of 10% significant. Welch's t-test provides evidence that the S&P 500 membership has a negative impact on the [0;+1] abnormal return at a 10% significance level. Whereas, the regression model shows a slightly negative, but insignificant correlation for the S&P 500 membership with CAR [0;+5]. Generally, the S&P 500 membership variable can be assessed as an approximation for capital strength, because of the required market capitalization to get listed in this index (S&P Down Jones Indices LLC, 2020). In previous literature and this paper, market capitalization approximations, such as the S&P 500 index membership in this study, are not proven as a significant factor to predict the amplitude of abnormal returns after hurricanes. Lanfear *et al.* (2017, p. 27) reveal that market equity is related negatively to abnormal returns. Gangopadhyay (2010, p. 146) utilizes the logarithm of market capitalization and finds a negative, but not statistically significant impact on CAR [-1;+1]. Therefore, the S&P 500 membership is most likely no significant variable to predict abnormal returns after hurricanes.

Overall, we can subsume, that US insurance stock prices react significantly negatively to the costliest hurricanes since 2004. Still, the negative abnormal returns seem not too severe as the CAAR is mostly less than 1%. Negative abnormal returns are concentrated on days one and two after hurricane landfall. Additionally, the results verify that hurricanes classified with a high category come along with more negative abnormal returns compared to low-category hurricanes. The hurricane damage has a negative correlation with abnormal returns, whereas the S&P 500 membership correlation with CAR is rejected.

1.7. Conclusion

This paper provides a broad overview of how insurance stock prices react to hurricanes. It is based on an extensive data sample, including the costliest and most recent hurricanes, whereas previous literature mainly investigates the reaction of insurance stock returns for a single or only a few individual events. Research about hurricanes is of high importance because their severity and frequency increased significantly throughout the last decades. This comes along with the increasing concern of investors about whether insurance companies are and will still be able to cope with environmental risks in the future. Thus, this paper aims to explain the implications of hurricanes for the stock returns of insurance companies. Therefore, this paper conducts an event study to answer the research question, how stock prices of US insurers reacted to the costliest hurricanes since 2004. The data sample consists of the 13 costliest hurricanes that have made landfall since 2004 and 32 P&L insurance companies listed on the US stock market. Additionally, the variables hurricane category (low, middle and high), hurricane damage and S&P 500 membership are investigated. The goal of the regression model is to find possible drivers of abnormal returns due to hurricanes.

To conclude, this paper confirms that hurricanes lead to negative, however not disruptive abnormal returns of P&L insurance stocks. Additionally, this paper attempts to understand which factors explain the strength of negative abnormal returns after hurricanes. Thereby, the regression model of this paper explains up to 10.41% of the variance of CAR [0;+5]. The event study and regression results reveal that hurricanes with a higher category lead to more negative abnormal returns. Additionally, the occurred hurricane damage is negatively correlated with abnormal returns. The hypothesis that the S&P 500 membership has a significant impact on abnormal returns cannot be confirmed. Although statistically significant negative abnormal returns prevail, the mean AARs are moderate with a maximum of -0.41% in the two weeks around the event. The insurance sector seems to be capable to cope with the uncertainty of hurricane risks as the market does not indicate extreme price jumps in price assessment. As negative abnormal returns are mainly concentrated on days one and two after hurricane landfall, we conclude that the insurance market reacts efficiently to new information generated by hurricanes.

This paper has some limitations: We utilize a subsample of listed companies, that might have a self-selection bias. Thus, a generalization of findings on non-listed companies is not generally given. As many hurricanes occur within a short period, it is difficult to avoid

spillover effects completely. This limitation is known as calendar clustering where events occur at or near the same time. This paper attempts to minimize this limitation by excluding hurricanes Ivan and Irma with partly overlapping event windows. Additionally, the influence of the overall political atmosphere concerning catastrophe relief and regulation, e.g. the consensus over federal disaster relief or the state of the National Flood Insurance Program, should be investigated more closely.

Overall, this paper provides further insights into the impact factors on abnormal returns after hurricanes. It can be used as a starting point for additional research. Further analyses can expand the data set of insurance firms, for example with smaller insurance companies, having the goal of further verifying and generalizing the outcomes of this study. Further coefficients that differentiate the insurance firms could be used as additional explanatory variables. A promising approach would be the utilization of exposure-weighted indicators such as e.g. the proportion of homeowner's insurance premiums written in hurricane-exposed states.

1.8. Appendix

Table 8: Final sample of 32 P&L insurance firms

Allstate Ordinary	Hanover Insurance Group
American Financial Group	Hartford Financial Services Group
American International Group	Horace Mann Educators
Argo Group International Holdings	Kemper
Aspen Insurance Holdings	Markel
Axis Capital Holdings	Mercury General
Berkshire Hathaway 'B'	Old Republic International
Chubb	Progressive Corporation
Cincinnati Financial	RenaissanceRe Holdings
CAN Financial	Safety Insurance Group
Donegal Group 'A'	Selective Insurance Group
EMC Insurance Group	Travelers Companies
Erie Indemnity 'A'	United Fire Group
Everest Re Group	Universal Insurance Holding
First Acceptance	W R Berkley
Hallmark Financial Services	White Mountains Insurance Group

Note: The selection of insurance companies is based on the sample from Hagendorff *et al.* (2015, p. 170), including publicly traded P&L insurers that earned premiums in the homeowners' business line

Table 9: Overview of AAR from -10 to +10 incl. significance test

[t]	Mean (AAR_t)	Median	t-test	p-value (t-test)	Wilcoxon signed-rank test	p-value (Wilcoxon)
-10	0.12%	0.03%	1.69*	(0.092)	1.89*	(0.059)
-9	-0.29%	-0.07%	-3.59***	(0.000)	-3.18***	(0.002)
-8	0.49%	0.34%	6.73***	(0.000)	6.71***	(0.000)
-7	0.14%	0.02%	1.33	(0.184)	2.64***	(0.008)
-6	0.10%	0.03%	1.50	(0.135)	1.69*	(0.091)
-5	-0.17%	-0.14%	-1.45	(0.148)	-3.77***	(0.000)
-4	-0.05%	-0.06%	-0.56	(0.577)	-1.20	(0.231)
-3	-0.05%	0.01%	-0.75	(0.455)	-0.42	(0.674)
-2	-0.18%	-0.18%	-2.12**	(0.035)	-3.31***	(0.001)
-1	0.28%	0.30%	2.36**	(0.019)	5.19***	(0.000)
0	0.08%	-0.02%	0.99	(0.321)	0.79	(0.430)
1	-0.28%	-0.28%	-3.08***	(0.002)	-5.64***	(0.000)
2	-0.41%	-0.22%	-3.60***	(0.000)	-4.42***	(0.000)
3	-0.11%	0.01%	-1.53	(0.127)	-0.77	(0.443)
4	0.02%	0.08%	0.27	(0.785)	1.35	(0.176)
5	-0.21%	-0.03%	-2.27**	(0.023)	-0.51	(0.610)
6	0.19%	0.12%	2.32**	(0.021)	2.18**	(0.030)
7	-0.22%	-0.06%	-2.67***	(0.008)	-1.80*	(0.073)
8	0.05%	-0.17%	0.55	(0.581)	-1.62	(0.105)
9	-0.08%	-0.10%	-1.00	(0.316)	-1.72*	(0.086)
10	0.18%	0.90%	3.09***	(0.002)	3.64***	(0.000)

Significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

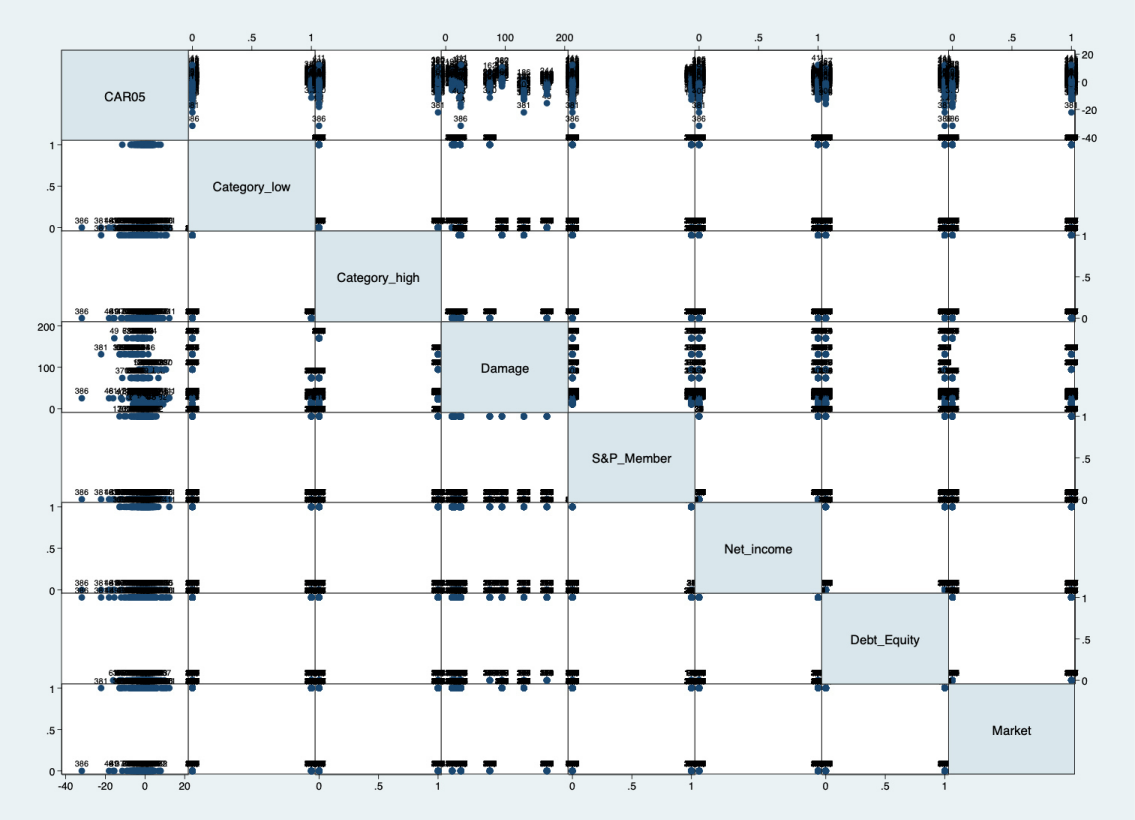
Note: This table indicates the average abnormal returns (AAR) and median abnormal return for the whole data sample (N=416) around the event date (day of hurricane landfall, t=0). The statistical significance is tested with the t-test and Wilcoxon sing-rank test.

Table 10: Summary statistics of sample characteristics

Variable	Mean	Std. Dev.	Median	5th percentile	95th percentile
CAR05	-0.90	4.35	-0.4	-7.35	4.76
Category_low	0.38	0.49	0.0	0.0	1.0
Category_high	0.31	0.46	0.0	0.0	1.0
Damage	49.55	49.95	25.2	10.5	170.0
S&P_Member	0.28	0.45	0.0	0.0	1.0
Net_income	0.50	0.5	0.5	0.0	1.0
Debt_Equity	0.56	0.5	1.0	0.0	1.0
Market	0.62	0.49	1.0	0.0	1.0

Note: N = 416

Figure 2: Correlation of coefficients (outliers test)



Note: N = 415 (id 386 excluded, number represents sample firm Universal Insurance Holding)

Table 11: Correlation matrix (correlation test)

	CAR05	Category_ low	Category_ high	Hurri- cane_ Damage	S&P_ Member	Net_in come	Debt_ Equity	Market
CAR05	1.000							
Category_low	0.188*	1.000						
Category_high	-0.155*	-0.527*	1.000					
Hurricane_Damage	-0.285*	-0.345*	0.252*	1.000				
S&P_Member	0.020	0.000	0.000	0.000	1.000			
Net_income	0.041	0.000	0.000	0.000	0.487*	1.000		
Debt_Equity	-0.019	0.000	0.000	0.000	0.131*	0.000	1.000	
Market	0.136*	-0.025	0.185*	-0.184*	0.000	0.000	0.000	1.000

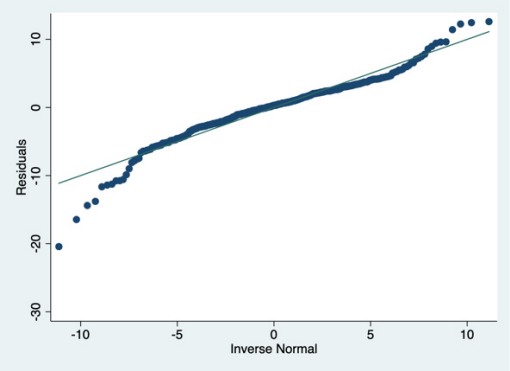
Note: N = 416; * indicates significance at 1%-level

Table 12: Shapiro-Wilk test for Model I to IV (normality test)

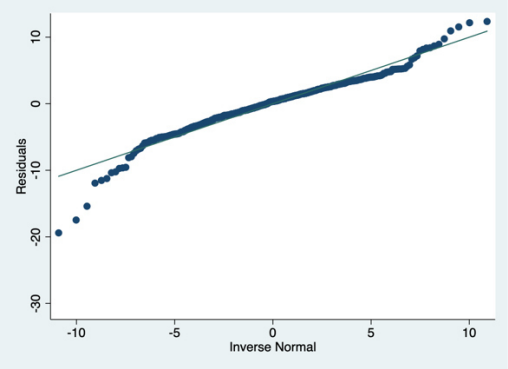
Variable	Obs	W	V	z	Prob > z
Res_Mod_1	415	0.94627	15.289	6.500	0.000
Res_Mod_2	415	0.95197	13.666	6.233	0.000
Res_Mod_3	415	0.94361	16.043	6.615	0.000
Res_Mod_4	415	0.95014	14.187	6.322	0.000

Note: The dependent variable is CAR [0;+5] for all regression models. The independent variables are: Model 1: Category_low, Category_high, Net_income, Debt_Equity, Market; Model 2: Hurricane_Damage, Net_income, Debt_Equity, Market; Model 3: S&P_Member, Net_income, Debt_Equity, Market; Model 4: Category_low, Category_high, Hurricane_Damage, S&P_Member, Net_income, Debt_Equity, Market.

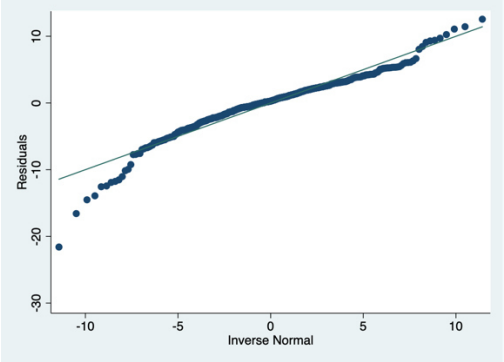
Figure 3: QQ-Plot: plots of quantiles against quantiles of the normal distribution (normality test)



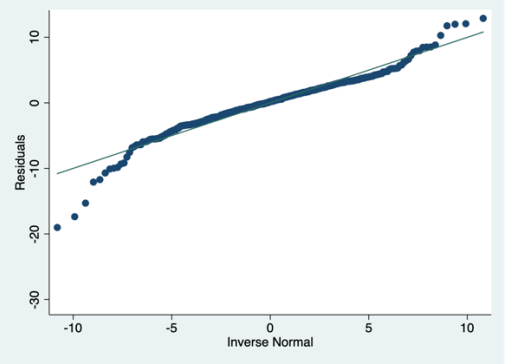
(Model I)



(Model II)



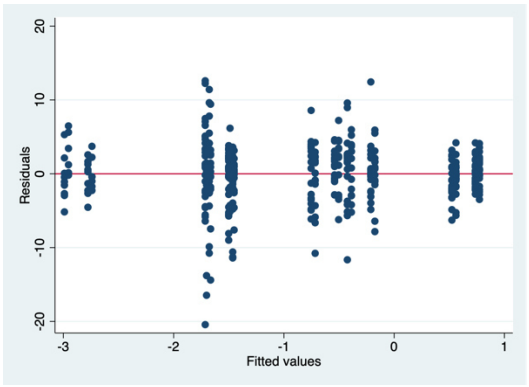
(Model III)



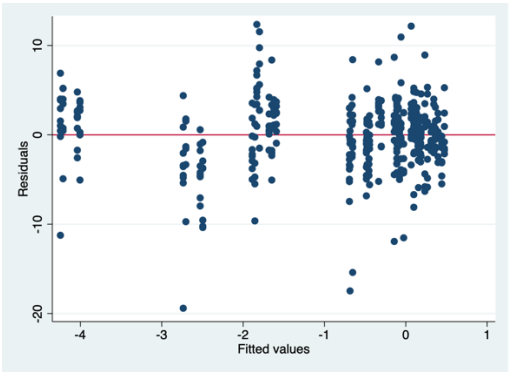
(Model IV)

Note: The dependent variable is CAR [0;+5] for all regression models. The independent variables are: Model 1: Category_low, Category_high, Net_income, Debt_Equity, Market; Model 2: Hurricane_Damage, Net_income, Debt_Equity, Market; Model 3: S&P_Member, Net_income, Debt_Equity, Market; Model 4: Category_low, Category_high, Hurricane_Damage, S&P_Member, Net_income, Debt_Equity, Market.

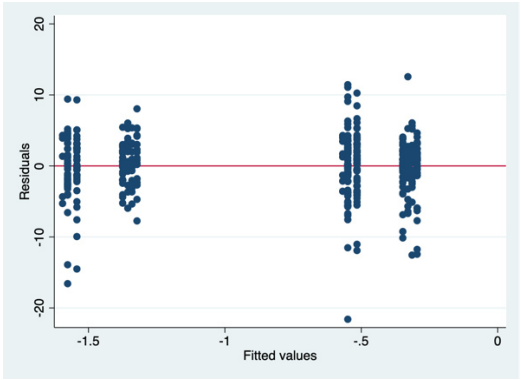
Figure 4: Residual-versus-fitted plot (homoscedasticity test)



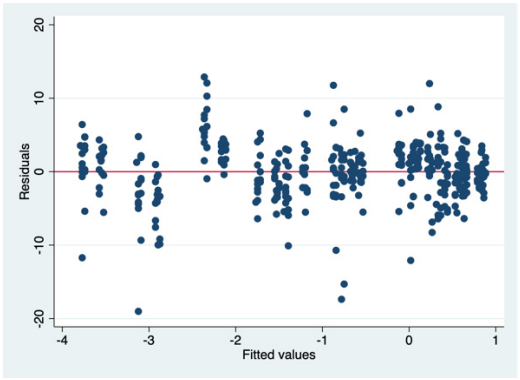
(Model I)



(Model II)



(Model III)



(Model IV)

Note: The dependent variable is CAR [0;+5] for all regression models. The independent variables are: Model 1: Category_low, Category_high, Net_income, Debt_Equity, Market; Model 2: Hurricane_Damage, Net_income, Debt_Equity, Market; Model 3: S&P_Member, Net_income, Debt_Equity, Market; Model 4: Category_low, Category_high, Hurricane_Damage, S&P_Member, Net_income, Debt_Equity, Market.

Figure 5: Variance inflation factors (multicollinearity test)

Variable	VIF	1/VIF
Category_low	1.40	0.7152
Category_high	1.45	0.6918
Net_income	1.00	1.0000
Market	1.04	0.9599
Debt_Equity	1.00	1.0000
Mean VIF	1.18	

(Model I)

Variable	VIF	1/VIF
Damage	1.04	0.9656
Net_income	1.00	1.0000
Market	1.04	0.9656
Debt_Equity	1.00	1.0000
Mean VIF	1.02	

(Model II)

Variable	VIF	1/VIF
S&P_Member	1.34	0.7466
Net_income	1.32	0.7600
Market	1.00	1.0000
Debt_Equity	1.02	0.9772
Mean VIF	1.17	

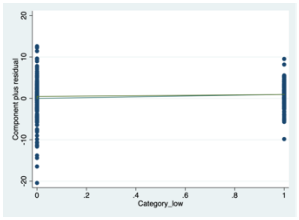
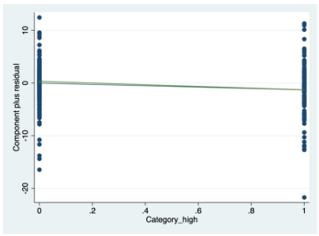
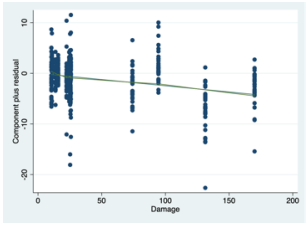
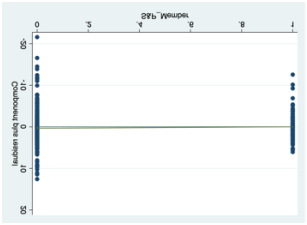
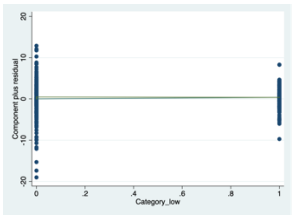
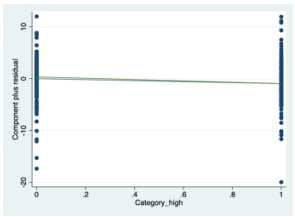
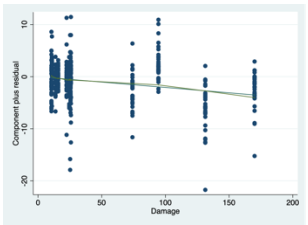
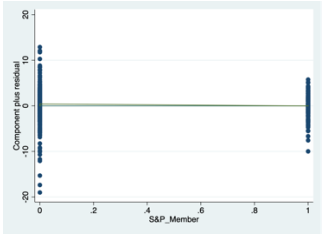
(Model III)

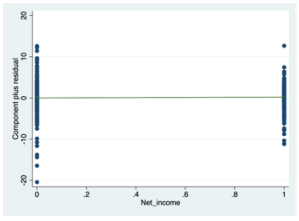
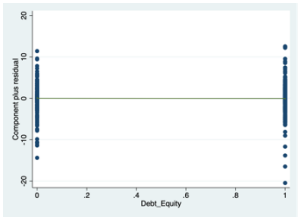
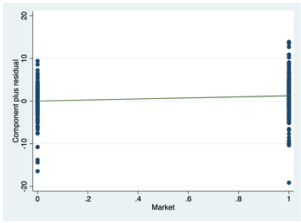
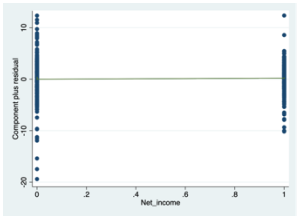
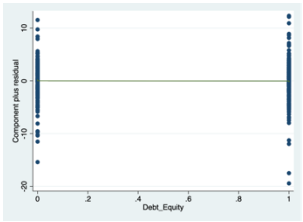
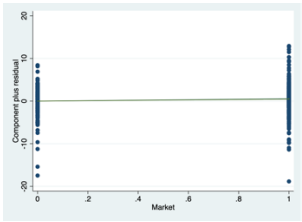
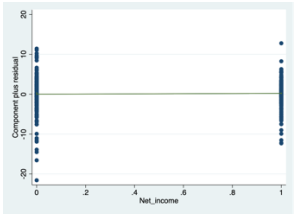
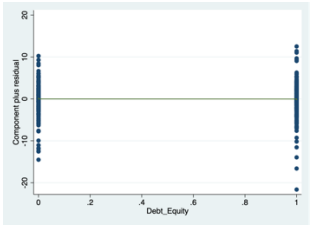
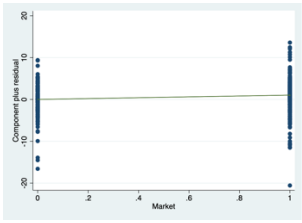
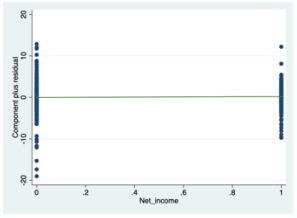
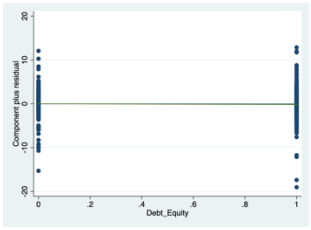
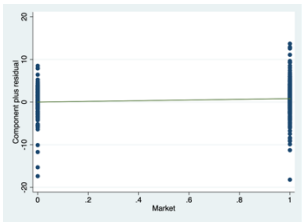
Variable	VIF	1/VIF
Category_low	1.49	0.6715
Category_high	1.47	0.6796
Damage	1.21	0.8274
S&P_Member	1.34	0.7466
Net_income	1.32	0.7600
Market	1.10	0.9089
Debt_Equity	1.02	0.9772
Mean VIF	1.28	

(Model IV)

Note: The dependent variable is CAR [0;+5] for all regression models. The independent variables are: Model 1: Category_low, Category_high, Net_income, Debt_Equity, Market; Model 2: Hurricane_Damage, Net_income, Debt_Equity, Market; Model 3: S&P_Member, Net_income, Debt_Equity, Market; Model 4: Category_low, Category_high, Hurricane_Damage, S&P_Member, Net_income, Debt_Equity, Market.

Figure 6: Component-plus-residual plot (linearity of variables test)

Varia-ble	Category_low	Category_high	Damage
Model I			
Model II			
Model III	Variable: S&P Member		
Model IV			
	Variable: S&P Member		

Variable	Net_income	Debt_Equity	Market
Model I			
Model II			
Model III			
Model IV			

Note: The dependent variable is CAR [0;+5] for all regression models. The independent variables are: Model 1: Category_low, Category_high, Net_income, Debt_Equity, Market; Model 2: Hurricane_Damage, Net_income, Debt_Equity, Market; Model 3: S&P_Member, Net_income, Debt_Equity, Market; Model 4: Category_low, Category_high, Hurricane_Damage, S&P_Member, Net_income, Debt_Equity, Market.

Essay 2: Ownership Structures and Risk Taking in the German Property-Liability Insurance Market

Schuh, F. & Noth, L. M. (2022).
"Ownership structures and risk taking in the German property-liability insurance market"
Journal of Co-operative Organization and Management, Volume 10, Issue 1, 2022,
https://doi.org/10.1016/j.jcom.2022.100165

Abstract:

This paper investigates whether the organizational form of a property-liability insurer influences its risk-taking. We investigate the investment and underwriting behavior of 62 German property-liability insurers in the period from 2000 to 2019. We find that stock insurers take higher risks, both in underwriting and in investments than mutual insurers. Our findings are relevant to customers, investors, and regulators, as they provide insights into the fundamental differences between stock and mutual insurers in the German property-liability insurance market.

Keywords: mutual insurance**,** stock companies, managerial behaviour**,** risk-taking**,** underwriting**,** investment**,** logit regression

2.1. Introduction

Ownership structure is a prominent driver of corporate value and performance (Mello & Parsons, 1998). The German insurance industry is characterized by multiple organizational forms coexisting in the marketplace, including mutual insurance associations, stock insurers, Lloyds associations, and public insurers. In 2018, 205 property-liability insurance companies were operating in the German market. Similar to many other markets, the most important legal forms chosen by insurance companies in the German property-liability market are for-profit stock corporations and non-profit mutual associations (Biener and Eling 2012). 193 out of those 205 insurance companies are for-profit stock companies (stocks) or non-profit mutual insurance associations (mutuals). These two organizational forms have a combined market share of 96.8 % of gross written premiums.[‡‡] Both forms are subject to the same underlying working principles (Schradin 2004) and capital requirements (Görg 2005). Historically, the number of mutual insurers has been high in Germany but throughout the last century stock insurers considerably increased their number and market share. However, *Figure 1* illustrates that the number of operating insurance companies and the market share between mutuals and stocks has remained largely unchanged over the last two decades. No organizational form is able to drive the other out of the market.

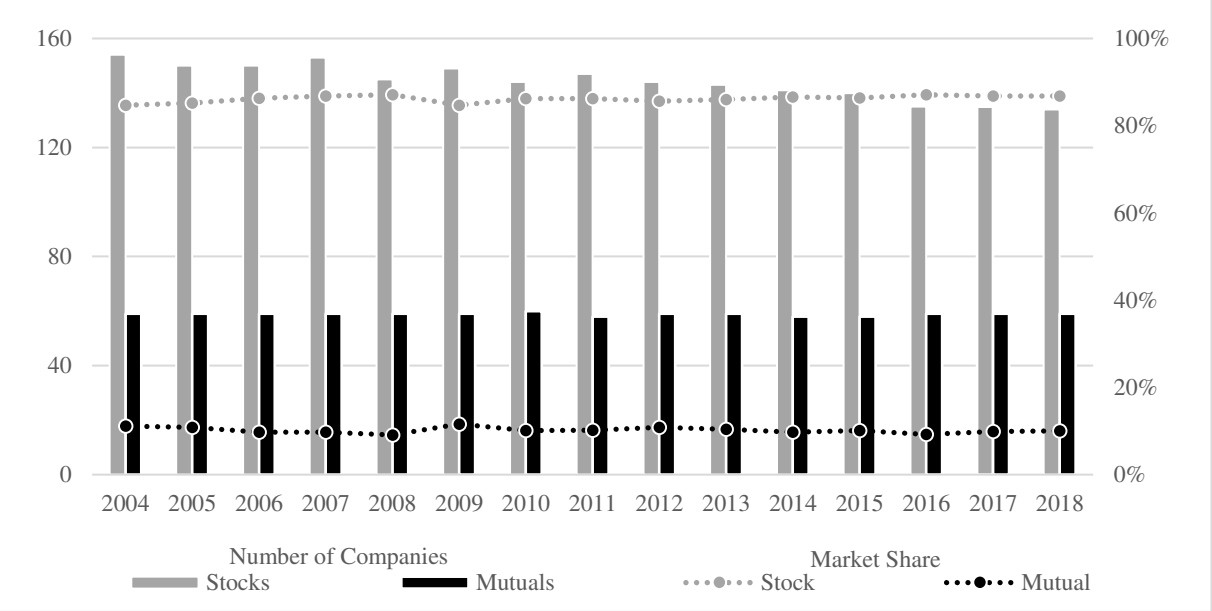


Figure 7: Number of Operating Companies & Market Share (Earned Gross Premiums) in the German P/L Insurance Market

[‡‡] *Insurance institutions under public law and other legal forms, such as branches of foreign-based insurance companies, are of secondary importance in the German market with a combined market share of about 3,2 %.*

The advantages of the respective organizational forms are an internationally well-investigated topic. For example, *Mayers and Smith* (1986) find that when an insurer changes its organizational form from a stock to a mutual structure the firm's efficiency increases, while *Chaddad and Cook* (2004) find that when an insurer changes its organizational form from mutual to stock its efficiency increases. No dominant advantage of one form over the other can be identified (Macminn and Ren 2011), which is reflected in the minimal market movements over the last years.[§§]

While the stock and mutual organizational forms successfully coexist in the market, their strategic implications are in conflict with each other. The main institutional differences of the forms are the different roles of essential interest groups in the company, consisting of the management, customers, and owners. The conflicts arising from this tripartite incentive structure are one of the main sources of strategic differences between stock and mutual insurers (Mayers and Smith 2013). Both organizational forms share the differentiation between ownership over residual claims and strategic control over company decisions (Demsetz 1983), but the underlying agency problems differ fundamentally (Fama and Jensen 1983b).

In stock insurance corporations a clear separation of the owner, manager, and customer parties prevails (Spiller 1972b). Among those groups, the incentives of customers and owners contradict each other. Owners desire the management to maximize the company profits while policyholders seek inexpensive insurance coverage. All claims paid out to policyholders have a direct negative effect on the profit of capital investors. Stockholders have the incentive to increase the firm's dividend at the expense of the customers (Mayers and Smith 2013). The management is obliged to find an effective equilibrium between the contradictory objectives of the other two interest groups. The groups of clients and investors are merged in mutual insurance associations (Hansmann 1985). Policyholders are owners and customers of the firm at the same time (Born *et al.*, 1998). Therefore, the conflicts of interest between policyholders and owners are internalized (Mayers and Smith 2013; Cheng, Qian, and Reeb 2020; Ligon and Thistle 2008). There is no conflict between the goal of profit maximization of the owners and cost reduction of the customers, as the company's residual profits are ultimately transferred back completely to the policyholders, e.g. via lowered insurance premiums (Hetherington 1969). Customers gain the firm's residual profits and correspondingly bear possible losses (Smith and Stutzer 1995). Furthermore, mutual policyholders have a more direct influence on

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[§§] The data on the German property-liability market in this paragraph is taken from GDV (German Insurance Association), 2020.

the company's management (Nemson 2014). The mutual management's main target is to supply the owners/customers of the association with qualitative and inexpensive insurance protection (O'Sullivan 1998; Talonen 2018).

Those fundamental differences and their incentive implications hint at different behavior of the company's management. As an initial step in our analysis, we determine if the mentioned incentive differences between stocks and mutuals result in a measurable behavioral difference. A prominent characteristic of stock insurers is their ability to raise additional capital due to their easy admission to financial markets (Born et al. 1998; Jensen and Meckling 1976). *Spiller* (1972) finds a significant strategic advantage for stock insurers, mainly driven by direct capital market access. *Erhemjamts and Leverty* (2010) confirm *Spiller's* results. While mutual insurers are unable to access capital markets in order to refinance (Viswanathan and Cummins 2003; Collier 1966; Kürn 2001), stocks can easily raise capital to improve liquidity, which has direct behavioral implications (Amihud and Mendelson 1988). This points to the conclusion that the core business of insurance, the transfer and transformation of risk, is approached differently in both types of insurance companies (Teale 2016). As stock insurers can pass on risks to other investors via capital markets, they can bear more risks compared to mutual insurance companies which are constrained by their restricted access to capital. As the customers are also owners in mutual associations they bear the residual business risk and show the tendency to promote less risky firm activities (Smith and Stutzer 1990).

The substantial disparity between the relative amounts of equity held by stock insurance companies and mutual insurers also hints at behavioral differences in terms of risk. *Table 1* indicates that mutual insurers hold about four to five times more equity capital compared to stocks (as measured in % of gross premiums written). In addition, we see opposing trends in the equity ratios. While mutual insurance companies increase their proportion of equity, stock insurers decrease it.

TABLE 1: Equity in % of Gross Premiums Written

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Stocks	31.6	29.8	29.4	28.5	27.9	27.0	25.0	24.9	22.9	22.4
Mutuals	144.5	142.6	132.7	142.3	156.6	152.7	177.3	162.8	162.4	163.6

Data from GDV (German Insurance Association), 2020.

The high level of equity held by mutual insurance companies indicates a more defensive managerial strategy (Modigliani and Miller 1958). The same can be argued for proportionally higher accruals of mutuals compared to stocks (Nemson 2014).

Based on these indicators, there is an essential disparity in the approaches that investor-owned insurance companies and mutual insurance associations use to manage risks. We hypothesize that stock insurers have a higher risk appetite than mutual insurance companies. This article aims to combine the analyses of the investigations by *Smith and Stutzer* (1990)*, Lamm-Tennant and Starks* (1993)*,* and *Born, Gentry, Viscusi and Zeckhauser* (Born et al. 1998) and apply them to the risk implications of organizational differences in the German insurance market. The initial step of our analysis examines the behavioral differences between the organizational forms. In the main part, we investigate the corresponding risk behavior. We analyze whether the legal form of an insurance company influences the way the firm deals with risk. In particular, we examine if stock insurers behave riskier in their underwriting and investment activities compared to mutual insurance associations via a logit-regression model using the data of 62 German property-liability insurers for the years 2000 to 2019.

The existing literature on managerial risk attitudes and organizational structures mainly focuses on the U.S. insurance market. In contrast to the U.S. literature, German discourse focused on evaluating organizational forms in the insurance sector is sparse. Our paper expands this literature by examining the risk preferences of stock and mutual insurers in the German property-liability insurance industry. To the best of our knowledge, this study is the first attempt to explore the risk implications of organizational forms in the German insurance market. We further expand the existing research, as we include both the asset and liability sides of the balance sheet to cover the characteristic duality of the insurance business.

Our analysis is of interest to regulators and legislators. The riskier stock insurers would have to be more strictly regulated, as a primary objective of insurance regulators is to prevent the default of insurance firms to protect the insurance customers (Klein 1995). As the same approach has been used in analyses of the U.S. market, we can deliver insights into the fundamental differences between developed financial markets with high investor protection and their counterparts. On the demand side, the customers are interested in the risk-strategic differences between the two organizational forms when choosing a provider of insurance coverage.

The remainder of this paper is organized as follows: Section 2 discusses the theoretical foundations of stock and mutual insurance companies and develops hypotheses concerning the

corresponding risk behavior. Section 3 provides a detailed empirical analysis of the risk behavior in the German property-liability insurance market. The section describes the dataset and investigates the risk implications of the investment and underwriting preferences by conducting a variance analysis and a logit regression. Finally, Section 4 provides an interpretation of the empirical results, a summary, and an outlook on implications for interesting future research.

2.2. Existing Research and Hypotheses

As explained above, the literature on German organizational structures in the insurance market is sparse. Several researchers have conducted analyses of the risk implications of different ownership structures and their respective conflict situations in the U.S. insurance market. *Fama and Jensen* (1983a) state that alternative ownership structures convey benefits in specific dimensions. Therefore, the strategic operations of firms with different organizational forms should differ fundamentally. *Mayers and Smith* (1988) deal with the implications of ownership structures in insurance markets and formulate their "line of business specialization hypothesis". It states that the competitive advantage of certain ownership structures in specific insurance lines should lead to a higher market share in those lines. They show a strong strategic difference between stocks and mutuals in line of business specialization (Mayers and Smith, 1988). *Mayers and Smith* (1981) also analyze the control of incentive conflicts provided by organizational structures. Their "managerial discretion hypothesis" identifies a comparative advantage for stock insurers in lines of business with high managerial discretion (Mayers and Smith 1981). Mutuals are relatively more successful in lines with long claim settlement periods where the merging of the owner and policyholder functions removes the owners' motivation to exploit policyholders (Wende, Berry-stölzle, and Lai 2008). According to their theory, different levels of managerial control are suitable for different kinds of insurance lines (Cummins, Weiss, and Zi 1999), which would result in a measurable difference between mutual and stock insurance companies in the German property-liability insurance market in both dimensions of the insurance business.

High managerial discretion is typically connected to commercial business lines, while in consumer lines less managerial discretion is required. In commercial lines, the number of policies is lower and the claims are typically higher than in consumer lines. Therefore, we derive that business lines with high managerial discretion, in which stocks write more business in, are also more volatile. Hence, the behavioral differences of mutual and stock insurance companies

should be directly reflected in their risk exposure. *Lamm-Tennant & Starks* investigate the underwriting of U.S. property-liability insurers regarding business concentration and risk. The authors address firm-type-specific measures of risk and test for a significant relationship between organizational form and risk, using a conditional logit model. They confirm the risk hypothesis that stock companies possess riskier cash flows than mutual insurers, measured in a higher variance of the loss ratio (Lamm-Tennant and Starks 1993). *Born, Gentry, Viscusi & Zeckhauser* (1998) examine that for a given amount of premium, stock companies have higher losses than mutual.

All of those findings are in line with the prediction that stocks are connected to riskier business activities and mutuals act more carefully than stock companies. Additionally, one of the few investigations of ownership implications in the German insurance industry finds cost advantages for stock insurers, which could compensate for riskier managerial decisions (Wende, Berry-stölzle, and Lai 2008). Summarizing those findings, our goal in this article is to examine the hypothesis that mutuals are prone to less risky commercial activities not only in the underwriting dimension but also for the investment facet of the insurance business, while stock insurers tend to take riskier managerial decisions.

H1: Mutual insurers exhibit less risk in their investment activities than stock insurers.

H2: Mutual insurers exhibit less risk in their underwriting activities than stock insurers.

This risk hypothesis would be a compelling explanation for the observed structure of the insurance market and visible managerial differences between mutual insurance companies and stock insurers. If the riskiness of assets is positively correlated with mutual insurers, we could conclude that the complicated access to additional capital drives the mutual insurance company towards riskier investment behavior. If the riskiness of assets is negatively correlated with mutual insurers, this would support the investment risk hypothesis. If the business premiums written by stock insurers show greater risk, this would further support the underwriting risk hypothesis. As stocks have better access to capital markets and have a relatively high level of managerial discretion, they should focus on business lines with relatively high risk.

2.3. Empirical Analysis

2.3.1. Data Overview and Methodology

The objective of this work is to employ the analytical ideas and methods developed for the case of the U.S. insurance industry to the case of the German property-liability insurance market. *Table 2* provides an overview of our dataset. Next to the general information on assets, equity, and premiums, the data provides information about the underwriting and investment composition of the insurers. Claim payments and hidden reserves act as risk indicators for the two dimensions of our analysis. All companies that write over EUR 50 million of net annual premiums are included in our dataset. It covers a total of 100 insurance companies with around EUR 73.2 billion gross premiums written in the German property-liability insurance market in 2019. The sample comprises approximately 87 % of the total gross premiums written in the German market and covers the years 2000 to 2019.

TABLE 2: Descriptive Statistics

	Stock Insurers (n = 780)			Mutual Insurers (n = 460)			Total (n = 1240)		
	Mean	**Std. dev.**	**Median**	**Mean**	**Std. dev.**	**Median**	**Mean**	**Std. dev.**	**Median**
	Balance Sheet (in EUR million)								
Total Assets	1964.54	4082.53	360.72	930.82	1475.52	279.68	1573.12	3380.14	349.67
Book Equity	228.03	405.15	68.27	356.35	633.14	106.00	223.87	438.94	60.74
Gross Premiums	849.55	1568.42	249.82	340.95	469.50	140.92	656.96	1293.03	202.60
	Hidden Reserves (in % of corresponding book values)								
Equity Investm.	23.77	52.82	12.04	30.37	52.71	7.40	25.83	52.39	10.01
Fixed-Income	5.03	6.45	3.53	5.13	5.35	3.30	5.01	6.07	3.36
	*Investment Composition (in % of total capital investment) **								
Equity Investm.	24.71	16.57	21.28	21.39	14.76	20.25	23.42	15.97	20.77
Fixed-Income	62.88	20.41	64.42	61.15	20.20	63.81	62.21	20.34	64.07
	Claim Payments (in EUR million)								
Legal Expenses	63.54	92.47	18.96	22.55	27.59	8.64	44.49	73.04	12.97
Property	61.25	101.05	20.42	30.17	36.02	17.13	50.72	86.03	18.77
Household	20.03	27.50	7.28	12.88	15.57	6.63	17.62	24.38	7.13
Automotive	321.81	477.73	127.59	189.47	276.60	96.52	274.40	421.63	115.40
	*Underwriting Composition (in % of total gross premiums written) **								
Legal Expenses	4.43	4.61	4.09	8.18	7.34	6.53	6.15	6.29	4.65
Property	8.52	6.19	7.35	7.88	4.76	6.98	8.31	5.75	7.31
Household	7.03	6.41	4.99	7.05	3.72	6.02	7.04	5.65	5.36
Automotive	49.45	28.12	38.84	45.70	17.84	46.55	48.11	24.99	41.69

** the omitted categories of our investigation are not depicted here.*

The data is provided by the University of Cologne and the Cologne Institute for Insurance Information and Business Services in collaboration with the ASSEKURATA Insurance Rating Agency (KIVI, 2020). We only examine the risk behavior of stock insurance companies and

mutual insurance associations. Legal public insurers are excluded from our analysis at the outset because of their unique business model. German branches of international insurance companies are excluded because of their relatively low market share. This results in the examination of 62 insurance companies over the span of 20 years. A particular feature of the German insurance industry are group structures characterized by profit-transfer agreements (Piojda 1997). Many stock insurance companies are not publicly traded but held entirely by a firm on a superordinate level. When insurance companies desire to offer insurance coverage in other insurance lines, they must form a new insurance company following the separation of insurance lines in § 8 of the German Insurance Supervision Act. Those companies are typically stock insurers of one business line that are completely held by a mutual insurance company. In our analysis, those stocks, which are predominantly owned by mutual insurance companies, are assigned to the organizational form of the controlling firm. The reasoning behind this procedure is that those stocks cannot independently enter the capital market and are not independent in their business decisions. Instead, they experience a high level of strategic governance from the holding company. This results in the analysis of 39 stock and 23 mutual insurers, collectively responsible for EUR 53.44 billion gross premiums written in the German property-liability insurance industry in 2019.[***]

To determine the different risk preferences of the two organizational forms, we use three main methods. Firstly, we define risk indicators and divide the investment instruments and business lines into more and less risky classes. Secondly, we observe the average composition of the underwriting and investment behavior of mutual insurers or stock insurers over time. Thirdly, we implement logistic regressions following the maximum-likelihood model introduced by *Lamm-Tennant & Starks* (1993) to determine deviations in the risk preferences between the two organizational forms.

2.3.2. Investment Risk

2.3.2.1. Riskiness of Asset Classes

To explore the relationship between the organizational form of an insurance company and the investment risk preferences, we first determine the riskiness of the two most important asset classes. We distinguish between shares and other variable-yield securities (equity investment) and fixed-rate investments (fixed-income) as defined by the German Commercial Code. This

[***] An overview of the analyzed companies and their respective organizational form is provided in the Appendix.

rather superficial distinction still has clear risk implications. Financial theory indicates a positive correlation between riskiness and the expected return of assets (Sharpe 1964). From there we derive that shares and other variable-yield securities, which on average provide higher returns, should be considered riskier than fixed-rate investments.

To statistically identify the riskiness of the respective asset classes, we use a volatility-of-returns-based indicator. The asset returns cannot be directly observed from published data in Germany, as it is heavily influenced by accounting measures, such as conservatism (Eling and Marek 2014; Hellman 2008). To solve this issue, we utilize current market values as an indicator of asset returns (Jaffe, Keim, and Westerfield 1989). The publication of hidden reserves, the difference between market values and the conservative German Commercial Code book values, is compulsory in Germany. We are using the volatility of these hidden reserves as a risk proxy for asset classes. We calculate the average standard deviation of hidden reserves for 'equity investment' and 'fixed-income investment' for every company individually. The company size weighted average volatility of hidden reserves is highest for 'equity investments' with a standard deviation of EUR 16.10 million, while 'fixed-rate investments' possess a standard deviation of EUR 4.07 million. These values mostly meet the theoretical expectation: Whereas shares and other variable-yield securities are more volatile and can therefore be regarded as the riskier asset class, fixed-rate investments are less volatile.

2.3.2.2. Investment Preferences

After identifying the riskiness of the analyzed investment classes, we examine the asset composition of insurance companies. To identify the risk preferences on the asset side, we first examine the average investment of mutual and stock insurers. *Figure 2* depicts the investment into 'fixed-income' and 'equity' of mutual and stock insurers for the considered timespan weighted by total assets of the insurers. Fixed-income investments are the most used investment class, followed by equity investments for both forms of ownership.

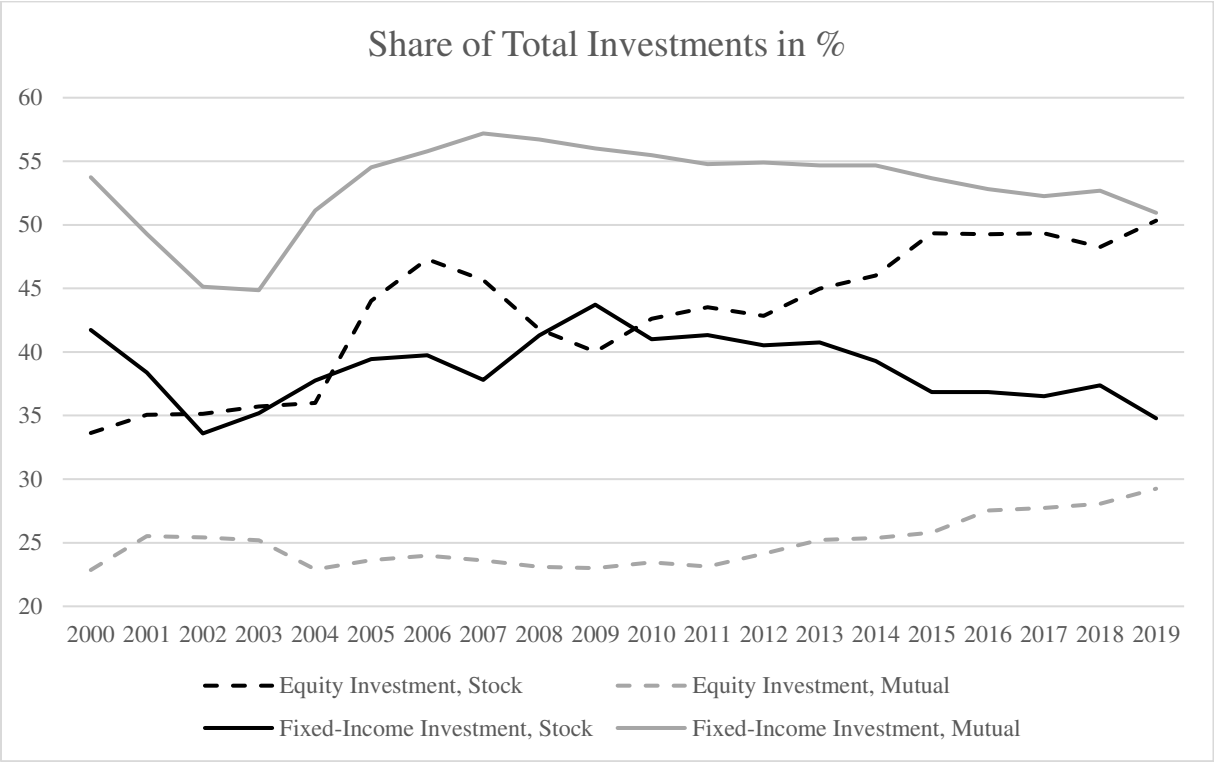

Figure 8: Comparison of Investment Composition by Ownership Form.

A steady difference between the investment composition of stocks and mutual insurers over the observed period is evident. Stocks invest substantially more into equity and less into fixed-rate instruments compared to mutuals. These results are supported by a t-test to compare the mean of the share of total investments between stock and mutual companies. For both 'equity investment' and 'fixed-income', the hypothesis of equal means is rejected with high significance ($p<1\%$). Mutuals and stocks differ fundamentally in terms of investment activities. In the next step, we use a logit regression to further disaggregate the link between investment composition and organizational form.

$$\log\left(\frac{P_{i,t}}{1-P_{i,t}}\right) = \beta_0 + \beta_1 * FI_{i,t} + \beta_2 * EQ_{i,t} + \beta_3 * SI_{i,t} + \epsilon_{i,t} + TFE_t$$

$P_{i,t}$ ≙ probability that the organizational form of company i at time t is a mutual

$FI_{i,t}$ ≙ share of fixed − income investment of total investments in %

$EQ_{i,t}$ ≙ share of equity investment of total investments in %

$SI_{i,t}$ ≙ size in ln(total assets)

$\epsilon_{i,t}$ ≙ error term

TFE_t ≙ time fixed effects in t

We use the logistic regression method as our data is based on the binomial *distribution* between the two organizational forms. A logistic maximum-likelihood estimation is employed. To avoid multicollinearity, we use the remaining investment classes as base categories for our analysis. We omit the categories investments in properties, investments in privately held companies (mainly in subsidiary companies), and cash holdings. On average, mutuals invest around 25 % and stocks around 15 % of their total investment into these remaining categories. To further test for robustness, we estimate four different variants of the regression. We vary our base analysis by including and excluding time-fixed effects as well as the Allianz AG because of its extraordinary size and market share. All regression tables are modeled after the probability of the company being a mutual insurer, i.e. a positive parameter estimate is linked to a higher probability that the company is a mutual insurer. To establish sufficient statistical significance, 81 datapoints of companies with no investments in the examined asset classes in an observation year, i.e. $FI_t = EQ_t = 0\ \forall t$, are excluded. According to our hypothesis, stock insurers should use a riskier asset composition than mutual insurers. As previously explained, we find that 'equity investments' are a risky investment category, whereas 'fixed-income investments' seem to be less risky. Therefore, we expect the parameter estimate of 'equity' to be more negative than the estimate of 'fixed-income'. As mutual insurers invest more into the omitted categories, we do not necessarily expect a positive impact of 'fixed-income investments', but a positive constant value. The results of the overall regression are shown in *Table 3*.

TABLE 3: Logit Regression Results, Investment

Variant	(A)	(B)	(C)	(D)
Constant	4.7793***	5.098***	4.6258***	4.9313***
	(8.0226)	(7.4685)	(7.7551)	(7.218)
Equity Investment	-0.0398***	-0.0447***	-0.0386***	-0.0433***
	(-5.8447)	(-6.2508)	(-5.668)	(-6.0404)
Fixed-Income	-0.042***	-0.0475***	-0.0418***	-0.0469***
	(-7.3662)	(-7.7972)	(-7.3391)	(-7.7296)
Size	-0.2948***	-0.3204***	-0.2723***	-0.298***
	(-6.5703)	(-6.9416)	(-5.9902)	(-6.3691)
pseudo R^2	0.0622	0.0677	0.0561	0.0611
Time fixed effects	No	Yes	No	Yes
Excluding Allianz	No	No	Yes	Yes
Observations	1162	1162	1142	1142

Size is included in our analysis as a control. We conduct our regression with and without time-fixed effects. To account for the dominance of the industry leader Allianz (with an average market share of 22,23 % of premiums written in our dataset), we also conducted the regression excluding Allianz.

The sign of the parameter estimates for equity investments and fixed-rate investments are both negative. Therefore, companies investing strongly into 'equity' and 'fixed-income instruments' are expected to be stock insurers. For example, a company with a 1 % higher share in 'equity investments' is up to 4.3 % less likely to be a mutual insurer. The difference between the parameters of 'equity investments' and 'fixed-rate investments' is not significant. The size control variable seems to explain the preference of stocks to invest in the equity category. As the parameter for 'fixed-income investments' does not significantly differ from the 'equity investments' parameter, hypothesis 1 is not supported by our data. The previously seen difference in investments seems to be rather driven by the larger size of stock insurers.

2.3.3. Underwriting Risk

2.3.3.1. Riskiness of Business Lines

Following the analysis of risk preferences on the investment side of the balance sheet, we now examine the respective risk implications of the underwriting of mutual insurance companies and stock insurers. Single business line insurers, specialized legal protection insurers in particular, are excluded from our analysis, as they do not possess a business mix influenced by

risk preferences. Correspondent to section 3.2 we first identify which underwriting habits may be considered risky.

Using a theoretical approach for the identification of risky and less-risky lines in the property-liability insurance business, we consider lines defined by a high severity and low probability of claims, e.g. property insurance, as rather risky. We empirically estimate the riskiness of underwriting in different lines of business using a statistical approximation of the loss ratio (Lamm-Tennant and Starks 1993; Born et al. 1998). The standard deviation of the individual net claim payments is put into relation to the direct underwriting volumes to account for differences in size. The results are represented in *Table 4*.

TABLE 4: Weighted Average Standard Deviation of Net Claim Payments

Household	22.0042	Liability	91.0433	Automotive	363.3664
Fire	50.2623	Accident	115.7845		
Legal expenses	62.6226	Property	134.1687		

in EUR million.

In line with theoretical considerations, we find 'property' to be a rather risky business line, with a standard deviation of EUR 134.17 million. 'Automotive' possesses by far the highest volatility in the sample expressed by a standard deviation of EUR 363.37 million. This observation does not meet our expectation that business lines, in which claims are defined by low severity and high frequency, generate a richer data background that results in reduced actuarial risk. We identify 'household' and 'fire' as the least volatile business lines, with a standard deviation of EUR 22.00 and 50.26 million respectively.

2.3.3.2. Underwriting Preferences

As the next step in our analysis, following the estimation of the riskiness of the respective business lines, we examine the underwriting habits of stock and mutual insurers. The two organizational forms vary by their business line concentration and composition. The development of their proportion in the net written premiums is exemplarily illustrated for three business lines in *Figure 3*.

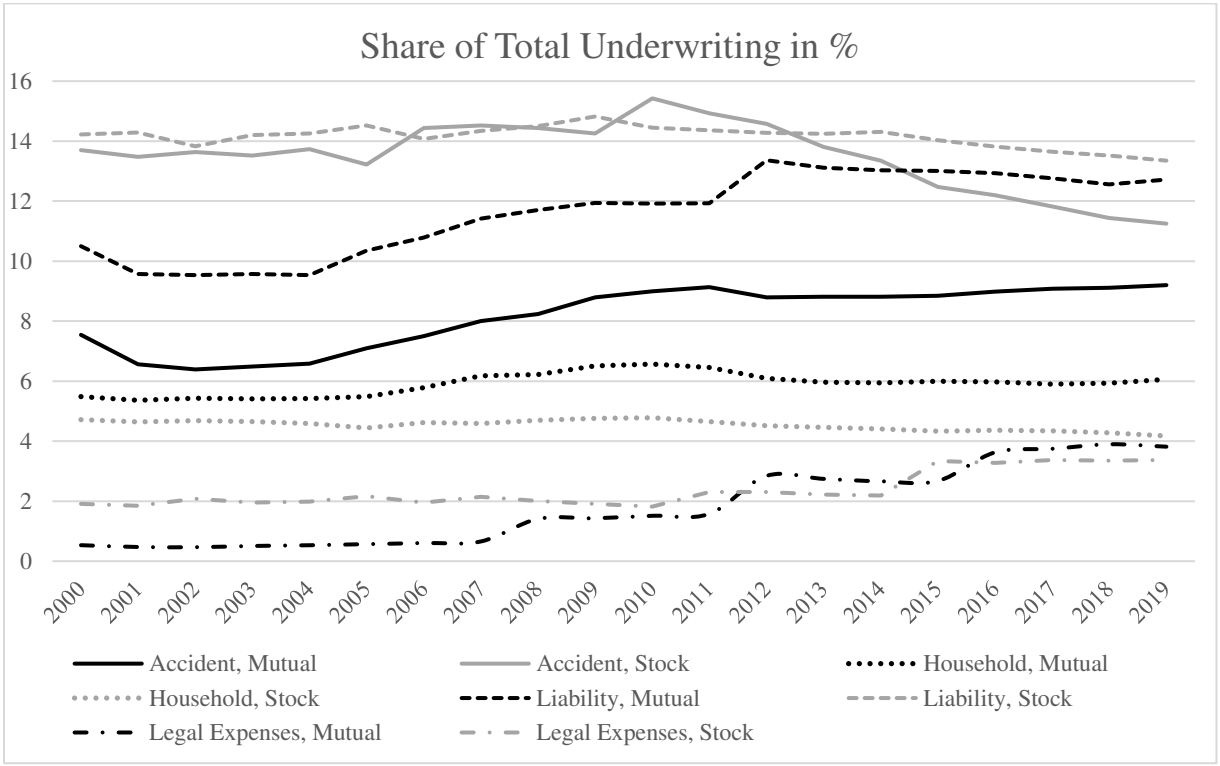

Figure 9: Comparison of Underwriting Composition by Ownership Form.

A clear difference between the underwriting composition of stocks and mutual insurers over the observed period is visible. We investigate the difference in underwriting habits via a t-test to compare the mean of the share of total underwriting between stock and mutual companies. We find a stable and significant difference in the underwriting practices of stocks and mutuals. To further determine whether the risk hypothesis holds for underwriting, we use another logit regression in the same way as for the investment dimension. We omit the average distribution of the medium risk categories, legal expenses, liability, and accident as the base for the analysis. We therefore solely examine if the two most and least risky categories show a predictive power on the company type. As seen in the previous regression, we test for robustness by including the same four variants.

$$\log\left(\frac{P_{i,t}}{1-P_{i,t}}\right) = \beta_0 + \beta_1 * FR_{i,t} + \beta_2 * PR_{i,t} + \beta_3 * HO_{i,t} + \beta_4 * AU_{i,t} + SI_{i,t} + \epsilon_{i,t} + TFE_t$$

$P_{i,t}$ ≙ probability that the organizational form of company i at time t is a mutual

$FR_{i,t}$ ≙ share of direct fire underwriting of total direct underwriting in %

$PR_{i,t}$ ≙ share of direct property underwriting of total direct underwriting in %

$HO_{i,t}$ ≙ share of direct household underwriting of total direct underwriting in %

$AU_{i,t}$ ≙ share of direct automotive underwriting of total direct underwriting in %

$SI_{i,t}$ ≙ size in ln(total assets)

$\epsilon_{i,t}$ ≙ error term

TFE_t ≙ time fixed effects in t

According to our risk hypothesis, we expect mutual insurers to rather concentrate on less risky business lines as identified in section 3.3.1. 'Fire' and 'household' are less risky, while 'property' and especially 'automotive' are riskier. Therefore, we expect the parameter estimates of 'fire' and 'household' to be positive and the ones of 'property' and 'automotive' to be negative. The results of the regression are presented in *Table 5*.

TABLE 5: Logit Regression Results, Underwriting

Variant	(A)	(B)	(C)	(D)
Constant	0.8098***	0.7236*	0.6572**	0.5945
	(2.9446)	(1.8223)	(2.3565)	(1.4871)
Automotive	-0.0074***	-0.0072***	-0.0082***	-0.008***
	(-3.0033)	(-2.8808)	(-3.2999)	(-3.1891)
Property	-0.0609***	-0.0636***	-0.0635***	-0.0656***
	(-3.7867)	(-3.8693)	(-3.9368)	(-3.9883)
Fire	0.1302***	0.1338***	0.125***	0.1277***
	(4.9521)	(4.9691)	(4.9375)	(4.9411)
Household	-0.0125	-0.0106	-0.0127	-0.0113
	(-0.7635)	(-0.6408)	(-0.7796)	(-0.6832)
Size	-0.1365***	-0.1401***	-0.0984**	-0.1019**
	(-3.2138)	(-3.2793)	(-2.2222)	(-2.2862)
pseudo R^2	0.0638	0.0644	0.0599	0.0603
Time fixed effects	No	Yes	No	Yes
Excluding Allianz	No	No	Yes	Yes
Observations	1142	1142	1122	1122

Size is included in our analysis as a control. We conduct our regression with and without time-fixed effects. To account for the dominance of the industry leader Allianz (with an average market share of 22,23 % of premiums written in our dataset), we also conducted the regression excluding Allianz.

The sign for the underwriting class 'fire' is positive and significant as expected. A company with a 1 % higher share in fire insurance is, c.p. 1.14 % more likely to be a mutual than a stock insurer. The parameter estimate for 'household' is negative but very close to zero. The parameters for 'property' and 'automotive' are negative and significant. As mutual insurers seem to write more business in the less risky lines, our results largely support hypothesis 2.

2.3.4. Interpretation of Results

Our results show that in the German property-liability insurance market a fundamental strategic difference in underwriting and investment prevails between investor-owned corporations and mutual associations. In the investment dimension, our data does not support the risk hypothesis, as we find the size to explain the difference in stocks and mutuals regarding their investment decisions. The bigger mutual companies might therefore behave more like we expected stock companies to do in their investment decisions. Hypothesis 1 is not supported by

our results. In line with our second risk hypothesis, we find that mutual insurers are substantially less involved in risky underwriting activities. We find a clear negative correlation between the relative amount of premiums written in property insurance and the probability of the insurance company being a mutual insurer in all our regressions. Therefore, hypothesis 2 is strongly supported. If a company underwrites less in risky business lines, it is more likely to be a mutual insurer.

The results are consistent with the existing findings for the U.S. insurance industry, although our results appear to be less significant. These differences could result from the development of the respective financial markets. The USA showed finance-led economic growth since its inception, whereas Germany was characterized by a fragmented financial economy with highly specialized mutual insurers (Allen et al. 2012). Today, the large U.S. financial markets show high investor protection while Germany is a civil law country with a comparatively underdeveloped capital market and low investor protection (Nowak 2004). The theory developed by *John, Litov & Yeung* (2008) suggests a negative influence of investor protection on risk aversion and could explain this difference. In addition, many German insurers possess roots in chambers of craft or professional associations that introduced a social security system for their members (Maurer and Somova 2007). The long historical roots of the German mutual insurers are apparent until today. These companies often still follow conservative business models and offer the same products as in their early days (Rauch and Wende 2015). In addition, the influence of the recently introduced European supervisory regime Solvency II on the probability of insolvencies has to be considered here (Eling, Schmit, and Schmeiser 2007). This market environment and its supervisory implications have an immediate impact on the risk preferences of insurers.

2.4. Conclusion and Outlook

The German insurance industry is characterized by the coexistence of different organizational forms of insurance companies. Two organizational forms, which fundamentally differ in terms of organization and derived managerial implications, dominate the German property-liability insurance market. Non-profit mutual insurance associations and for-profit joint-stock companies are responsible for over 96 % of gross written premiums in the German property-liability insurance market today. We first demonstrate that there is a significant difference between the strategic behavior of investor-owned insurance companies and mutual insurance associations. We further analyze the risk preferences of the two organizational forms. We hypothesize that the different organizational implications of the stock and mutual form manifest in an essential disparity in the approaches used to manage risks. We examine if the legal form of an

insurance company in the German property-liability insurance market is influenced by the way the firm deals with risks in both business dimensions: underwriting and investment. Our results indicate that stock insurance companies act in a riskier way than mutual insurance associations. On the investment side, stocks exhibit a proportionally higher investment in more volatile asset classes, but this difference can be explained by size effects. In the underwriting dimension, mutuals write more business in less risky business lines, as characterized by the volatility of claim payments. Stock insurers underwrite proportionally more business in riskier business lines, e.g. property insurance. The risk hypothesis is confirmed for underwriting in the German property-liability insurance industry.

Our analysis creates opportunities and implications for further research. We were unable to conduct a more granular examination of the investment strategies of the insurance companies as the annual reports according to the German Commercial Code only publish rather superficial data concerning the asset mix. It is desirable to extend our analysis with a developed approach or more detailed data to capture investment risk. In addition, an event study covering insurance companies changing their legal form from stock to mutual (or the other way around) could be used to determine if this change initiates a shift of risk preferences. This investigation could provide further insights into the causal relationship of organizational form and risk preferences. Unfortunately, the number of suitable events for such an examination in our dataset is too low to conduct a conclusive analysis.

2.5. Appendix

Overview of German P/L-Insurers included in the Dataset

Stocks	
1 ADLER	21 HUK-COBURG Allgemeine
2 Allianz	22 HUK24 AG
3 Allianz Direct	23 Interlloyd
4 ARAG Allgemeine	24 InterRisk
5 AXA	25 Janitos
6 Basler Sach	26 Mannheimer
7 Condor Allgemeine	27 Nürnberger Allgemeine
8 Cosmos	28 Nürnberger Beamten Allgemeine
9 Continentale Sach	29 PVAG Polizei-Versicherung
10 Deutsche Allgemeine	30 R+V Allgemeine
11 DEVK Allgemeine	31 R+V Direkt
12 ERGO	32 RheinLand
13 ERGO Direkt	33 Signal Iduna Allgemeine
14 Europa	34 TARGO
15 Garanta	35 Verti Versicherung
16 Generali	36 VHV Allgemeine
17 Generali Deutschland	37 VPV
18 Gothaer Allgemeine	38 WGV
19 HanseMerkur Allgemeine	39 Württembergische
20 Helvetia	

Mutuals	
1 Alte Leipziger	13 Itzehoer/Brandgilde
2 Barmenia Allgemeine	14 LSH
3 Bayerische Beamten	15 LVM
4 Concordia	16 Mecklenburgische
5 Debeka Allgemeine	17 Münchener Verein Allgemeine
6 DEVK VVaG	18 NV-Versicherung
7 Die Haftpflichtkasse VVaG	19 Stuttgarter
8 Gartenbau	20 Universa Allgemeine
9 GVV-Kommunal	21 Volkswohl-Bund Sach
10 HDI	22 WWK Allgemeine
11 HUK-COBURG VVaG	23 Württembergische Gemeinde
12 Ideal	

Essay 3: Mutual Insurance in Germany – Still A Success Story?

Schuh, F. (2023)
"Mutual Insurance in Germany – Still A Success Story?"
Rivista Bancaria Minerva Bancaria,
Nr. 5-6 September-Dezember 2023
Special issue dedicated to Mutual Financial Institutions

Abstract:

My detailed analysis of mutual insurance associations shows that they have performed strongly across all lines of business in Germany over the past 25 years. They have gained market share, have a cost advantage, and provided a higher average level of solvency than stock firms. On the other hand, survey results show that German customers do not understand the concept of mutuality and do not even know if they are a customer of a mutual insurer. Most policyholders only put a small value on the legal form in the purchase of insurance. This contradiction between performance and perception suggests an opportunity for mutual insurers in promoting the advantages of their form.

Keywords: Insurance, Insurance Companies, Actuarial Studies, Cooperative Enterprises

JEL codes: G22, P13, N23

3.1. Introduction

Mutual insurance associations are the original form of insurance companies in Germany. A mutual insurance company initially intends to offer its members appropriate insurance coverage and charges favorable premiums, as the insured members are also owners of the association. The mutual form can serve the interests of its members, as the form is independent of profit-seeking capital providers. As early as the Middle Ages, merchants and farmers joined together to form so-called protection or fire guilds to insure themselves jointly against raids, fire damage, or livestock losses. One of the first mutuals in Germany goes back to the merchant *Ernst-Wilhelm Arnoldi*, who realized the idea of mutual assistance in 1820. Mutual insurance associations in Germany grew significantly during the Industrial Revolution. More recent years have seen a decline in the popularity of the form worldwide, as more and more mutual insurance companies have been converted into stock corporations. However, mutual insurance retains a significant role: In 2020, 240 mutuals were active in Germany with a market share of around 14 %.

My research builds on studies that analyze the implications of organizational form for the success of insurance companies. Historically, the scholarly literature in Germany has stressed the disadvantages of mutuals, though few papers have addressed the topic in recent years. Furthermore, the structure of insurance groups in Germany makes it difficult to appropriately evaluate the performance of mutuals. I use an extensive dataset to investigate the success of stock and mutual insurers in various dimensions, such as growth, costs, and solvency. I also conduct a survey that investigates the perception of mutual insurance companies in Germany. I examine if customers are aware of the special implications of the insurer's legal form for policyholders.

Thus, this paper makes two contributions to the existing research. First, I update the investigation of mutual insurance performance. Second, I combine the performance analysis with a survey to show the contrast between mutual insurance performance and the perception of mutual insurance held by consumers. My results indicate that, compared with stock corporations, mutuals have higher growth rates and lower cost ratios, especially in property/liability. In terms of investment returns no clear difference is visible and the return on revenue disadvantage of mutuals has been decreasing over time. Mutual insurers provide a greater margin of protection against risk as they hold more equity.

Despite the performance of mutual insurance, the survey clearly shows that most policyholders attach little importance to the legal form of the insurer when making an insurance purchase. Most customers are unaware if they are mutual insurance members, and many do not understand the mutual insurance concept.

The remainder of this paper is organized as follows: Section 2 discusses the roots of mutual insurance in Germany. Section 3 is an introduction into organizational form theory before Section 4 gives an overview of the market development in Germany since 1945. Section 5 provides an explanation of insurance regulation in Germany. The special structures of insurance groups in Germany are described in Section 6. Performance is analyzed in Section 7. Section 8 explains the survey results. In the final section, I provide a summary and an outlook on opportunities for future research.

3.2. Organizational Form Theory

The main institutional differences between stock and mutual companies concern the different roles of essential interest groups in the company, consisting of the management, customers, and owners. The effects of the different organizational structures on the various conflicts of interest among these groups produce important strategic differences between stock and mutual insurers (Mayers and Smith 2013). Both organizational forms share the differentiation between ownership over residual claims and strategic control over company decisions (Demsetz 1983), but the underlying agency problems differ fundamentally (Fama and Jensen 1983a).

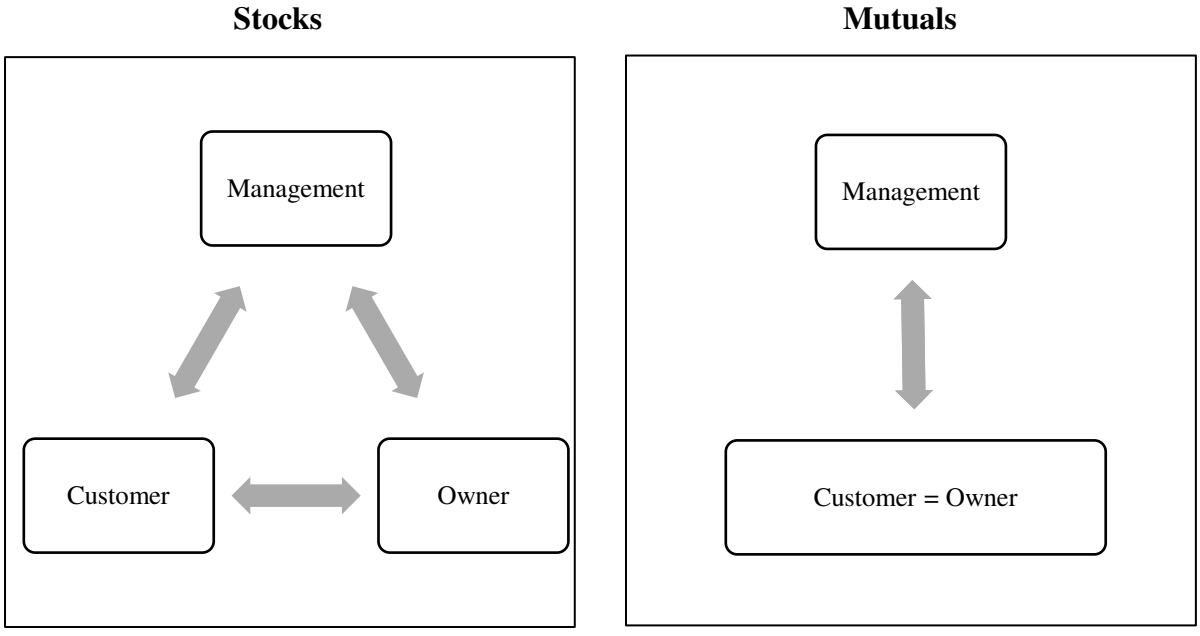

Figure 10: Interest Groups in Stock Insurance Companies and Mutual Insurance Associations

In stock insurance corporations, a clear separation of the owner, manager, and customer parties prevails (Spiller, 1972). Among those groups, the incentives of customers and owners contradict each other. Owners desire the management to maximize the company profits while policyholders seek inexpensive insurance coverage. All claims paid out to policyholders have a direct negative effect on the profit of capital investors. Stockholders have the incentive to increase the firm's dividend at the expense of the customers (Mayers and Smith 2013). The management is thus obliged to balance the contradictory objectives of the other two interest groups.

Consumers and investors are merged in mutual insurance associations (Hansmann 1985). The interest conflicts between policyholders and owners are therefore internalized (Mayers and Smith 2013; Ligon and Thistle 2008; Born et al. 1998). Mutual insurance corporations function like cooperatives, where the members are not only policyholders but also owners of the company (Hansmann 1985; Armbrüster 2008; Formisano 1978). Policyholders gain the firm's residual profits, e.g. via lowered insurance premiums, but correspondingly bear possible losses (Smith and Stutzer 1995; Mayers and Smith, 1988; Hetherington 1969). Furthermore, mutual policyholders have a more direct influence on the company's management (Nemson 2014). In this respect, mutuals contrast with stock corporations, which are exposed to considerable third-party influence through a shareholder structure (Piojda 1997). Insurance mutuals are not subject to these influences and can accordingly pursue a more long-term and community-oriented corporate policy in the best interest of the owners/customers (Talonen 2018). *Mayers & Smith* (1981) also find disadvantages of the mutual organizational form in their research. They identify a critical shortcoming of the mutual insurance forms, as with dispersed ownership control over the management is lowered.

3.3. The Roots of Mutual Insurance in Germany

In some sense, mutuality is present within all forms of insurance realized through risk pooling in the collective. In this sense, insurance without mutuality is therefore inconceivable. Mutuality in the narrower technical sense is embodied by mutual insurance associations (Büchner 1965). In the corporate embodiment of mutuality, the insurance business was historically run to provide the most favorable insurance coverage for its members and not with the primary intention of profit-making (O'Sullivan 1998; Kaphan 2010; Gerner 2003).

Long before mutual insurance companies were introduced, the idea of mutuality was a central part of life in Germanic clans (Nemson 2014). The communal use of nature inevitably also referred to negative risks, which exceeded the individual risk-bearing capacity (Lehner 1989). In the early Middle Ages, guilds used contributions to support members in emergencies such as illness and disability (Rahlfs 2007). The forms of mutual insurance known today are based on these medieval guilds (Brenzel 1975; Görg 2003). The sense of responsibility rather than the pursuit of profit was the driving force behind the founding of these associations (von Zedtwitz 2000). They were not set up to make a profit but instead worked on a mutual basis, as all income, minus administrative costs, was distributed to members. In the principle of cooperative associations, these guilds are the roots of modern mutual insurance (Merdausl 2000). The first insurance companies of the 16th century, which served to protect possessions and goods in Schleswig-Holstein, are considered to be the origin of fire insurance based on the principle of mutuality (Kampshoff 2003; Schewe 2000).

Modern insurance associations have their continental European origins in the establishment of two large mutual insurers in Gotha by the merchant Ernst Wilhelm Arnoldi in 1820 (Müller 2000). The Industrial Revolution promoted the insurance industry in Germany significantly, as insurance was an innovative answer to the new risks emerging from social and economic change (Borscheid 2010). The early insurance institutions were initially intended only for a locally defined area of activity or a certain group of persons (Krišto, Talonen, and Pauković 2021). This is evidenced by company names that emphasize the customer group like *DEVK* (*Deutsche Eisenbahn Versicherungskasse* translated to "*German Railway Insurance Fund*") or *HUK* (*Haftpflicht-Unterstützungs-Kasse kraftfahrender Beamter Deutschlands* translated to "*Liability Support Fund for Motoring Civil Servants in Germany*"). Other names were taken from specific towns or the surrounding areas, such as *Gothaer, Alte Leipziger, Magdeburger, Thuringia* or *Württembergische*. These firm names reveal local origins even if the firms themselves are now active on a national scale (Koch and Swiss Re Corporate History 2013).

3.4. Development of German Mutuals after 1945

Many of the mutual insurers had to abandon their geographical roots after the German division in 1945. The Soviet military administration banned the activities of all insurance companies and expropriated their assets. This ban also applied to mutual insurers. The

German insurance industry lost a third of its total premium volume. Almost all companies based in East Germany, which had already established contacts in the western parts of Germany before the end of the war, moved their headquarters to the West (Koch 2012).

Figure 11: Location of Mutual Insurance Group Headquarters in Germany 2023

Examples of mutual insurers that moved to the West after the German division are *Gothaer* (founded in Gotha, now located in Cologne), *HUK* (founded in Erfurt, now located in Coburg) and *Barmenia* (founded in Leipzig, now located in Wuppertal). Only one insurer in my data set that is still active today remained in the western parts of the divided city of Berlin (Koch 2012). Only specialized local mutual insurers that were founded after 1990 have a notable market influence in the former German Democratic Republic (GDR) today. In my data set of the 67 biggest insurance groups in Germany, only one mutual insurer is located in the former east[10], as illustrated in *Figure 2*.

[10] *OKV – Ostdeutsche Kommunalversicherung auf Gegenseitigkeit* is located in the former eastern parts of the divided city Berlin.

The first comparable insurance statistics available for the German market are dated to the 1950s. Historically the number of mutual insurers was high in Germany but over the last century, the number of stocks increased substantially.

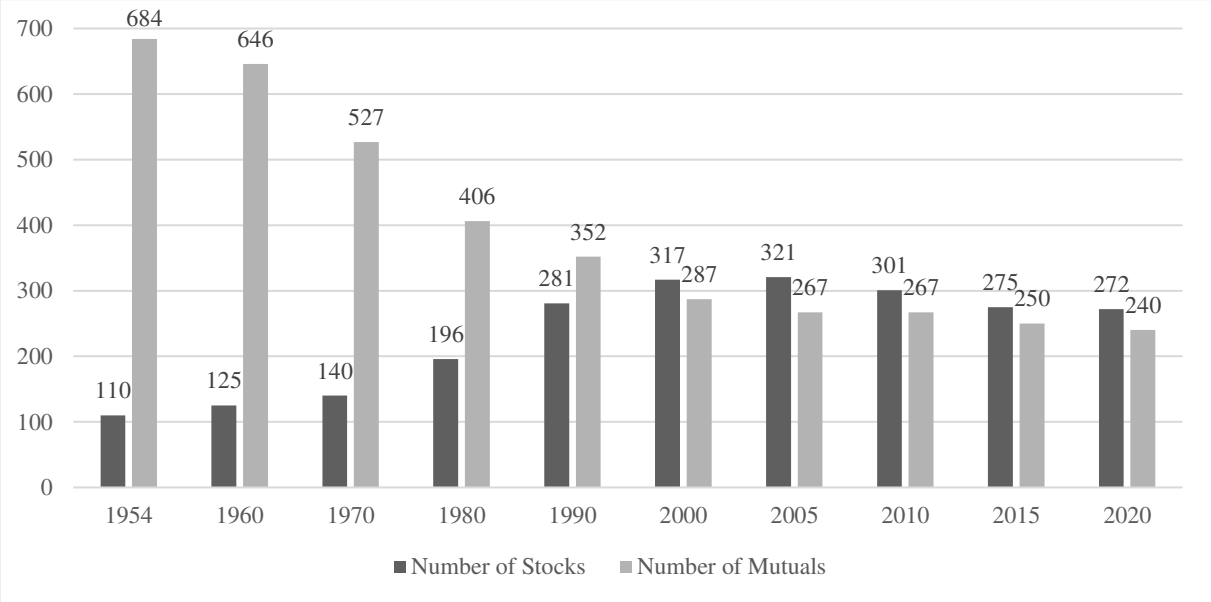

Figure 12: Number of Stock and Mutual Insurers in Germany

As depicted in *Figure 3*, the time from post-war reconstruction until reunification was characterized by consolidation. A large number of mergers and a tendency toward concentration in small and regional mutuals were present (Frels 1979). Despite a further liberalization of the German insurance market in 1994, the numbers of insurance companies in Germany have changed little since then (Cox and Bode 2002). The ratio of stocks to mutuals has remained constant since the middle of the 1990s.

In terms of gross premiums written, stock firms have increased their market share over the last seventy years (*Figure 4*).

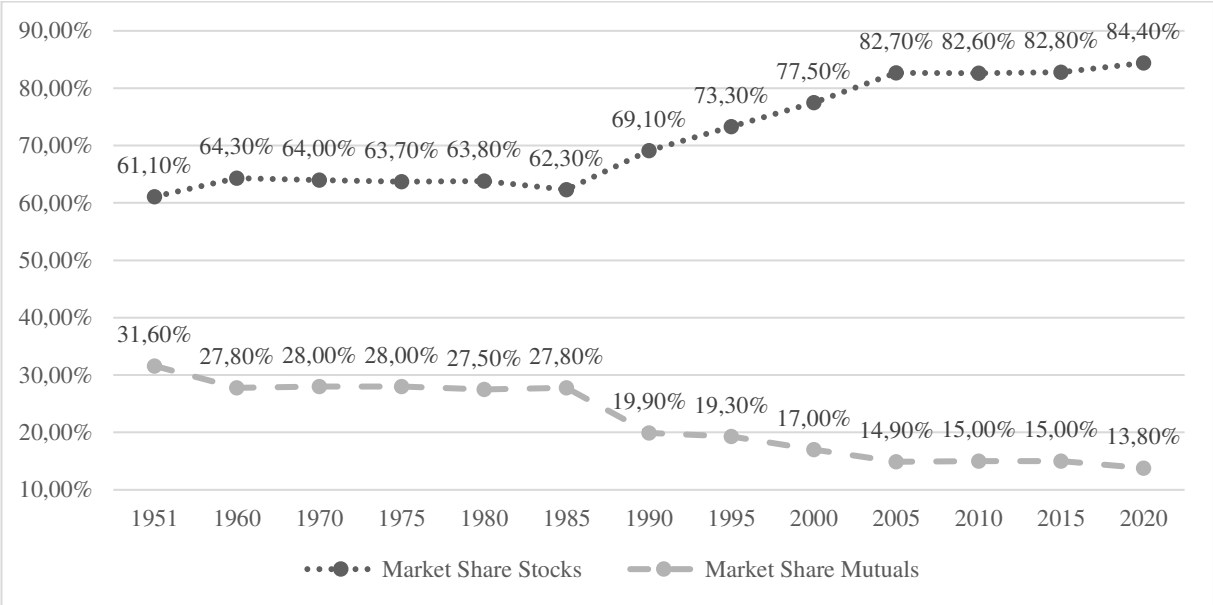

Figure 13: Market Share of Stocks and Mutuals (Gross Written Premiums) in Germany

A big drop in the market share of mutuals is observed in 1990. This drop is largely attributable to the German reunification: Deutsche Versicherungs AG, a stock insurance company, was formed to manage all the insurance contracts of the former GDR to initiate the shift from a state-owned enterprise to the market economy system (Eggenkämper 2010). The overall market volume increased considerably while mutuals did not gain any of this new business. Deutsche Versicherungs AG later became part of the Allianz group, which continues to have a significant market influence in the eastern regions today (Eggenkämper and Pretzlik 2010). The market shares of mutual insurers stabilized in more recent years. Today, mutual insurers act as preservers of competition against oligopoly, as they are immune to direct hostile takeovers (Müller 2000).

3.5. Insurance Regulation in Germany

Uniform state insurance supervision in Germany dates to as early as 1901 (Kaulbach, Bähr, and Pohlmann 2019). Today all insurance companies that provide private insurance and have their registered office in Germany are subject to the Insurance Supervision Act. This law does not distinguish between legal forms but makes distinctions based on insurer size (Bähr 2011). German regulation aims at protecting 1) consumer interests and 2) the longer-term interests of insurance companies (Rees, Gravelle, and Wambach 1999). Supervision ensures the fulfillment of contracts and uses uniform regulation for both stocks

and mutuals. The difference between mutuals and stocks is reduced by uniform supervision (Hübner 1986). Today's supervisory law is largely based on developments at the European level (Rees and Kessner 1999). In 1994, these developments led to a single European market in insurance (Guenter and Ditomassi 2017). On January 1, 2016, a uniform supervisory system came into force throughout Europe with Solvency II. The Solvency II Directive (Directive 2009/138/EC) introduces more advanced solvency requirements for insurers, based on a holistic view of risk and market value-oriented valuation rules (Oehlenberg, Stahl, and Bennemann 2011). All insurers, regardless of their legal form, also fall within the scope of the Solvency II Directive. The proportionality principle is intended to take into account the individual characteristics of insurance companies, resulting in potential relief for medium-sized and smaller insurance companies (Brandstätter and Wiedermann-Ondrej 2016). Small insurers whose annual gross premiums written are less than five million euros or whose gross technical provisions are less than 25 million euros are generally not required to apply the Solvency II rules. Thus, both the European and the German insurance supervisory authorities differentiate only according to size and not according to legal form.

3.6. Mutual Insurance Group Structures

An understanding of the group structures in the German insurance market is required to evaluate the success of mutuals in Germany. When mutual insurance companies desire to offer insurance coverage in other insurance lines, they must form a new insurance company following the separation of insurance lines mandated by § 8 of the German Insurance Supervision Act. The Act prohibits the operation of private health insurance or life insurance together with other lines of insurance so that multiple lines cannot be sold within one insurance company (Benkel 2002). This requirement can be explained by the particularly high value placed on policyholder protection in life and health insurance. Insured persons are to be protected by separating the companies to prevent cross-subsidization, i.e. the financing of one business line by other insurance lines, in the event of losses. Thus, an insurance group that wants to offer products in all three insurance areas in Germany must consist of at least three legally independent companies (Farny 2002). When applied to mutuals, this means that the company in a new line in direct contact with the customer is typically a stock insurer that is wholly owned by the mutual insurance company (Hoppmann 2000). The German insurance industry is therefore characterized by group structures with profit-transfer agreements (Piojda 1997). Numerous mutual

groups have been formed or reformed with a mutual holding company, an intermediate holding company, and several operating stocks (Farny, Malik, and Dregert 2011). The mutual has strategic control and ultimately pools all risks in the group, but the stock company offers the insurance policies to the end customer (Müller-Wiedenhorn 1993). The policyholder holds a contract with a stock insurer, which is part of a mutual group.[11] *Figure 5* illustrates a typical structure of a mutual insurance group. The *HUK-Coburg Group*, the biggest car insurer in Germany, is used as an example.

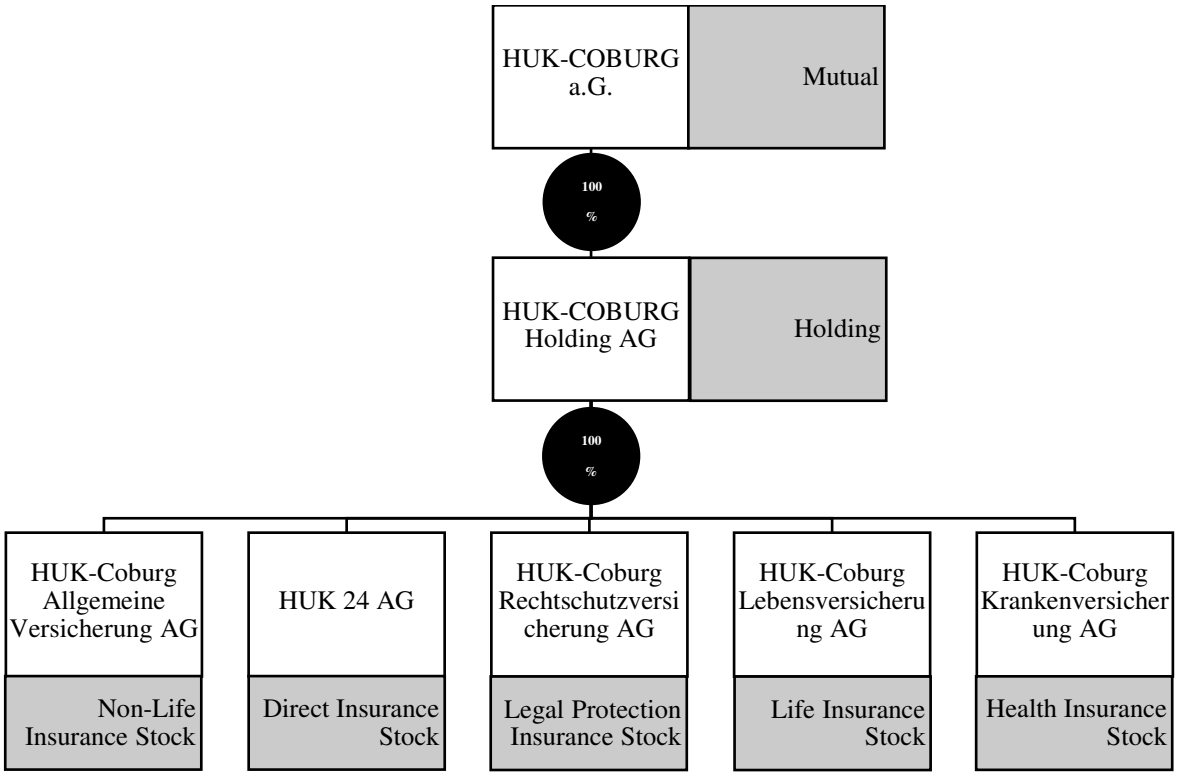

Figure 14: HUK-Coburg Group Structure[12]

This group structure provides for different levels of reciprocity and mutuality for different policyholders (Farny 2010). It implies limitations of the mutual insurance concept as not all policyholders in the group become direct members of the mutual. The policyholders of stock insurers that are held by the mutual parent company do not directly participate

[11] The mutual group parent is not allowed to insure only vicariously through control of the companies on subordinate levels. The mutual parent company must underwrite insurance contracts itself to be allowed to have this legal form.

[12] A joint venture for specialized products for employees of the church is not depicted here.

in the group's profits. Also, the members' influence on the business is only indirect. The value of membership is decreased (Dreher 2008). This decreases the discernible difference between mutuals and stocks for the policyholder significantly. Insurance regulation also reduces the difference between mutuals and stocks. The capital requirements for stocks and mutuals are equal, while only the smallest mutuals operate under privileged supervisory arrangements (Müller 2000; Wackerbeck 2002). To reach the capital requirements mutuals must generate equity despite being unable to sell shares. This generates pressure to obtain profits as a source of safety capital (Hoppmann 2000; Müller 2000). These factors sum up to tendencies of alignment between the organizational forms, a phenomenon first scientifically examined in Germany in the 1950s (Frey 1957).

3.7. Mutual Insurance Performance

3.7.1. Background

The behavioral differences between stock and mutual insurers in other countries have been examined in several papers. However, the findings are ambiguous and inconclusive. *Spiller* (1972) and *Frech* (1980) identify higher costs in American mutuals than stocks. *Fields* (1988), *Boose* (1990), *Gardner/Grace* (1993) and *Grace/Timme* (1992) find no cost differences in American life insurance between ownership types. *Armitage/Kirk* (1994) find higher costs for British stocks compared to mutuals. Concerning growth, *Spiller* (1972) shows higher growth in stocks while *Mayers/Smith* (1986) and *McNamara/Rhee* (1992) do not find differences. *Mayers & Smith* find that a change from a stock to a mutual insurance increases efficiency (Mayers and Smith 1986), while *Chaddad & Cook* determine demutualization as efficiency-enhancing (Chaddad and Cook 2004). *Lamm-Tennant/Star*ks (1993) show that the business activities of mutuals are exposed to lower levels of risk compared to stocks. In Germany, the disadvantage of missing management control in mutuals and the complicated supervision structures have been noted (Breuer 1999; Wackerbeck 2002). But in the meantime, a level playing field for all legal forms is reached (Nemson 2014). Empirical examinations are rare. *Finsinger/Flöthmann* (1982) find the costs of stocks to be higher than the costs of mutuals in the German property/liability market. *Schuh/Noth* (2022) show that mutuals are exposed to less underwriting risk in the German property/liability market.

These research results serve as a starting point for an extensive performance analysis of stocks and mutuals in the German insurance markets. Section 3 uses aggregate company-level data from the German Insurance Association ((GDV), 2022). This data shows a distorted impression of the market development, as the GDV defines mutual insurance companies in the narrowest possible sense by ignoring the group structures and only counting "original" mutuals, as explained in Section 4. The upcoming analysis uses a different approach. Those stock companies which are predominantly owned by mutual insurance companies are assigned to the organizational form of the controlling firm. The reasoning behind this procedure is that they are not independent in their business decisions and cannot independently enter the capital market. They experience a high level of governance from the holding company and are influenced by the business strategy of the mutual parent company. Therefore, the analysis shows a broad picture of mutual insurance activities in the German insurance market. This paper presents analyses of the long-term development of aggregate of mutual insurance companies in comparison to the aggregate of stock corporations. The investigation concerns the development of market shares, costs, and security. The analysis covers 25 years (1997-2021) and subsumes more than 100.000 data elements from over 5.000 annual reports of the individual companies included in the aggregates. This provides a representative picture of the overall market and the weighted-average legal form aggregates under consideration. The data is provided by *KIVI GmbH Cologne Institute for Insurance Information and Business Services* in cooperation with the *Department of Risk Management and Insurance* at the *University of Cologne.* The study covers developments in health, life, and property/liability as well as the overall market. Both the non-life and life analyses include all insurers with direct gross premium income of at least 50 million euros. Non-life companies that cede 100% of their business to reinsurers are not included. The 65 insurance groups in the sample underwrite about 97,92 % of gross written premiums in the German primary insurance market. In life, both the "market aggregate" and the "market aggregate excluding Allianz" are used as benchmarks, due to Allianz's high market share in this segment. The market aggregate consists of insurance institutions under public law and other legal forms, such as branches of foreign-based insurance companies, which are of secondary importance in the German market with a relatively low market share. To underline the direct comparability of stocks and mutuals *Figure 6* depicts the underwriting composition of the organizational forms in the data set. The figure clearly shows that the underwriting of stocks

and mutuals is relatively similar. A Mann-Whitney-U-Test confirms that there is no statistical difference in underwriting behavior for the stock and mutual aggregates over the years 1997 – 2021.

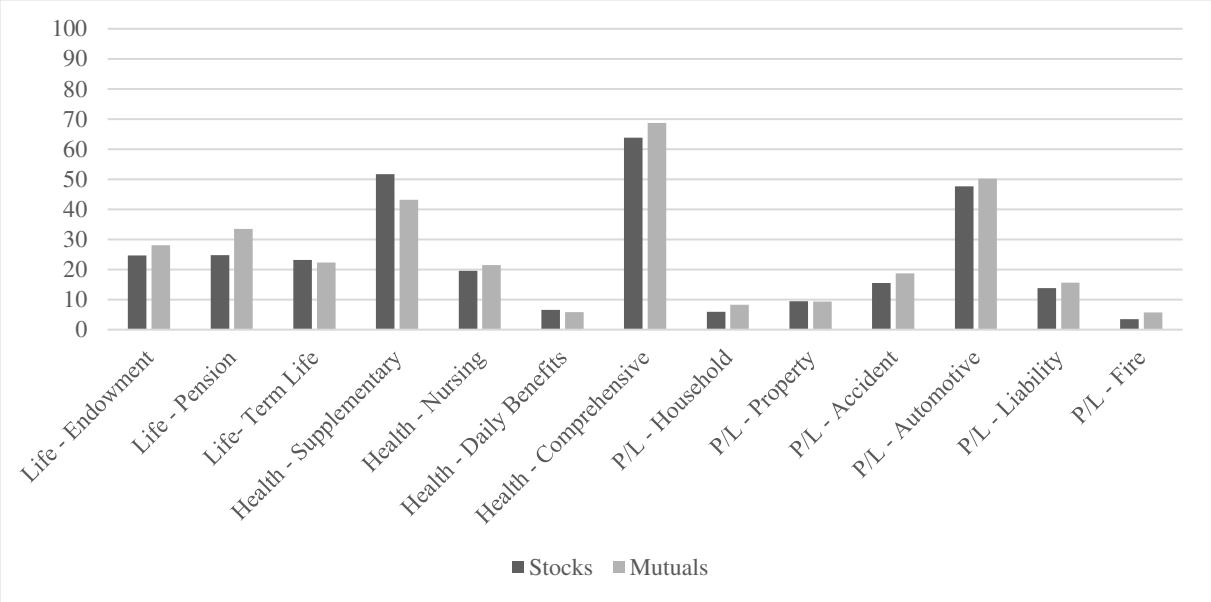

Figure 15: Underwriting Composition[13]

3.7.2. Market Share

Gross Written Premiums (Mio. €)	**1997**	**2021**	**Δ absolute**	**Δ relative**
Stocks	63.297,75	120.380,19	57.082,44	90,18 %
Mutuals	29.569,10	83.987,65	54.418,55	184,04 %
Market	105.065,88	228.206,79	123.140,91	117,20 %
Market Share	**1997**	**2021**	**Δ absolute**	**Δ relative**
Stocks	60,25 %	52,75 %	-7,50 %	-12,44 %
Mutuals	28,14 %	36,80 %	8,66 %	30,77 %

Figure 16: Stock and Mutual Market Share, 1997 vs. 2021

Gross premiums written in the overall market more than doubled across all three lines of business from around 105,1 billion € in 1997 to 228,2 billion € in 2021. This corresponds to average premium growth of 3,3 % or 5,1 billion € per year. Stocks were able to increase their total premium income by 90,2 %, but mutuals recorded higher growth in premium income at just over 184 %. Gross premiums for mutual groups increased from 29,6 billion € in 1997 to 84.0 billion € in 2021. The market shares of mutual groups grew from

[13] The organizational form aggregate of the individual product share for the years 1997-2021 is measured in percent of the overall premiums written (sum insured in life insurance).

28,1 % to 36,8 %. The stock group market share declined significantly from 60,2 % in 1997 to 52,8 % in the year 2021. Mutuals thus emerged as the market share winners of the past 25 years.

In health insurance, mutuals are expanding their market-leading position in terms of premiums compared to stocks. Mutuals account for more than half of premium income in the health sector (2021: 55,4 %). They increased their market share by 4,6 % during the period under review. Stocks lost just under 5 percentage points of market share.

In life insurance, premiums and market shares of stocks as well as those of the market are significantly influenced by Allianz. In addition to a strong Allianz on the stock side, mutuals in life are growing at an above-average rate and are also gaining market share. The mutuals were able to expand their market share by an above-average 6,3 percentage points from 21,3 % in 1997 to 27,5 % in 2021. Premiums show stable ongoing new business growth with an average of 4,4 % per year during this period.

Premium income in property/liability more than doubled over the period under review from 41,7 billion € in 1997 to 85,4 billion € in 2021. Stock groups (171,7 %) grew at a below-average rate, while mutual groups nearly tripled their gross premiums and thus grew significantly faster than the market (298,2 %). Mutuals gained 11,8 percentage points of market share, rising from 25,9 % in 1997 to 37,7 % in 2021. This is mainly at the expense of the stocks. They lose 9,6 percentage points of market share, declining from 59,2 % in 1997 to 49,6 % market share in 2021.

3.7.3. Costs

Over the analyzed period, the cost ratio (costs set in relation to gross premiums written) for both aggregates in the health insurance market declines. In the case of health insurance, mutual insurance companies have a long-term cost advantage over stock corporations, although the gap has narrowed somewhat in the recent past (*Figure 8*).

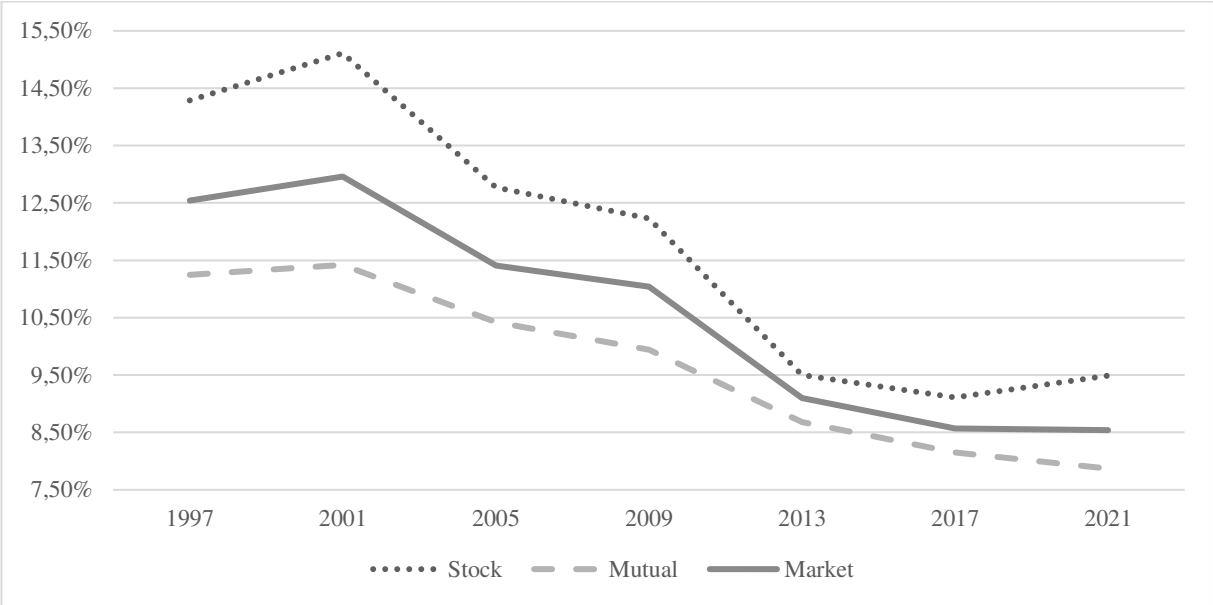

Figure 17: Cost Ratio, Health Insurance

Costs can be further divided into administrative and acquisition costs. The administrative cost ratio of mutual health insurers (2,44 %) is at the same level as the long-term average. The gap to stocks (3,15 %) is considerable, at over 70 basis points. The acquisition cost ratio of the mutuals is also consistently lower than that of the stock groups over the examined years, though there appears to be convergence over time. The mutual acquisition cost ratio reached a sample low in 2021 (5,91 %).

Over the past 25 years, the life insurance cost ratio declined for both mutuals and stocks, as seen in *Figure 9*. The administrative expense ratios of mutuals are above average. However, over time they have converged with those of the stock firms, especially when excluding Allianz. Allianz significantly lowers the administrative expense ratio of stocks and of the overall market. The size of the Allianz is noticeable here. In contrast with the administrative expense ratio, the acquisition cost ratio of the mutual groups is below the market average and has the lowest long-term average value compared with the other aggregates (4.70 %). The acquisition cost ratio is relatively constant over time in all aggregates.

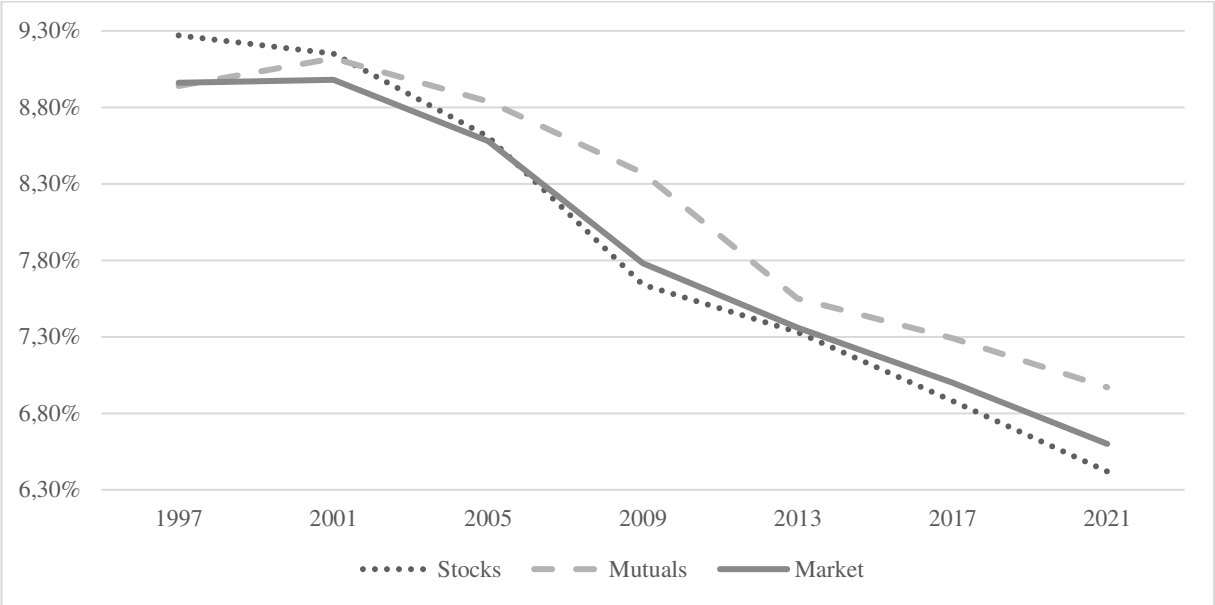

Figure 18: Cost Ratio, Life Insurance

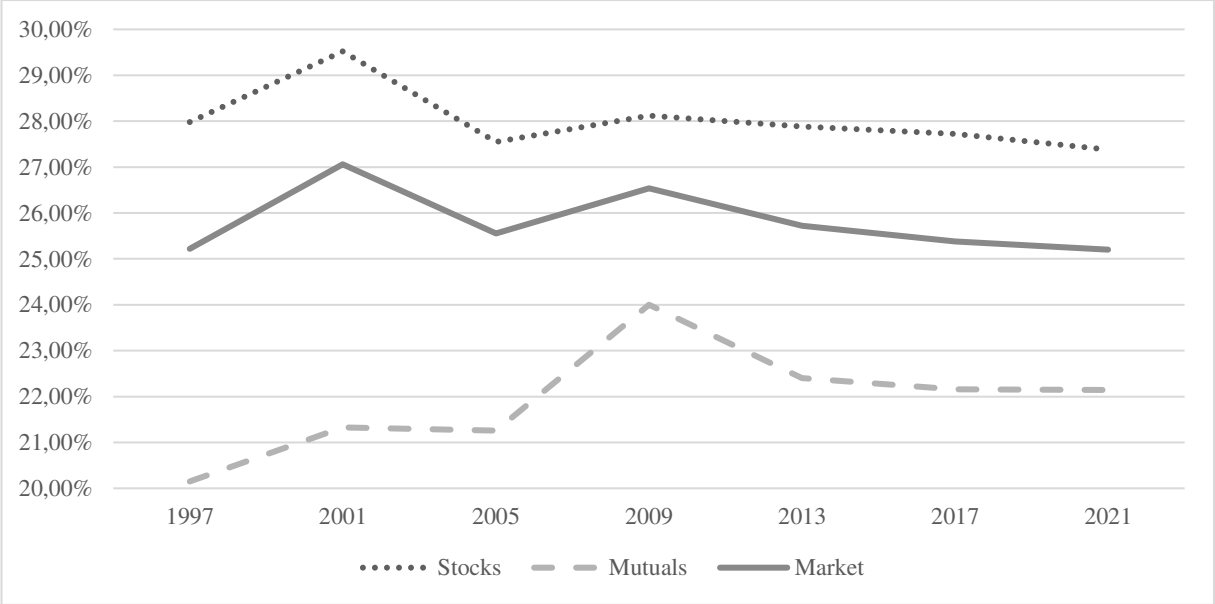

Figure 19: Cost Ratio, Property/Liability Insurance

In the property/liability market, mutuals show a cost advantage over the other aggregates as depicted in *Figure 10*. In administrative costs, the initial and final values of the time series for the aggregates in property/liability differ only slightly from one another. From 1997 to the mid-2000s, all aggregates show an upward trend in administrative cost ratios. A trend reversal has been evident since around 2010. Except for 2009, the administrative expense ratio of mutuals is always the lowest of the aggregates. At 13.25 %, the mutual groups also have the lowest average administrative cost ratio over the sample period.

Acquisition costs have remained fairly constant. There are significant differences between the aggregates in the level of the acquisition cost ratio. In 2021, mutuals have the lowest ratio at 9.55 %, while stocks are at the top with 12.15 %.

3.7.4. Net Investment Return

The net investment return is the quotient of investment income including capital gains and losses, less investment expenses, and the average investment portfolio. This gives the percentage investment result of an insurance company following German Commercial Code logic.

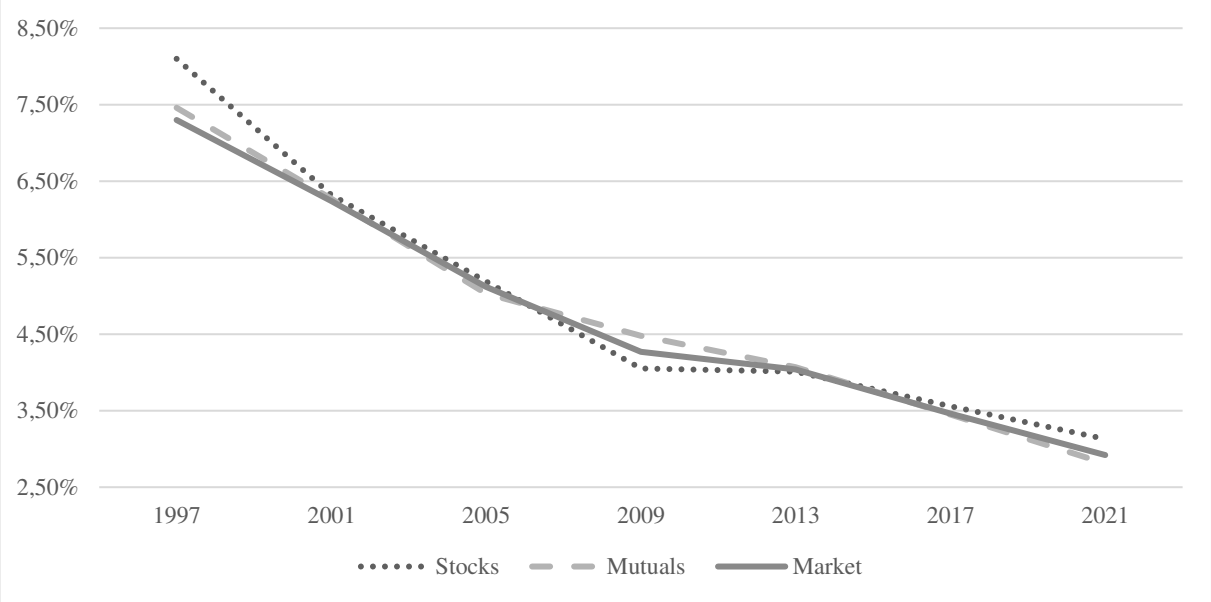

Figure 20: Net Investment Return, Health Insurance

In terms of the reported return on investment (net investment return), the aggregates in health differ only slightly (*Figure 11*). However, the average return for mutual groups (4.64%) is slightly lower than that for stock groups (4.72%). At the aggregate level, no significant differences can be identified between stocks and mutuals. The very similar profile of net investment returns testifies to the fact that the companies in health pursue similar investment policies.

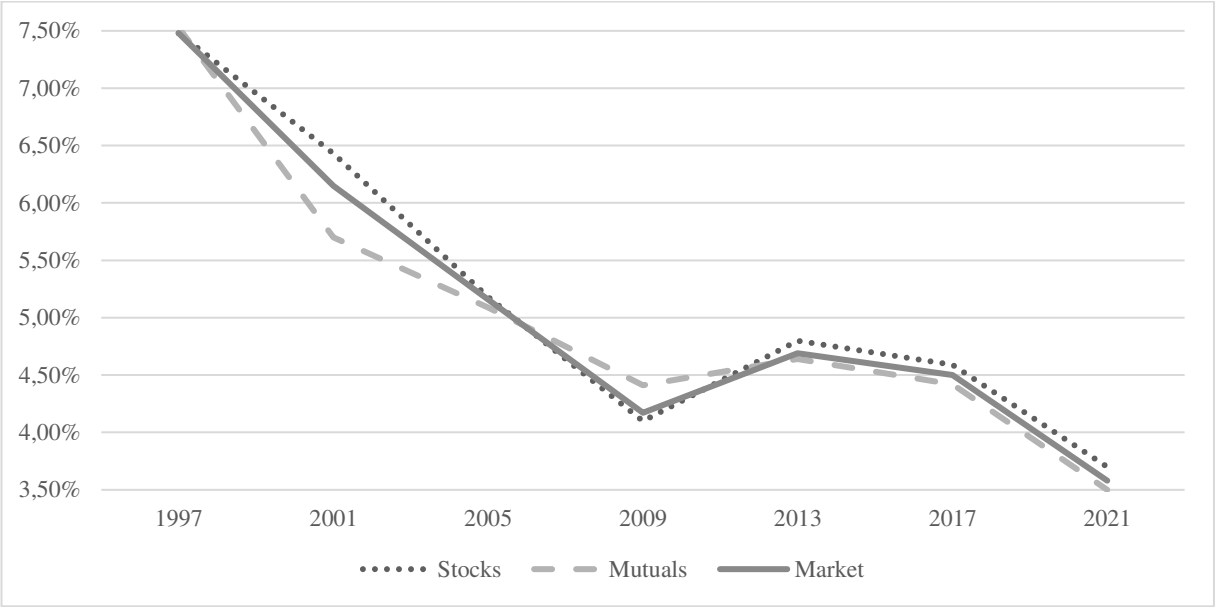

Figure 21: Net Investment Return, Life Insurance

The aggregate net investment return in life insurance shows a long-term decline driven by declining interest rates, as depicted in *Figure 12*. It is also clear that despite low-interest rates, net investment returns are comparatively high. Over 25 years, the market average net interest rate is 4.94%. The stock group returns (5.01%) are higher, although this is mainly influenced by Allianz. Stocks without Allianz (4.88%) and mutuals (4.90%) are at about the same level over the long term. This applies in particular to the more recent past. In the long term, stocks, closely followed by mutuals, have the highest average return on investment in life insurance.

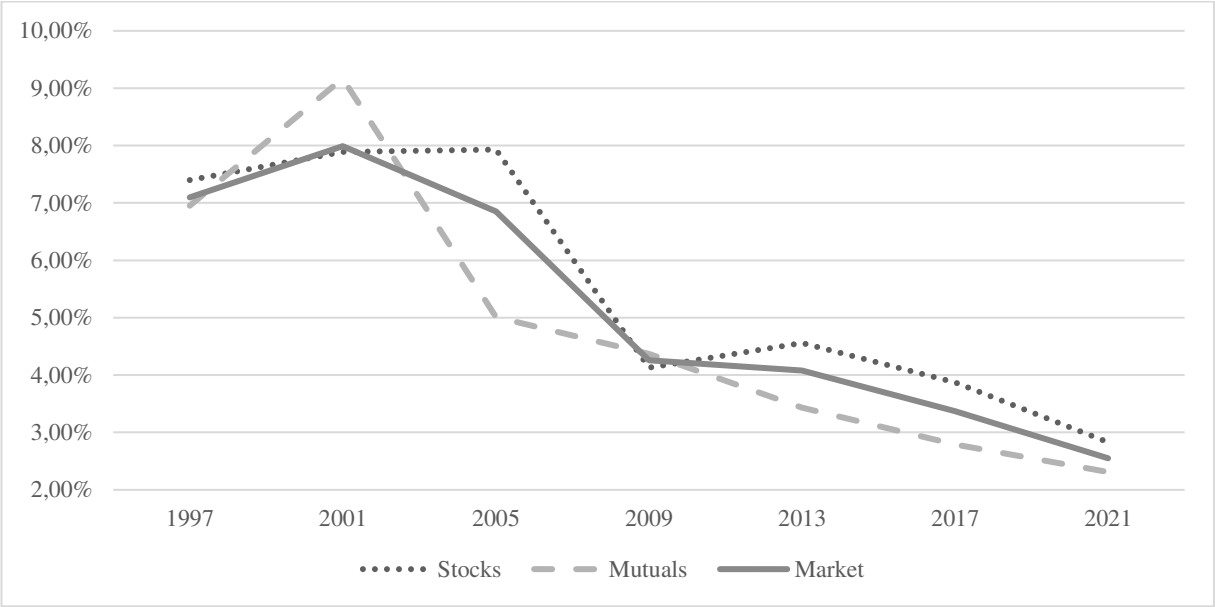

Figure 22: Net Investment Return, Property/Liability Insurance

The development of the net investment return in the property/liability market over time shows a decline over time (*Figure 13*). While changes in the aggregate were somewhat mixed before 2008, the post-crisis period showed a more consistent relation between the net investment returns at stock and mutual groups. The similarity in return profiles suggests that the average investment policy in property/liability is similar for stock and mutual groups. However, the average return of the mutual groups (4.27%) is significantly lower than that of the stock groups (5.49%) and the market (4.94%). The year 2002 stands out in that extreme key ratio values for net investment return ranged from -8.24% to 22.76%.

3.7.5. Security

To analyze the insurers' stability and safety, I examine the equity ratio (equity capitalization in relation to gross premiums written) and the solvency ratio. Higher equity ratios for mutuals are anticipated (Harrington and Niehaus 2003).

In health insurance, the equity ratio shows large differences between the legal form aggregates. On average, mutual group ratios (18.31 %) are much higher than stock group ratios (11.07 %) and the overall market ratios (15.14 %). The stock ratios are declining over the long term, reaching a sample minimum in 2021. In contrast, the equity ratios of mutual groups increase over almost the entire period under review and are consistently the highest of the aggregates (*Figure 14*). For this reason, the market aggregate also grew

over the sample period. The solvency ratios of mutuals are also above the market average in the health sector.

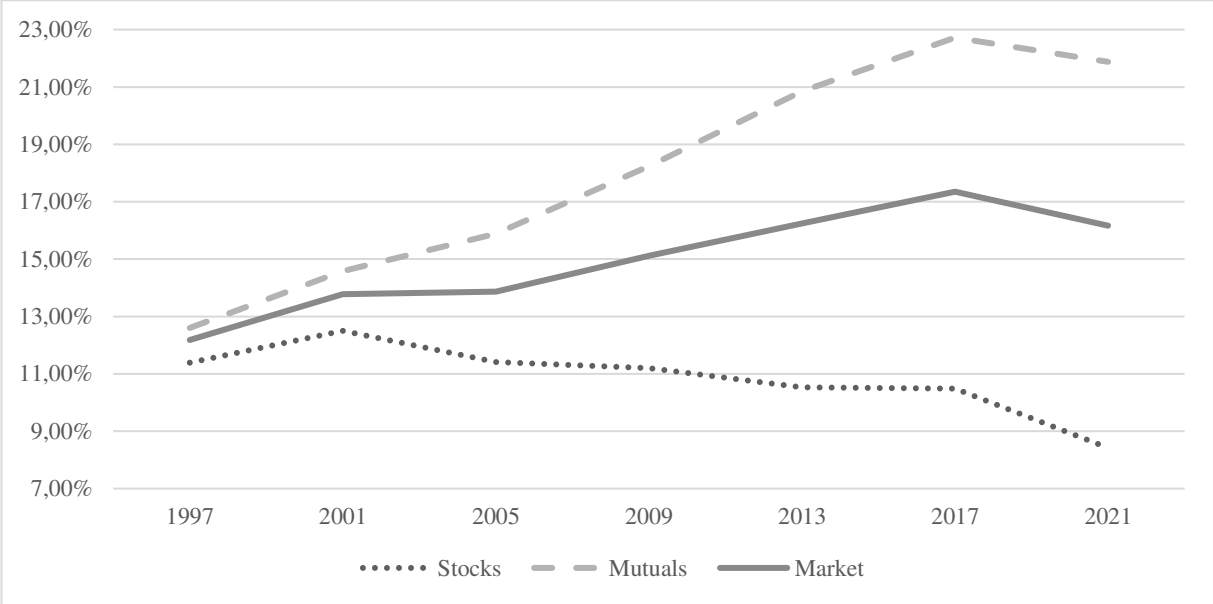

Figure 23: Equity Ratio, Health Insurance

As in the case of health, the current equity ratio is higher for mutual groups than for stock groups in the life insurance market.[14] Mutuals have the highest equity ratios over the entire period under review (*Figure 15*). Stocks partly compensate for their significantly lower equity capitalization by having a comparatively higher capital reserve. The mutual group aggregate also has the highest solvency ratios in life. However, they also exhibit the greatest volatility.

[14] In contrast to health and property/liability, the equity ratio in life does not show equity in relation to premiums, but to the actuarial reserve.

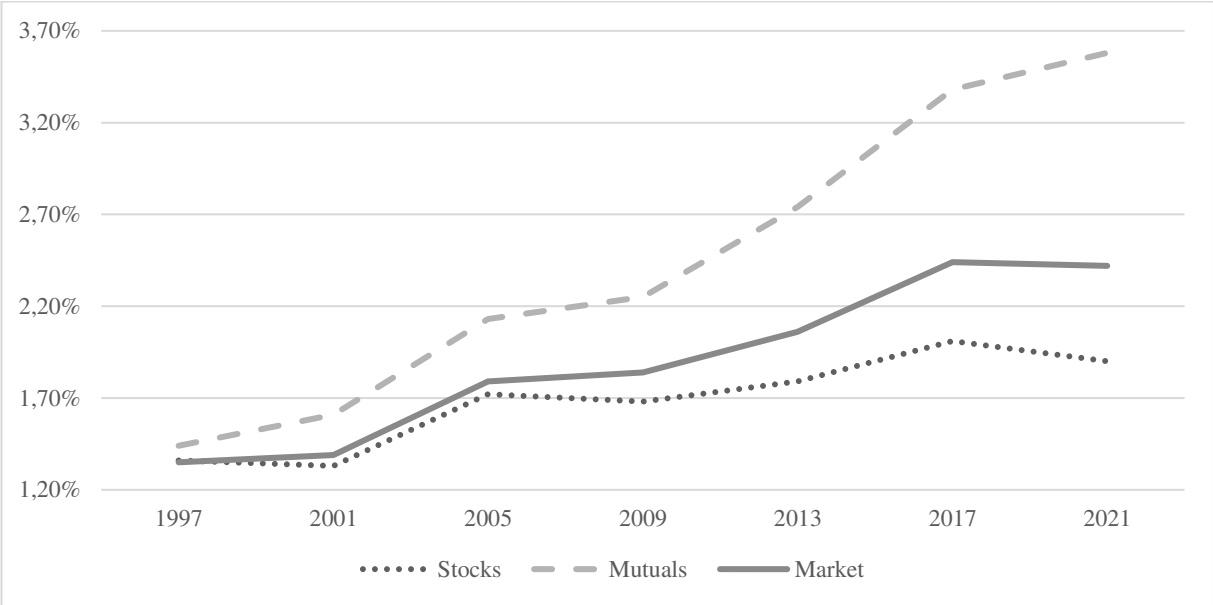

Figure 24: Equity Ratio, Life Insurance

Mutuals (63.06 %) also have an above-average equity ratio in property/liability insurance (*Figure 16*). The legal form aggregates differ significantly in their equity ratios in non-life. The mutual aggregate shows the highest equity ratio over the entire period under review. The equity ratio of stocks is significantly lower than that of mutuals throughout the entire period under review (mean value 33.1 %). In addition, it reaches its minimum for the entire period under review in 2021 at 23.95 %. The solvency requirements are exceeded by all three legal entities. The coverage ratios are very constant. Unlike in life, the high equity base of mutuals in non-life is also reflected in above-average solvency ratios.

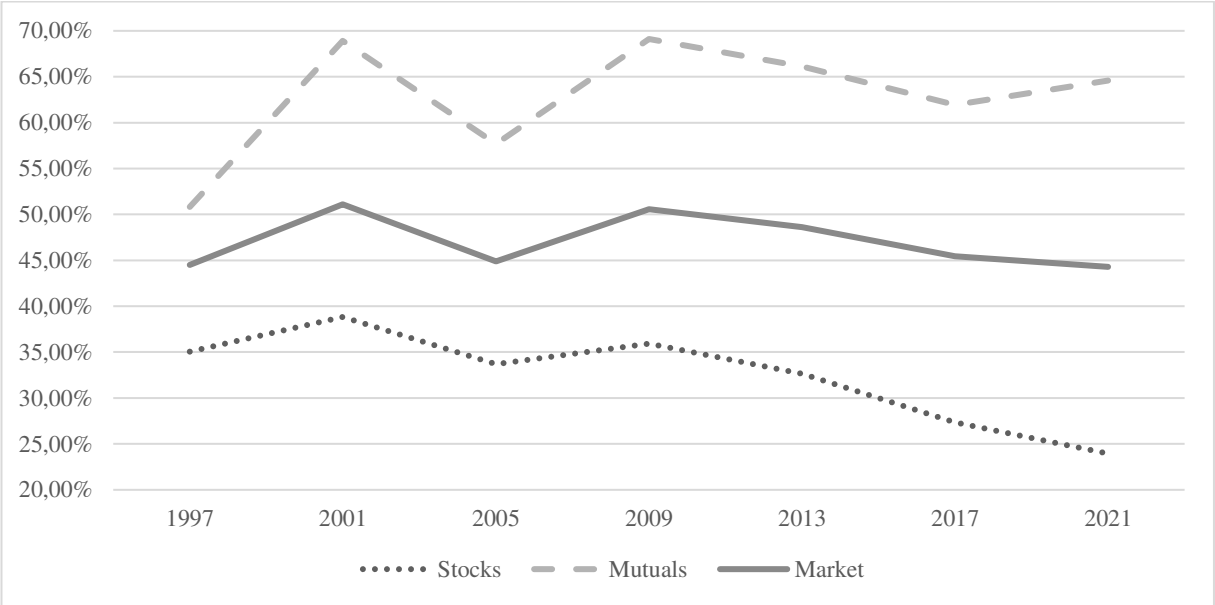

Figure 25: Equity Ratio, Property/Liability Insurance

3.7.6. Return on Revenue

Return on revenue (or return on sales) is the sum of net income/loss for the year and profits transferred to shareholders in relation to gross premiums written. It represents the return on sales from the owner's or company's perspective. Higher values for stocks are inherent in the system, as shareholders must receive an appropriate share of the profits.

In health insurance, the differences between the aggregates are significant on average (stocks 2.16%, mutuals 1.18%), but the level compared with other service sectors is rather low[15]. As expected, stocks are ahead of mutuals in terms of return on revenue. After the financial market crisis in 2008, stock ratios trended upward, reaching a historic high in 2021, as seen in *Figure 17*.

[15] According to the KfW-Bank, the average return on revenue was 4.7% for other service sectors in 2021.

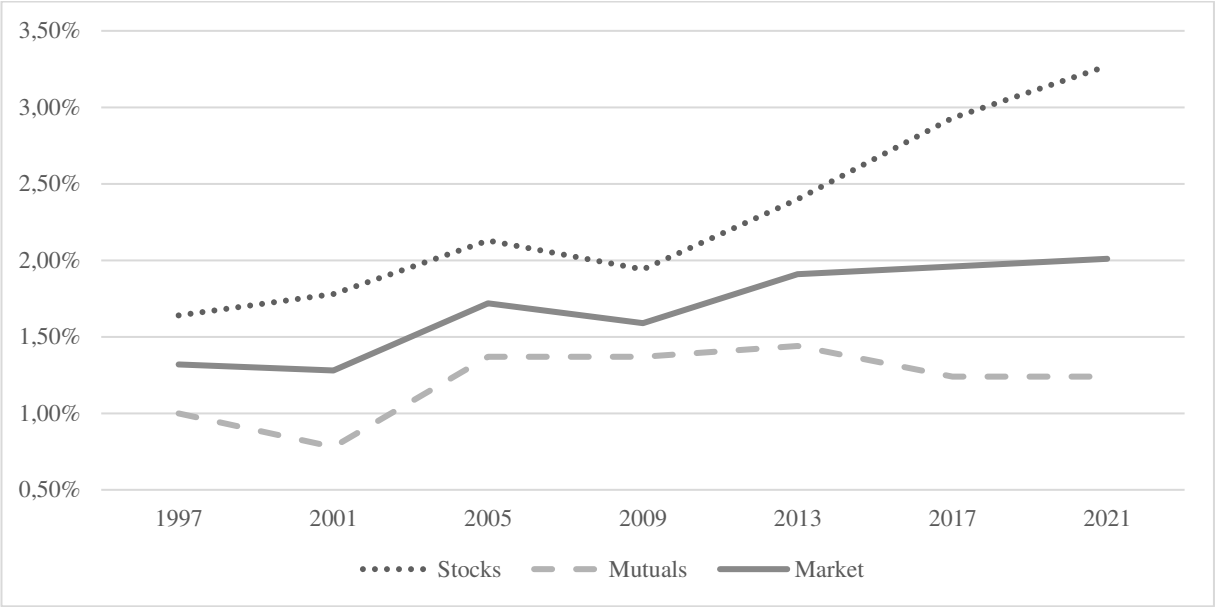

Figure 26: Return on Revenue, Health Insurance

The long-term market average return on revenue in life (1.65%) and health (1.62%) is almost the same. Within the aggregates, there are some clear deviations noticeable (*Figure 18*). As in the case of health insurance, the average return on revenue for life insurance is also higher for stock groups (1.92%). Again, the influence of Allianz is noticeable, as the average return on revenue for stock life insurers without Allianz only reaches 1.63%. In the years after 2002, in the aftermath of the dot-com bubble, the development of the ratios initially showed a significant increase for all aggregates. From 2005 onwards, only the stock groups continued this trend over the long term until a downward development is seen after 2017.

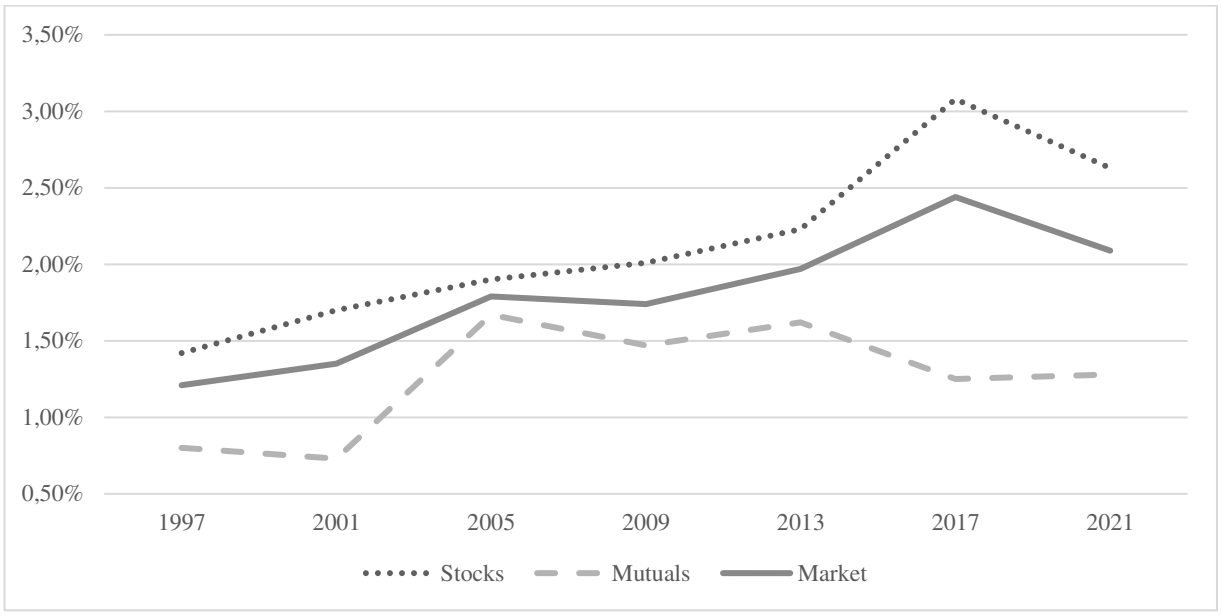

Figure 27: Return on Revenue, Life Insurance

The pattern of health and life can also be seen, to some extent, in property/liability insurance (*Figure 19*), with stock groups (6.39%) showing higher ratios on average than mutual groups (5.30%). The averages are noticeably higher than those in the other two business lines. With a long-term market average of 5.73%, compared with 1.65% in life and 1.62% in health, property/liability has by far the highest return on revenue figures. At the same time, the fluctuation of the return on revenue is much higher in the property/liability market compared to health or life.

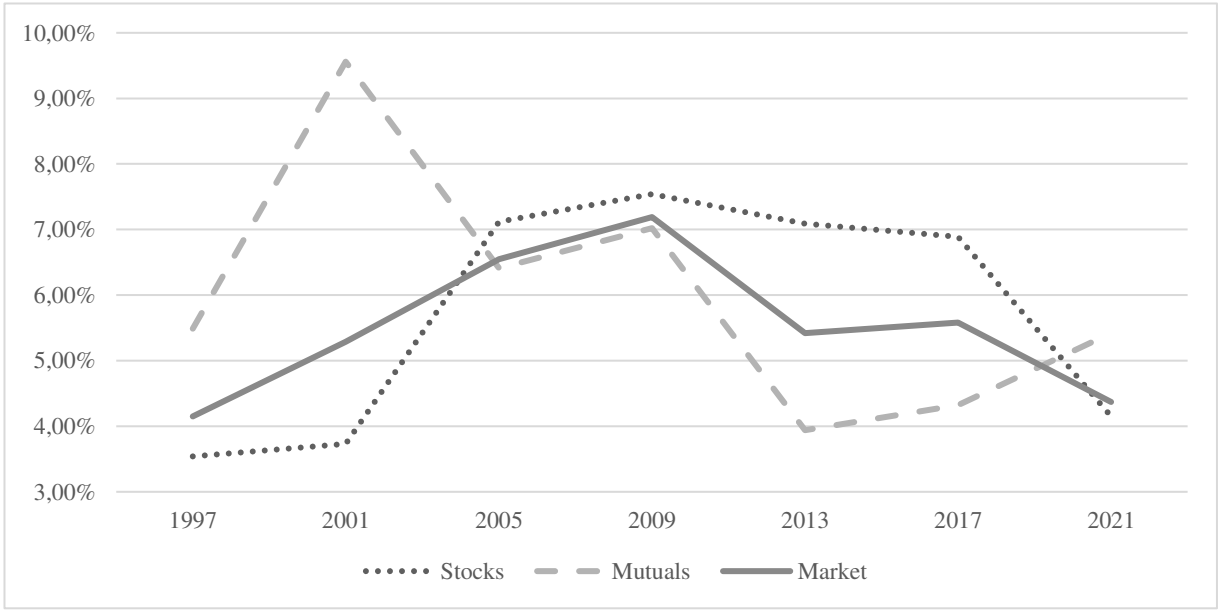

Figure 28: Return on Revenue, Property/Liability Insurance

3.8. Mutual Insurance Perception

Summarizing the results of the analysis of the German insurance market in Section 6, mutual insurers perform well in all parts of the German insurance market. Mutuals significantly increased their market share, especially in the property/liability market. In terms of investment returns no clear difference is visible, as the net investment returns for stocks and mutuals are very similar. The return on revenue disadvantage of mutuals has been decreasing over time. Mutuals show a cost advantage in health and property/liability, influenced by lower administration costs. In life insurance, mutuals have lower acquisition costs than stocks. Success and growth of mutuals do not appear to be achieved at the expense of substance or security, as mutuals show higher equity ratios compared to stocks.

From the perspective of an owner or regulator mutuals perform well. But what does that mean for customers? Does mutuality play an important role for customers when deciding to purchase an insurance contract? As early as the 1960s, experts assumed that most mutual insurance members were unaware that they were members of a mutual insurance company (Zöllner, 1964). The regulation allows advertising of the historical mutual guiding principle if the reciprocity idea is still clearly recognizable (Dreher and Ballmaier 2011). Therefore, revitalization of the mutual idea by emphasizing the actual participation and property rights would seem a potentially attractive and promising strategy for mutuals (Nemson 2014). In any case, the structural advantages for members, which are the basis of the historical success of mutuals, are often ignored today (Kürn 2001). A survey by *Bain & Company* identified price, product transparency, and personal reachability as the most important factors for customers (Bain & Company 2012).

To investigate the perception of mutual insurance companies in the German market today, a survey with 500 participants was conducted at the *University of Cologne*. About 88 % of the respondents held at least one active insurance contract. In total, only 3,31 % of respondents knew if they held an active contract with a mutual insurance company. Over 45 % answered “I don’t know” when asked if they hold a mutual insurance contract. A second question is aimed at the value customers attach to certain attributes when choosing an insurance provider. The interviewees were asked if the following aspects are rather important for them when buying insurance. *Figure 20* depicts the share of “yes” answers. It is evident that “Legal Form” is one of the least important factors in the insurance purchase decision for the respondents. “Safety and Stability”, “Low Prices”, “Transparency”,

"Customer Service" and "Fairness" are important factors for over 80 % of the respondents.

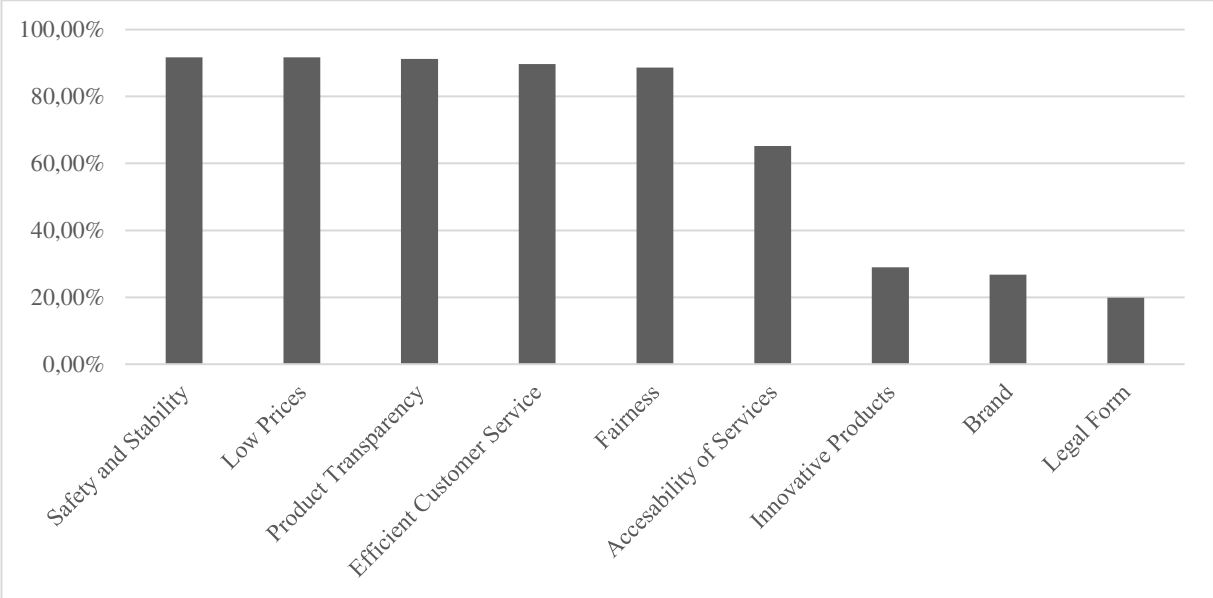

Figure 29: Importance of Attributes in Insurance Purchase

Another question further explored the value the interviewees attached to the legal form. Here only 6 % of responders named the legal form of the insurance company as an important factor. For over 28 %, the legal form was not important when picking an insurance provider. *Figure 21* depicts the answers.

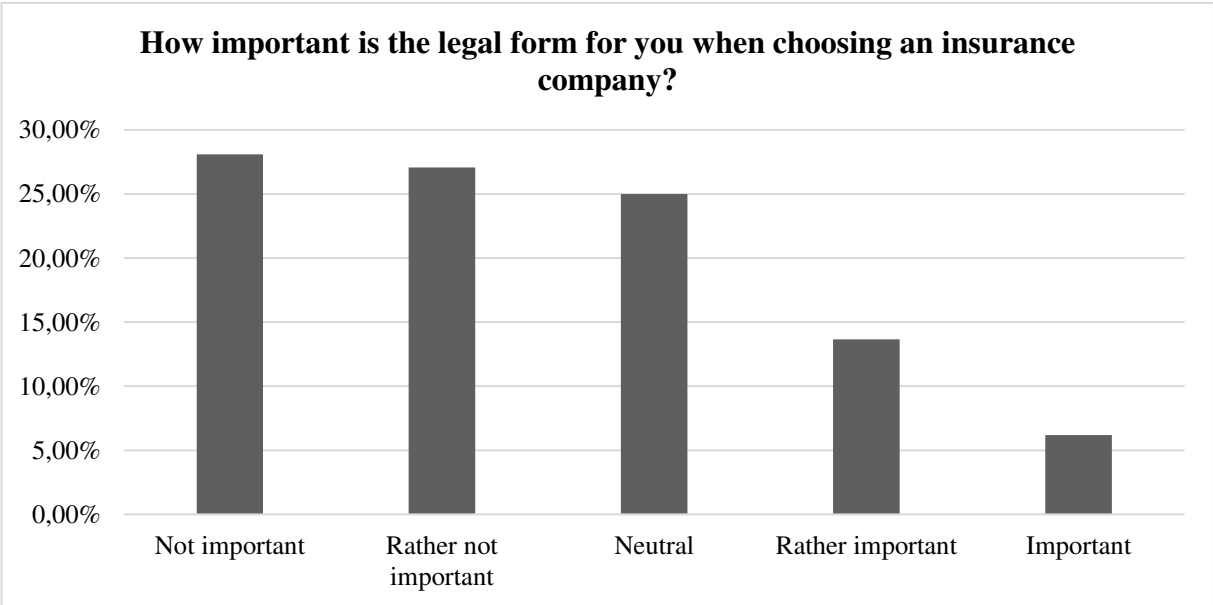

Figure 30: Value attached to „Legal Form"

The next question investigates the self-assessment of the respondents concerning their knowledge of mutual insurance companies. The interviewees were asked if they understand the difference between the legal forms in the German insurance market. Almost 65 % of the respondents said that they do not know the difference at all, while only 8 % were sure they knew the difference between stock and mutual insurers.

The survey clearly shows that most policyholders do not know if they are mutual insurance members and that many customers do not understand the mutual insurance concept. Further, most customers only put a small value on the legal form in their insurance purchase decision. These findings suggest that the group structures in the German insurance market may undermine the value of mutuality for the individual policyholder, as explained in section 5.

3.9. Conclusion

The empirical results indicate that mutual insurance firms show higher growth rates and have lower expense ratios than stock insurers. Mutual groups have won market share from stock groups over the past 25 years. Mutuals also have substantially lower-than-average administrative costs in health and property/liability insurance. Furthermore, the success and growth of mutuals are not achieved at the expense of substance or security. Mutuals have higher equity and cover more solvency ratios.

I examine in the second step how an insurance firm's organizational form is valued by customers. The survey shows that many policyholders only put a small value on the legal form. Customers often do not understand the mutual insurance concept and don't know if they hold an insurance contract with a mutual insurance group. A clear contrast is visible. The scientifically much-emphasized advantage of mutuality is not perceived by the individual policyholder. Despite measurably strong mutual insurance performance, mutuality does not play a vital role in insurance purchase decisions.

I contribute to the literature by updating the investigations of mutual insurance performance. My combination of performance analysis and a survey shows a clear contradiction between mutual insurance performance and perception. This research provides important findings for regulators, managers, and customers of insurance firms, as it sheds light on the differences between mutual and stock insurance corporations and shows the value of mutuality for the individual policyholder. Putting more emphasis on the special features of mutual insurance and educating customers about those features could be a promising

marketing approach for mutual insurers.

This research does suffer from limitations. Many of the respondents in my survey are students and therefore not perfectly representative when examining the main factors in choosing an insurance policy. At the same time, it must be emphasized, that those students have an above average financial literacy. This literacy strengthens the survey results about the low average knowledge about mutual insurance in Germany. The results could function as a starting point for a more detailed examination of the perception of mutual insurance concepts in Germany. A longitudinal study of the investigated German market would be interesting. Further research could also focus on a comparison of the performance/perception contradiction in international mutual insurance, and other facets and dimensions of success could be explored more widely. Furthermore,

3.10. Appendix

Overview of Analysed Mutual Insurance Groups

				Number of Companies				Market Share				
ID	**Name**	**Parent Mutual**	**Gross Written Premiums (million Euro)**	**Non-Life**	**Life**	**Health**	**Total**	**Non-Life**	**Life**	**Health**	**Total**	
								in %	**in %**	**in %**	**in %**	**Rank Whole Market**
1	Debeka	Life	11.390,78	1	1	1	3	1,21	3,86	15,51	5,02	6
2	Talanx	Non-Life	8.945,85	7	5		12	5,45	4,3		3,94	8
3	HUK Coburg	Non-Life	8.059,33	6	2	2	10	6,41	0,83	3,95	3,55	9
4	SIGNAL IDUNA	Life	5.661,89	5	1	1	7	1,65	1,2	7,23	2,49	11
5	ALTE LEIPZIGER - HALLESCHE	Life	4.477,13	1	1	1	3	0,44	2,84	3,12	1,97	12
6	Gothaer	Non-Life	4.313,41	4	1	1	6	2,43	1,34	2,1	1,9	14
7	Continentale	Health	4.171,60	3	2	1	6	1,29	1,29	4,24	1,84	15
8	LVM	Non-Life	3.886,50	1	1	1	3	3,09	0,84	0,9	1,71	16
9	VHV	Non-Life	3.262,09	2	1		3	2,57	1,05		1,44	19
10	DEVK	Non-Life	3.034,40	4	2	1	7	2,44	0,83	0,24	1,34	20
11	HanseMerkur	Health	2.495,04	3	1	3	7	0,24	0,67	3,87	1,1	21
12	Barmenia	Life	2.336,12	2	1	1	4	0,25	0,27	4,39	1,03	22
13	VOLKSWOHL BUND	Life	1.642,62	1	2		3	0,1	1,59		0,72	23
14	WWK	Life	1.294,64	1	1		2	0,15	1,19		0,57	25
15	INTER	Health	936,84	2	1	2	5	0,08	0,1	1,84	0,41	28
16	SDK	Health	910,35	1	1	1	3	0	0,03	2,07	0,4	30
17	LKH	Health	877,61		1	1	2		0,01	2,06	0,39	31
18	Concordia	Non-Life	854,28	1	1	1	3	0,69	0,18	0,18	0,38	32
19	WGV	Non-Life	812,48	2	1		3	0,89	0,04		0,36	33
20	Universa	Health	799,56	1	1	1	3	0,03	0,13	1,53	0,35	34
21	Münchener Verein	Health	777,17	1	1	1	3	0,06	0,16	1,34	0,34	35
22	Stuttgarter	Life	776,01	1	2		3	0,14	0,67		0,34	36
23	LV 1871	Life	727,63	1	2		3	0	0,74		0,32	38
24	Die Bayerische	Life	620,12	1	2		3	0,2	0,45		0,27	39
25	Itzehoer	Non-Life	613,38	1	1		2	0,65	0,05		0,27	40
26	Mecklenburgische	Non-Life	612,28	1	1	1	3	0,53	0,13	0,06	0,27	41
27	VPV	Life	430,81	1	2		3	0,07	0,38		0,19	43
28	IDEAL	Life	403,12	1	1		2	0,01	0,4		0,18	44
29	AGRORISK	Non-Life	286,12	2			2	0,33			0,13	48
30	GVV	Non-Life	228,82	2			2	0,26			0,1	50
31	Uelzener	Non-Life	129,30	1			1	0,15			0,06	56
32	Fahrlehrer	Non-Life	64,90	1			1	0,07			0,03	60
33	Ammerländer	Non-Life	64,45	1			1	0,07			0,03	61
34	GEV	Non-Life	53,21	1			1	0,06			0,02	63
35	OKV	Non-Life	50,56	1			1	0,06			0,02	65
	Sum		**76.000,40**	**65**	**40**	**21**	**126**	**32,07**	**25,57**	**54,63**	**33,48**	

Essay 4: Earnings Quality and Ownership Structures: Evidence from the German Property-Liability Insurance Sector

Rauch, J. & Schuh, F (2024)
Working Paper

Abstract:

We analyse whether an insurance firm's organizational form affects the degree of earnings quality in the German property-liability insurance industry. Using a dataset of 1,856 firm-year observations for the years 2001-2021 and regression analyses, we study differences in the earnings quality of mutual and stock insurance firms. Our results indicate that mutual insurance firms show higher levels of earnings quality. The results hold for various measures of earnings quality and are not affected by macroeconomic conditions. Our findings illuminate the determinants of earnings quality, which can assist various stakeholders in assessing the financial position of insurers.

Keywords: Insurance, Earnings Quality, Earnings Management, Ownership, Mutual Insurance, Stock Insurance

4.1. Introduction

Earnings reports contain important information about a firm's financial performance for analysts, customers, and investors. (Eckles, Halek, and Zhang 2013). In the words of Dechow, Ge, and Schrand (2010): "Higher quality earnings provide more information about the features of a firm's financial performance that are relevant to a specific decision made by a specific decision-maker.". Earnings of higher quality provide internal and external decision-makers with better information when evaluating a company's financial position (Hsu, Huang, and Lai 2019). Quality in earnings reports, however, cannot be taken for granted: Research shows that managers have clear incentives to manipulate their company's reported earnings to reach certain audit and reporting thresholds (Gaver and Paterson 2001). Organizational form has been identified as one of the relevant variables affecting earnings quality, with the influence operating through governance mechanisms and demand effects (Dichev et al. 2013; Wang 2006; Givoly, Hayn, and Katz 2010).

The insurance sector provides a unique setting to further evaluate the impact of the firm's organizational form on the quality of earnings. An insurance company is typically organized either as a stock or as a mutual firm. These forms differ significantly in terms of the roles and incentives of the various stakeholders. The policyholders of mutual insurers are customers and investors of the firm at the same time, while the customer and investor functions are separate in stock insurance companies (Born et al. 1998; Cummins, Weiss, and Zi 1999).[16] Thus, the incentive conflict between customers and owners is internalized in mutuals (Mayers and Smith 1981; Hetherington 1969). On the other hand, stock managers face additional pressure from external investors and pecuniary incentives connected to stock-linked compensation. Thus, managers face different pressures and incentives concerning earnings management, depending on the organizational structure of the company (Mayers and Smith 2013). We study how an insurance firm's organizational form affects the degree of earnings quality in the German property-liability insurance industry. Specifically, we exploit the different behavioural incentives facing managers in mutual and stock insurers to examine the "demand" hypothesis versus the "opportunistic behaviour" hypothesis (Givoly et al., 2010). The demand hypothesis states that stocks have better earnings quality than mutual companies because there is a higher demand for fi-

[16] Managers are separate functions in both stock and mutual firms.

nancial information (Ball and Shivakumar 2005). The opportunistic behaviour hypothesis states that managers of stock companies tend to manipulate earnings more severely than their mutual counterparts (Givoly, Hayn, and Katz 2010; Narayanamoorthy, Page, and Song 2024).

Our research builds on a number of studies that analyse earnings quality and its determinants, such as Basu (1997); Beatty, Ke, & Petroni (2002); Burgstahler & Dichev (1997); Degeorge, Patel, & Zeckhauser (1999); Leuz, Nanda, & Wysocki (2003). Research on earnings management in Germany is mainly focused on the influence of accounting standards (van Tendeloo and Vanstraelen 2005; Zimmermann and Goncharov 2005). Dilger & Graschitz (2015) further examine the influence of the economic sector. Achleitner et al. (2014) investigate earnings management in family firms.

Different manifestations of earnings management have been examined in the US insurance industry (Weiss 1985; Petroni 1992; Beaver, McNichols, and Nelson 2003; Gaver and Paterson 2004; Eckles et al. 2011; M. F. Grace and Tyler Leverty 2012). In contrast, few papers have studied earnings management in the insurance sector outside of the USA. Kelly, Kleffner, and Li (2012) analyse the influence of the employment status of the Appointed Actuary on the accuracy of reserves in the Canadian property-liability insurance sector. We expand the existing research by extending the study of ownership form and earnings quality to the German property-liability insurance sector. We are interested in whether there is a measurable difference in the earnings quality between stock and mutual insurance firms despite both company types facing the same technical legal requirements to report earnings of high quality. To our knowledge, we are the first to examine the influence of organizational form on the degree of earnings quality in the German insurance market.

As a code-law country with a highly regulated market but simultaneously comparatively low investor protection (World Economic Forum 2018), Germany offers a novel setting for inquiry. For our analysis, we use company-level data from German property-liability insurance firms for the years 2001-2021. Our sample contains 1,856 firm-year observations for 124 insurance firms. We use three different measures of earnings quality to analyse differences between mutual and stock insurers: the standard deviation of the insurers' return on equity (ROE), the insurers' loss reserve error, and a measure of the difference between net operating income and net earnings. In addition, we test if additional

firm-level factors and macroeconomic developments impact the degree of earnings quality.

Our results indicate that mutual insurance firms show higher levels of earnings quality, irrespective of the measures used in our analyses. This result is consistent with the opportunistic behaviour hypothesis. Hence, the organizational form is a major determinant of an insurance firm's earnings quality. This result for the German property-liability insurance market is consistent with the findings of Ball & Shivakumar (2005) and Burgstahler et al. (2006) concerning public and private firms. The results are not affected by the inclusion of additional firm-level factors and hold regardless of macroeconomic conditions. Our research is of relevance to various stakeholders. It equips investors and regulators with the tools to interpret published earnings results to better understand a company's underlying true state of health. Further, understanding the truthfulness of earnings is important for customers when choosing a provider of insurance coverage (Schipper and Vincent 2003). Our results provide knowledge on the determinants of earnings quality, hence supporting improved consumer product decisions.

The remainder of this paper is organized as follows: Section 2 discusses existing research concerning the implications of ownership on earnings quality and derives hypotheses for our analysis. Sections 3 and 4 describe our earnings quality measures, the data, and the applied methodology. The empirical analysis of ownership and earnings quality in the German property-liability insurance market is conducted in section 5. In the final section, we explain and interpret the empirical results, and we provide a summary and outlook for future research.

4.2. Existing Research and Derived Hypotheses

Previous studies have established connections between earnings quality and the company's incentives. Earnings quality is influenced by institutional factors, e.g. the choice and implementation of accounting methods, and market forces, such as regulatory demands (Burgstahler, Hail, and Leuz 2006; Teets 2002). Some level of interpretation flexibility is necessary for managers to provide a correct measure of economic performance, as the effect of future economic events, e.g., on pension provisions, has to be estimated (Dechow & Skinner, 2000; Healy & Wahlen, 1998). Management must balance legal

issues and internal motivation when producing reports. Earnings quality can also be affected by unintentional errors or inaccuracies in addition to intentional managerial manipulation (Dechow & Dichev, 2002; Demerjian et al., 2013). There is evidence of managers manipulating earnings in their interest, e.g., income overestimation, and to the detriment of other interest groups (Francoeur, Gargouri, and Shabou 2010; Beneish 2001; Holthausen, Larcker, and Sloan 1995). The accounting implications of the insurance business make insurance companies especially vulnerable to the manipulation of earnings. Insurers do not sell tangible products but a promise to their policyholders (Baker 2003). Hence, most processes are internal and not directly assessable for customers or supervisors (Levitt 1981). Insurers estimate individual and collective probabilities in underwriting, which requires underlying assumptions (Foroughi et al. 2012). These assumptions are at the discretion of the responsible managers and actuaries and leave some legal room for interpretation. On the investment side, the anticipation of unrealized capital gains is incorporated into the insurance business in the form of interest rates (BarNiv 1990). Other central processes in an insurance company rely on predicted future cash flows (Meyer 2004). For example, accruals represent an easy possibility to manipulate income to avoid regulatory costs (McNichols and Wilson 1988; Call et al. 2014).

Earnings quality in insurance is a well-researched field. Anderson (1971) identifies that loss reserve errors have a significant influence on the surplus of policyholders. Petroni (1992) empirically shows that managers of property-liability insurers intentionally bias downward their estimates of claim loss reserves to avoid direct regulatory attention. Her results, documenting financial weakness as a motivation to understate reserves, are confirmed by Grace & Leverty (2012). Gaver & Paterson (2004) investigate the association between the timing of state accreditation and the loss reserving practices of financially struggling insurers in the property-liability industry. They find manipulation of loss reserves to avoid reported losses and to avoid supervisory interventions. Grace & Leverty (2010) show that managers of property-liability insurers manipulate loss reserves to reduce wealth transfer rates and regulatory costs. Kelly, Kleffner & Li (2012) analyse reserve errors in Canadian property-liability insurers and find that larger negative reserve errors are connected to rapid growth while they do not find evidence for reserve manipulation.

The insurance sector provides a unique possibility for the examination of the influence of ownership form on earnings quality, as reported earnings of both for-profit stock companies and non-profit mutual insurance associations are publicly available (Biener and Eling

2012). Both organizational forms are subject to the same reporting and disclosure standards and share the separation of ownership and managerial control (He and Sommer 2010; Demsetz 1983; Berry-Stölzle and Born 2010). In stock insurance corporations the owner, manager, and customer functions are separated (Spiller 1972b). Managers are required to react to the contradicting interests of the owners and customers of an insurance firm. While owners want the management to maximize company profits, policyholders desire inexpensive insurance coverage (Rejda and McNamara 2014; Mayers and Smith 2013; Lamm-Tennant and Starks 1993). The policyholders of mutuals are clients and investors of the firm at the same time (Born et al. 1998; Cummins, Weiss, and Zi 1999). Hence, the incentive conflict between customers and owners is internalized (Mayers and Smith 1981; Hetherington 1969). Managers of mutual insurers face fewer agency problems, as their main target is to act in the best interest of the owners/customers (Hetherington 1969; Lafond and Roychowdhury 2008). There are several research papers on the relationship between ownership structure and earnings quality. Weiss's (1985) investigation shows that loss reserve errors stabilize underwriting results and that stock insurers tend to underreserve more than mutuals. Beaver, McNichols & Nelson (2003) show that mutual property-liability insurers manage loss reserves to avoid losses while private insurance companies do not. Givoly et al. (2010) find that private equity companies have higher earnings quality than public equity firms, driven by managerial incentives to manipulate earnings. Further, Eckles et al. (2011) find that a higher proportion of stock-based compensation for managers increases the degree of earnings management in property-liability insurance companies. We translate these findings to the insurance market, with mutual insurers not being traded on the stock market at all.

The research results considering organizational form and earnings quality are mostly in line with one of two major research hypotheses depicted in Figure 1. The opportunistic behaviour hypothesis states that managers of stock companies tend to manipulate earnings more severely than their mutual counterparts (Givoly, Hayn, and Katz 2010). The management of stock insurers is under continuous pressure by investors to meet or exceed certain financial performance benchmarks (Myers, Myers, and Skinner 2006; Gaio and Raposo 2011; He and Sommer 2011; Barton and Simko 2002). Firms with more predictable and persistent earnings are valued more highly in stock markets, as many decision-makers rely on earnings-based decision heuristics (Lipe 1990; Beatty, Ke, and Petroni 2002; Chaney and Lewis 1995). Also, stock firms may seek lower earnings quality to raise low-cost external financing (Dechow et al., 1996; Givoly et al., 2010). Owners could

also force managers to benefit them at the expense of other stakeholders and conceal these conversion activities via earnings manipulation (Leuz, Nanda, and Wysocki 2003). Furthermore, managerial rewards are often linked to reaching or surpassing earnings thresholds, which naturally generates incentives to overvalue earnings (Degeorge, Patel, and Zeckhauser 1999; Sun 2016). Bonus plans are strongly associated with managers' income-reporting incentives (Healy 1985; Eckles and Halek 2010). Hence, the stock market listing increases the managers' incentives to opportunistically influence financial accounting and reporting methods (Penno and Simon 1986; Healy and Wahlen 1998; Yi and Kim 2006). This leads to the inference that mutual insurers have better earnings quality than their listed stock counterparts (Dhaliwal, Salamon, and Dan Smith 1982). The demand hypothesis follows a different direction. It states that stocks have better earnings quality compared to mutual companies because there is a higher demand for financial information about those companies (Ball and Shivakumar 2005). Discrepancies in earnings quality between the organizational forms represent demand differences. Especially external investors of stocks demand more precise financial information (Givoly, Hayn, and Katz 2010). Hence, stocks need to enhance their accounting and disclosure policies to improve financial transparency. Mutual companies are less influenced by market-based measures of performance, which results in them having lower earnings quality compared to stocks (Ball and Shivakumar 2005).

H1. *Opportunistic Behaviour: Mutuals have better earnings quality compared to stock companies.*

H2. *Demand: Stocks have better earnings quality compared to mutual companies.*

The following part will give an overview of the measures we use to analyse earnings quality after this chapter introduces the research status quo and our hypotheses.

4.3. Measures of Earnings Quality

Multiple approaches exist on how to define a measure of earnings quality (Gissel, Giacomino, and Akers 2005), but there is no normative method in the accounting literature (Defond 2010). It is agreed upon that earnings quality is a multidimensional concept that can only be identified via a combination of proxies (McNichols 2000). The goal of multidimensional measures is to avoid the potential pitfalls of identifying earnings management from published numbers after the possible manipulation (Abdelghany 2005).

Following McNichols' comments on research design issues in earnings management studies, we use measures based on accruals and measures based on earnings distributions (McNichols 2002). Our analysis includes three measures of earnings quality, to take the advantages and disadvantages of different measures into consideration to provide a holistic picture of the insurers' earnings quality[17]: *Standard Deviation of Return on Equity* (*SD(ROE))*, *Loss Reserve Error,* and *Earnings Ratio*:

1. Standard Deviation of Return on Equity (SD (ROE))

We include a measure to control for the variation in the insurers' profitability, as firms with more persistent earnings have more "sustainable" earnings, indicating higher levels of earnings quality, as smooth earnings provide higher earnings informativeness (Dechow et al., 2010).[18] Such measures are simple and consider the idea that managers prefer to present stable earnings to their shareholders and hence manipulate reported accounting numbers. On the other hand, volatile earnings might be due to the firm's fundamental performance, and such measures are therefore unable to disentangle intended earnings manipulation from economic effects.

We include the corrected standard deviation of return on equity (ROE) over the last 5 years as a measure of the variation in the insurers' profitability.[19] ROE is defined as profit divided by average book equity:

$$SD(ROE) = \sqrt{\frac{1}{n-1}\sum_{t=1}^{n}(ROE_t - \overline{ROE})^2}$$

Where *t* denotes the respective year of the observation and *n* the period over which the standard deviation is calculated (*n*=5).[20] We define the insurer's profit as gross profit (pre-tax and before policyholder bonuses and participation) plus (minus) extraordinary losses

[17] Other measures that examine how fully accruals map into cash flows are frequently used in related studies (e.g. Eckles et al. (2014) or Dechow et al. (2010)), but are not included in our analyses due to the absence of suitable cash flow variables in the KIVI database.

[18] Consistent with measures that indicate how fully accruals map into cash flows mentioned above, measures of smoothness that relate earnings volatility to relative to chase flow volatility (Dechow et al., 2010) are not available in our database due to the absence of cash flow information.

[19] As the standard deviation of return on equity might not only explain earnings quality but can also be the consequence of activities in risky lines of business (Cummins, Weiss and Xi, 1999), our analyses include a measure of the volatility of the loss ratio and line of business control variables.

[20] For robustness the standard deviation of return on equity (ROE) over the last 3 years is also examined. The results remain unaffected.

(profits), before changes in the equalization reserve[21] and the provision for contingent losses (Berry-Stölzle and Born 2010). This measure is based on the distribution of earnings as utilized in Burgstahler & Dichev (1997) and Degeorge et al. (1999). As fluctuations of earnings are natural in property-liability insurance (Altuntas, Berry-Stölzle, and Hoyt 2020) this measure is used to identify the lack of variability in the insurers' economic success as an indication for earnings management (Licerán-Gutiérrez and Cano-Rodríguez 2019).

2. Loss Reserve Error:

Related studies have frequently used measures based on accruals or, in the context of insurance, loss reserves (Eckles et al. (2014), Dechow et al. (2010)). Beaver, McNichols, and Nelson (2003) and Grace (1990) show that insurance managers influence accounting profits through accruals reporting by employing loss reserve errors, hence indicating their potential to affect earnings quality. To capture the specifics of the German insurance industry, we use the insurer's run-off result (*Abwicklungsergebnis*) scaled by the previous year's loss reserve to proxy for the insurers' loss reserve error. The *Abwicklungsergebnis* is an indicator of the accuracy of loss reserving and has to be reported in the insurers' financial statements. Hence, it is closely monitored by regulators and managers and thus a commonly observed ratio within the industry. As loss reserves represent a major part of property-liability insurers' balance sheets, this measure provides information on an important potential source of earnings quality. However, it does not disentangle discretionary manipulation from unexpected events which might explain major discrepancies in the loss reserves.

Hence, we include the insurer's reserve run-off (*Abwicklungsergebnis*) result divided by the previous year's loss reserve as an absolute value:

$$Loss\ Reserve\ Error = \left|\frac{LR_{t-1} - CP_t - LR_t}{LR_{t-1}}\right|$$

where LR_{t-1} is the insurer's reserve for losses for claims from the prior year in year t-1, CP_t is the insurer's claims payments for insurance claims from the prior year in year *t* and

[21] The equalization reserve (Schwankungsrückstellung) is a reserve to equalize losses in volatile lines of business. German insurers are required to keep a claims equalization reserve in certain lines, as it is mandated by the German regulatory authority. See Berry-Stölzle & Born (2010) for a comprehensive literature review.

LR_t is the insurer's loss reserve for claims from the prior year in year *t*. This measure is taken from the Jones model (Jones 1991) and several other studies using accrual-based proxies (McNichols and Wilson 1988; Chan et al. 2006; Defond and Jiambalvo 1994; Dechow and Dichev 2002; Basu 1997; Hsu, Huang, and Lai 2019; Francis et al. 2005). We focus on the insurer loss reserve as a central part of actuarial processes and an obvious opportunity for possible manipulation. We utilize a ratio that analyses the settlement of the loss reserve scaled by the previous year's loss reserve.

3. Earnings Ratio*:*

The difference between the firm's true performance based on its business activities and its reported (accounting) earnings is a major determinant of earnings quality. As accounting figures can be manipulated by the management, they do not always reflect the company's true financial situation. As an example, Barnea et al. (1976) state that net income can be smoothed through the accounting manipulation of extraordinary items, hence making ordinary income superior to its net income as a predictor of the firm's future earnings. Similarly, Dempsey et al. (1993) state that managers can interpret a non-operating loss as extraordinary, and then take that loss directly to retained earnings without explicitly labeling it as a component of income to increase earnings, indicating that net income might be very prone to manipulation when compared to the profit from its regular business activities. We therefore include a measure that compares the insurer's net operating income (i.e., the profit from its ordinary business activities) and its net earnings (accounting profit). While the latter can be more easily manipulated by the firm's management, the gross profit provides a better picture of the real economic situation. Hence, a large difference between these two measures can indicate larger degrees of earnings management.

Therefore, we include the insurer's *Earnings Ratio,*

$$Earnings\ Ratio = \left| \frac{\text{Profit from Ordinary Business}_t - \text{Net Earnings}_t}{\text{Gross Written Premiums}_t} \right|$$

defined as the insurer's profit from ordinary business in year t minus its net earnings in

year t,[22] scaled by the insurers' gross written premiums, as an absolute value. While this measure can indicate differences between operating activities and net income that are potentially due to the use of accounting rules, it cannot identify if these differences are justified or applied to manipulate earnings.

After the introduction of our earnings quality measures the following section will explain our data and methodology.

4.4. Data and Methodology

Data

Our analysis includes company-level data from German property-liability insurers included in the KIVI GmbH financial statement database [23] from 2001 to 2021. The data is based on German Commercial Code figures, which are used as a basis for the policyholder surplus participation, dividend specification, and tax determination. We focus on property-liability insurers and exclude life and health insurance firms because of their different business models and different regulatory frameworks.[24] We exclude pure reinsurance firms and commercial insurers due to their different business models (Gores and Rauch, 2021). Insurers with negative or missing total assets, equity, or premiums are dropped. As we focus on comparing stock insurers and mutual insurers, we drop state-owned insurers[25]. A special feature of the German insurance industry is that group structures are characterized by profit-transfer agreements and an insurance firm as a parent

[22] The insurer's profit from ordinary business is calculated as the insurers result from its underwriting (insurance) activities plus/ minus its non-underwriting result (mostly, its investment income). Net earnings is the profit available to shareholders.

[23] The KIVI database includes firm level data for German insurance companies. The database comprises information on the insurers' financial statements, financial ratios and certain non-financial characteristics. The database generally includes firms with GWP above 50 Mio. €, but also contains selected special cases with less than 50 Mio. € GWP. The database covers about 96% of the German market (measured by gross premiums). The database is widely used in the German insurance industry by brokers, analysts and reinsurers. See Altuntas et al. (2021) for additional information on the KIVI database.

[24] Health insurers and life insurers in Germany are obliged to allow their policyholders to benefit from part of the company's profits. For example, in life insurance 90 % of the investment result must be transferred back to the insured following § 140 II VAG ("Insurance Supervision Law") and the Mindestzuführungsverordnung ("Minimum

1. Transfer Directive"). Hence, the incentive differences between mutual and stock companies are strongly reduced in life and health insurance.

[25] State owned insurers (in German "*Öffentliche Versicherer"*) are non-profit organizations under public law to serve a certain region or administrative district in Germany. They are of secondary importance in the German market with a combined market share of about 11%. See Rauch & Wende (2015) for additional information.

company (Piojda 1997). Furthermore, many stock insurance companies are not publicly traded but are completely owned by another insurance firm. Those companies are typically stock insurers in one business line that are completely held by a mutual insurance company of another line. Because of these circumstances in our analysis those stocks, which are predominantly owned by mutual insurance companies are assigned to the organizational form of the controlling firm. To reduce the impact of extreme outliers, variables are winsorized at the 1 and 99 percentiles. Our final sample contains 1,856 firm-year observations for 124 insurance firms.[26] All variables and their definitions are provided in Table I.

[insert Table I here]

Methodology

To analyse the impact of the insurers' organizational form on the degree of earnings management, we estimate the following OLS regression:

$$Earnings\_Quality_{i,t} = \beta_0 + \beta_1 * \text{Mutual}_{i,t} + \varepsilon_{i,t} \qquad (1)$$

where *Earnings_Quality*$_{i,t}$ denotes a measure of earnings quality (*SD(ROE), Loss Reserve Error* or *Earnings Ratio*) of the insurance firm *i* in year *t*. The model is estimated for each measure of earnings quality separately. *Mutual*$_{,t}$ is a dummy variable equal to one if insurer *i* is a mutual insurance company (and zero otherwise). For robustness, all regressions are estimated with and without time-fixed effects.[27] Bootstrapped standard errors are used to overcome issues on serial correlation in our panel data. We control for firm-specific factors that might explain the degree of earnings quality in addition to the insurers' organizational form as an additional test for robustness (Kang and Sivaramakrishnan 1995; Hribar and Nichols 2007). We, therefore, extend model (1) as follows in additional OLS regression analyses:

$$Earnings\_Quality_{i,t} = \beta_0 + \beta_1 * \text{Mutual}_{i,t} + \beta' Control + \varepsilon_{i,t} \qquad (2)$$

where *Control* denotes a vector of firm-specific variables. The vector includes *Assets*, a

[26] Not all measures of earnings quality and control variables are available for all insurance firms in our analyses. Hence, the amount of observations differs in our analyses in Table III-V, depending on the measure of earnings quality and the control variables used.

[27] Our regressions do not include firm fixed effects due to the time-invariance of our main variable of interest, *Mutual*.

measure of companies' size, defined as the natural logarithm of the firms' total book assets. Following Berry-Stölzle, Eastman, and Xu (2018) and Eckles, Halek, He, Sommer, and Zhang (2011), we assume that firm size has a considerable effect on the degree of earnings quality. Larger firms are usually more complex and engaged in a wider range of activities than smaller firms (Beck, Demirgüç-Kunt, and Levine 2006; Laeven and Levine 2007). This provides more possibilities for managing earnings. On the other hand, larger firms usually have stronger governance mechanisms and are more closely monitored by regulators and investors. This makes it more likely to report earnings that truly represent the insurer's activities. In addition, we include *Risky Assets*, a measure of the insurer's exposure to volatile assets (equity investments divided by book investments), because insurers with a higher share of *Risky Assets* require higher capital buffers in case their investments show negative developments (Cummins and Nini 2002). This increases their incentives to report earnings in a favourable way that keeps their capital at sufficient levels.

Moreover, an insurance firm's profitability is an important determinant of earnings management (Eckles et al. 2011). Thus, we measure their operational profitability by the firms' *Combined Ratio* (the insurers' losses and expenses divided by premiums). Apart from underwriting insurance risks, insurance firms generate their earnings from their investments (Spellman, Witt, and Rentz 1975). In case their investments provide a relatively low level of income, their overall earnings are reduced. Hence, management is more prone to manage their earnings in a way that counteracts the negative development of the investment income. We control for the insurers' investment income, measured by *Yield* (the insurer's investment result divided by average book investments[28]). We further implement control variables to verify that the results can be directly compared and are not influenced by differing managerial behaviour between mutual and stocks in underwriting and investment. Moreover, we include variables related to the loss ratios as well as underwriting composition control variables to ensure that our results are not affected by different product mixes within mutuals and stocks. Cummins, Weiss, and Xi (1999) state that stock insurers are more active in lines of business where managers must be given a relatively large amount of discretion in pricing and underwriting, e.g. commercial

[28] The insurer's investment result is defined as income from investments minus expenses from investments. Book investments include the book values of the insurance firm's investments, that is, real estate, shares in affiliated companies, participations in companies, stocks, fixed-income securities and other investments.

coverages. Such lines are usually riskier and hence provide more volatile earnings. We therefore include the standard deviation in insurance company loss ratios (*SD Loss Ratio*, defined as the standard deviation of the loss ratio over the last 5 years) as well as line of business control variables for volatile lines. In particular, we include *%Liability*, *%Homeowner*, *%Legal*, *%Fire,* and *%Household*, all defined as the ratio of GWP (direct) in the respective line of business (liability, homeowner, legal, fire, and household) divided by total GWP (direct).[29]

In addition, we test if the macroeconomic development impacts the degree of earnings quality. In poor macroeconomic environments, a firm's profitability might deteriorate, which incentivizes earnings management and might therefore affect the insurer's earnings quality. Shen & Chih (2005) find that a higher gross domestic product decreases the degree of earnings management in the banking sector. Though the property-liability insurance industry is not as sensitive to economic conditions as the banking industry because the demand for non-life insurance is relatively inelastic (Baluch, Mutenga, and Parsons 2011), its performance is still linked to the aggregate economy. For example, investments such as equity and bond investments lose value, and insurer's claim levels tend to rise generally in an economic downturn (Baluch, Mutenga, and Parsons 2011), which has a negative effect on the insurers' level of profitability. We, therefore, extend model (2) as follows in additional regression analyses:

$$Earnings\_Quality_{i,t} = \beta_0 + \beta_1 * \text{Mutual}_{i,t} + \beta_2 * \text{GDP}_t + \beta' Control + \varepsilon_{i,t} \qquad (3)$$

Where *GDP* denotes the German gross domestic product (GDP) growth rate in year *t*.[30] We use GDP because it is the most important measure of the macroeconomic development of a country (Chen et al. 2020; J. V. Henderson, Storeygard, and Weil 2012).[31] We use the official GDP Growth rate provided by the German Federal Statistical Office.[32]

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[29] The KIVI Database includes information on the following lines of business: accident, liability, motor vehicle liability, other motor vehicle, fire, household, homeowner, legal and rest (residual category).

[30] In these regressions, year fixed effects are not included due to the inclusion of yearly gdp measures, causing strong multicollinearity issues in these regressions.

[31] In addition, we conduct a robustness test to analyse if our results hold if we drop small firms (insurers with GWP less than 100 Mio. €). We assume that larger firms are more complex and opaque, hence making large firms more prone to manage their earnings when compared to smaller firms. The results remain unaffected and are available upon request.

[32] https://www.destatis.de.

4.5. Results

Summary Statistics

Table II provides summary statistics for all variables used in our analyses. The table indicates a certain degree of variance between the measures of *Earnings Quality* in Panel A, as shown by the standard deviation. Moreover, the table shows that around 50% of property-liability insurers in our sample are mutual insurance companies (indicated by *Mutual Dummy* in Panel B). In addition, our dataset includes a wide range of different business models, as the control variables in Panel B vary widely.

[insert Table II here]

Empirical Results

Table III presents the empirical results for equation (1) for all property-liability insurers in our dataset for the years 2001-2021. Columns (A), (C), and (E) include the results for the three measures of earnings quality in our analyses: Column (A) includes the results for equation (1) using *SD(ROE)* as the dependent variable, while columns (C) and (E) use *Loss Reserve Error* and *Earnings Ratio*, respectively. The results for both models are also shown including time-fixed effects in columns (B), (D), and (F).

[insert Table III here]

Our results provide evidence that mutual insurance firms show higher levels of earnings quality, as indicated by the negative coefficients of *Mutual* (recall that a higher value of the dependent variable suggests poorer earnings quality). The results are highly significant and show that mutual insurers show lower levels of *SD(ROE)*, lower *Loss Reserve Error,* and lower differences between net operating profit and economic profit (as indicated by the *Earnings ratio*). The results are robust to the inclusion of time-fixed effects, as the coefficients of *Mutual* and their significance in columns (B), (D) and (F) remain very similar to those in columns (A), (C) and (E). Hence, our results provide evidence for the opportunistic behaviour hypothesis (H1), indicating that managers of mutual insurance companies tend to manipulate earnings less severely than their stock counterparts. The findings are consistent with the results from other sectors, such as Givoly *et al.* (2010), who find that privately held equity firms have a lower propensity to manage income than publicly held equity firms.

Various robustness tests support the findings of our empirical analysis. First, as indicated in Table IV, our results are not affected by the inclusion of additional firm-level factors.

The coefficients on the *Mutual* variable across specifications remain very similar to those in Table III concerning the direction and the levels of significance. The coefficients are still negative and highly significant, hence providing empirical evidence that mutual insurance firms show higher levels of earnings quality.

[insert Table IV here]

Moreover, our results hold independent of the macroeconomic conditions, as shown by the results in Table V. The coefficient of *Mutual* remains significantly negative for all three measures of *Earnings Quality*, while the coefficient of *GDP* is insignificant. Hence, the macroeconomic environment appears to play a subordinated role in explaining insurance firms' earnings quality, while their organizational form is a major determinant. The results again support the opportunistic behaviour hypothesis. Managers of stock companies tend to manipulate earnings more severely than their mutual counterparts due to incentive differences caused by investor performance pressure. Mutual insurance managers seem to have weaker manipulation incentives than managers of stock insurers.

[insert Table V here]

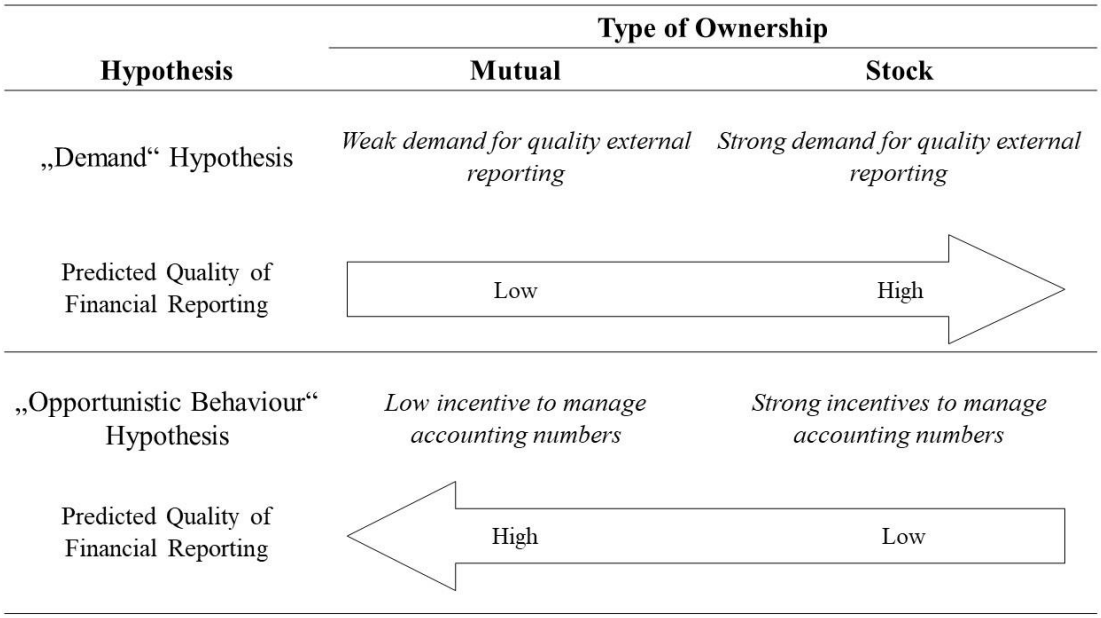
4.6. Conclusion

Reported earnings of higher quality help decision-makers properly evaluate a firm's financial success. An insurance company's organizational form (e.g., stock or mutual), is a relevant factor influencing a company's earnings quality in the US, as shown in prior research. We examine whether an insurance firm's organizational form affects the degree of earnings quality in the German property-liability insurance industry by analyzing differences between mutual and stock insurers with respect to various measures of earnings management. Moreover, we test whether this relationship is affected by the macroeconomic environment. We examine the "demand" hypothesis versus the "opportunistic behaviour" hypothesis that is derived from different behavioural incentives for managers of mutual and stock insurers. Using a dataset of 1,856 firm-year observations for 124 German property-liability insurance firms for the years 2001-2021, our results indicate that mutual insurance firms show higher levels of earnings quality, providing evidence for the opportunistic behaviour hypothesis. The results hold regardless of the measure of the insurance firm's earnings quality and the macroeconomic conditions. Our findings are consistent with existing empirical results, e.g., Ball & Shivakumar, (2005) and Burgstahler et al. (2006). Our research does suffer from limitations. While we use different control

variables, we cannot exclude the possibility that other factors (such as management's behaviour or the firms' internal accounting systems and governance) have a substantial effect. However, such measures are not publicly available. A further examination of aggregate data at the group level would give additional insights into earnings management practices in insurance groups and the role of group structures' profit-transfer agreements. We contribute to the literature by expanding existing research to the German insurance industry with its special ownership structures. This provides an important contribution to the literature that examines the differences between mutual and stock insurance companies. Reported earnings and financial ratios derived from these reports are a widespread heuristic, used when the financial situation of a company is evaluated as an investment opportunity or provider of insurance coverage. Our research provides important findings for investors, regulators, and customers of insurance firms, as it sheds light on the liability of earnings reports.

4.7. Figures

Figure 31: Type of Ownership and Expected Quality of Financial Reporting



Note: Own illustration based on Givoly et al., 2010

4.8. Tables

Table I: Variables

Variable	Description
SD(ROE)	The standard deviation of return on equity (ROE) over the last 5 years. ROE is defined as economic profit divided by average book equity
Loss Reserve Error	The insurer's reserve run-off results divided by previous year's loss reserve as an absolute value
Earnings Ratio	The insurer's profit from ordinary business minus its net earnings, scaled by the insurers' gross written premiums, as an absolute value
Mutual	A dummy variable equal to 1 if the firm is a mutual insurance firm
Assets	The natural logarithm of the insurer's total book assets
Risky Assets	The insurer's equity investments divided by book investments
Yield	The insurer's investment result divided by average book investments
Combined Ratio	The insurers' losses and expenses divided by premiums
SD Loss Ratio	The standard deviation of the loss ratio over the last 5 years.
% Liability	The ratio of GWP (direct) in liability divided by total GWP (direct)
% Homeowner	The ratio of GWP (direct) in homeowner divided by total GWP (direct)
% Legal	The ratio of GWP (direct) in legal divided by total GWP (direct)
% Fire	The ratio of GWP (direct) in fire divided by total GWP (direct)
% Household	The ratio of GWP (direct) in household divided by total GWP (direct)

Notes: The table provides the variables and their definitions used in our analyses.

Table II: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Panel A: Measures of Earnings Quality					
SD(ROE)	1,489	14.4	13.2	0.6	92.3
Run-off result	1,504	10.5	7.5	0	43.1
Earnings Ratio	1,248	6.1	36.6	0	370.0
Panel B: Control Variables					
Mutual	1,856	0.5	0.5	0	1
Assets	1,856	5.8	1.5	2.5	9.9
Risky Assets	1,856	22.5	18.2	0	80.3
Yield	1,856	3.6	2.3	-1.7	14.4
Combined Ratio	1,856	94.8	11.4	57.0	133.0
SD Loss Ratio	1,856	5.6	5.1	0	29.5
% Liability	1,856	0.1	0.1	0	0.6
% Homeowner	1,856	0.1	0.1	0	0.3
% Legal	1,856	0.1	0.3	0	1
% Fire	1,856	0.0	0.0	0	0.3
% Household	1,856	0.0	0.1	0	0.3

Notes: The table shows summary statistics for the firm-level variables used in the regression analyses. The variables are defined in Table I. All variable values are reported over the 2001 to 2021 time period. Obs denotes the number of observations. Mean denotes the respective mean of the variable. Std. Dev. denotes the standard deviation. Min and Max denote the minimum and maximum observation for each variable.

Table III: Regression results: Baseline regression analyses

Dependent Variable:	(1) SD(ROE)	(2) SD(ROE)	(3) Loss Reserve Error	(4) Loss Reserve Error	(5) Earnings Ratio	(6) Earnings Ratio
Mutual	**-4.096*** **	**-4.022*** **	**-0.883** **	**-0.884** **	**-7.769*** **	**-7.261*** **
	(0.623)	**(0.645)**	**(0.444)**	**(0.421)**	**(2.335)**	**(1.913)**
Constant	16.563***	22.715***	10.977***	11.296***	10.538***	18.692**
	(0.495)	(2.111)	(0.337)	(1.300)	(2.233)	(8.893)
R^2	0.024	0.063	0.003	0.010	0.011	0.036
Adjusted R^2	0.023	0.051	0.003	-0.004	0.010	0.019
Time fixed effects	No	Yes	No	Yes	No	Yes
Observations	1,489	1,489	1,504	1,504	1,248	1,248

*Notes: The table shows the results of regression analyses from Equation 1 for all insurers in our sample for the years 2001-2021. The dependent variable is denoted in the second row. Variables are described in Table I. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Standard errors are bootstrapped in all regressions.*

Table IV: Regression results: Robustness test including firm-level factors

Dependent Variable:	(1) SD(ROE)	(2) SD(ROE)	(3) Loss Reserve Error	(4) Loss Reserve Error	(5) Earnings Ratio	(6) Earnings Ratio
Mutual	**-4.605*** **	**-4.531*** **	**-1.329*** **	**-1.306*** **	**-10.681*** **	**-10.168*** **
	(0.535)	**(0.669)**	**(0.304)**	**(0.338)**	**(3.375)**	**(3.024)**
Assets	0.132	0.086	-1.233***	-1.205***	3.627***	3.639***
	(0.186)	(0.218)	(0.112)	(0.138)	(1.026)	(1.322)
Risky Assets	-0.001	-0.004	-0.010	-0.007	0.204***	0.198**
	(0.017)	(0.018)	(0.013)	(0.013)	(0.076)	(0.092)
Yield	0.394*	0.251	-0.004	-0.051	1.760***	1.558*
	(0.207)	(0.295)	(0.091)	(0.102)	(0.554)	(0.823)
Combined Ratio	0.104**	0.120***	-0.182***	-0.197***	0.046	-0.023
	(0.047)	(0.046)	(0.025)	(0.023)	(0.101)	(0.095)
SD Loss Ratio	1.126***	1.117***	0.172***	0.182***	-0.235	-0.159
	(0.120)	(0.121)	(0.054)	(0.065)	(0.215)	(0.189)
% Liability	-5.671*	-4.396	-8.460***	-8.543***	-5.090	-3.828
	(2.895)	(3.022)	(1.745)	(1.619)	(4.822)	(6.287)
% Homeowner	-28.698***	-24.132***	6.584	8.534	-51.605***	-40.956*
	(6.312)	(8.616)	(4.901)	(5.849)	(18.717)	(21.631)
% Legal	-4.677***	-4.597***	-5.947***	-5.788***	-14.319***	-12.516***
	(0.896)	(1.042)	(0.456)	(0.584)	(4.127)	(4.669)
% Fire	32.183*	29.063*	-1.376	-3.296	74.645***	66.495**
	(17.114)	(17.073)	(4.504)	(5.922)	(25.474)	(29.279)
% Household	17.574***	11.420	-2.166	-3.653	74.694***	66.940**
	(6.806)	(6.947)	(6.749)	(7.088)	(27.506)	(31.269)
Constant	0.155	3.421	36.094***	38.396***	-21.328**	-10.033
	(4.788)	(5.702)	(2.359)	(2.769)	(9.935)	(12.955)
R^2	0.228	0.254	0.272	0.282	0.064	0.083
Adjusted R^2	0.222	0.240	0.266	0.267	0.056	0.059
Time fixed effects	No	Yes	No	Yes	No	Yes
Observations	1489	1489	1504	1504	1248	1248

*Notes: The table shows the results of regression analyses from equations 2 for all insurers in our sample for the years 2001-2021. The dependent variable is denoted in the second row. Variables are described in Table I. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Standard errors are bootstrapped in all regressions.*

Table V: Regression results: Robustness test including macroeconomic development

Dependent Variable:	(1) SD(ROE)	(2) Loss Reserve Error	(3) Earnings Ratio
Mutual	**-4.603*** **	**-1.333*** **	**-10.688*** **
	(0.646)	**(0.361)**	**(3.071)**
Assets	0.132	-1.233***	3.625**
	(0.219)	(0.125)	(1.479)
Risky Assets	-0.001	-0.010	0.204**
	(0.019)	(0.014)	(0.084)
Yield	0.387*	-0.001	1.766**
	(0.219)	(0.083)	(0.794)
Combined Ratio	0.105**	-0.182***	0.046
	(0.048)	(0.026)	(0.107)
SD Loss Ratio	1.129***	0.172**	-0.236
	(0.133)	(0.071)	(0.185)
% Liability	-5.670	-8.462***	-5.103
	(4.041)	(1.922)	(5.780)
% Homeowner	-28.601***	6.497	-51.767**
	(7.554)	(4.622)	(21.724)
% Legal	-4.682***	-5.946***	-14.329***
	(0.889)	(0.584)	(4.962)
% Fire	31.994**	-1.289	74.785***
	(15.450)	(5.077)	(27.678)
% Household	17.452***	-2.075	74.827**
	(6.459)	(6.151)	(29.914)
GDP Growth	-0.114	0.042	0.084
	(0.136)	(0.080)	(0.331)
Constant	0.379	36.011***	-21.514*
	(4.891)	(2.684)	(13.078)
R^2	0.228	0.272	0.064
Adjusted R^2	0.222	0.266	0.055
Time fixed effects	No	No	No
Observations	1489	1504	1248

*Notes: The table shows the results of regression analyses from equation 3 for all insurers in our sample for the years 2001-2021. The dependent variable is denoted in the second row. Variables are described in Table I. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Standard errors are bootstrapped in all regressions.*

4.7. Appendix

English Translation, German Commercial Code, Equity and Liabilities

€ thou					
as of 31 December					
EQUITY AND LIABILITIES					
A. Shareholders' equity					
I. Issued capital		1 169 920			1 169 920
Less: mathematical value of own shares		5 003			684
			1 164 917		1 169 236
II. Additional paid-in capital			28 035 065		28 035 065
III. Revenue reserves					
1. Statutory reserve		1 229			1 229
2. Other revenue reserves		5 995 557			6 802 397
			5 996 786		6 803 626
IV. Net earnings			4 929 827		5 021 300
				40 126 595	41 029 227
B. Subordinated liabilities	12, 15			17 053 842	15 780 844
C. Insurance reserves	13				
I. Unearned premiums					
1. Gross		2 360 125			2 259 274
2. Less: amounts ceded		23 418			20 870
			2 336 707		2 238 404
II. Aggregate policy reserves					
1. Gross		1 824 034			2 005 106
2. Less: amounts ceded		1 439 513			1 510 103
			384 521		495 003
III. Reserves for loss and loss adjustment expenses					
1. Gross		18 439 173			18 184 772
2. Less: amounts ceded		3 465 648			3 431 905
			14 973 525		14 752 867
IV. Reserves for premium refunds					
1. Gross		38 694			42 685
2. Less: amounts ceded		-			8
			38 694		42 677
V. Claims equalization and similar reserves			2 520 837		3 006 370
VI. Other insurance reserves					
1. Gross		25 469			59 985
2. Less: amounts ceded		-			-
			25 469		59 985
				20 279 753	20 595 306
D. Other provisions	14			11 343 798	10 097 804
E. Funds held with reinsurance business ceded				2 694 202	2 848 253
F. Other liabilities					
I. Accounts payable on reinsurance business			416 064		420 739
thereof to affiliated enterprises: € 68,620 thou (2021: € 236,844 thou)					
thereof to participations[1]: € 35,406 thou (2021: € 5,725 thou)					
II. Bonds	15		2 723 784		2 734 133
thereof to affiliated enterprises: € 2,723,784 thou (2021: € 2,734,133 thou)					
III. Liabilities to banks	15		430		145
IV. Miscellaneous liabilities	15		31 142 411		35 998 203
thereof for taxes: € 15,268 thou (2021: € 22,320 thou)					
thereof for social security: € 195 thou (2021: € 191 thou)					
thereof to affiliated enterprises: € 29,290,981 thou (2021: € 34,758,016 thou)					
				34 282 690	39 153 220
G. Deferred income				6 548	10 567
Total equity and liabilities				125 787 428	129 515 222

1_Companies in which we hold a participating interest.

Tsd €					
Stand 31. Dezember	Anhangsangabe				
PASSIVA					
A. Eigenkapital	11				
I. Gezeichnetes Kapital		1 169 920			1 169 920
davon ab: rechnerischer Wert eigene Anteile		5 003			684
			1 164 917		1 169 236
II. Kapitalrücklage			28 035 065		28 035 065
III. Gewinnrücklagen					
1. gesetzliche Rücklage		1 229			1 229
2. andere Gewinnrücklagen		5 995 557			6 802 397
			5 996 786		6 803 626
IV. Bilanzgewinn			4 929 827		5 021 300
				40 126 595	41 029 227
B. Nachrangige Verbindlichkeiten	12, 15			17 053 842	15 780 844
C. Versicherungstechnische Rückstellungen	13				
I. Beitragsüberträge					
1. Bruttobetrag		2 360 125			2 259 274
2. davon ab: Anteil für das in Rückdeckung gegebene Versicherungsgeschäft		23 418			20 870
			2 336 707		2 238 404
II. Deckungsrückstellung					
1. Bruttobetrag		1 824 034			2 005 106
2. davon ab: Anteil für das in Rückdeckung gegebene Versicherungsgeschäft		1 439 513			1 510 103
			384 521		495 003
III. Rückstellung für noch nicht abgewickelte Versicherungsfälle					
1. Bruttobetrag		18 439 173			18 184 772
2. davon ab: Anteil für das in Rückdeckung gegebene Versicherungsgeschäft		3 465 648			3 431 905
			14 973 525		14 752 867
IV. Rückstellung für erfolgsunchängige Beitragsrückerstattung					
1. Bruttobetrag		38 694			42 685
2. davon ab: Anteil für das in Rückdeckung gegebene Versicherungsgeschäft		-			8
			38 694		42 677
V. Schwankungsrückstellung und ähnliche Rückstellungen			2 520 837		3 006 370
VI. Sanstige versicherungstechnische Rückstellungen					
1. Bruttobetrag		25 469			59 985
2. davon ab: Anteil für das in Rückdeckung gegebene Versicherungsgeschäft		-			-
			25 469		59 985
				20 279 753	20 595 306
D. Andere Rückstellungen	14			11 343 798	10 097 804
E. Depotverbindlichkeiten aus den in Rückdeckung gegebenen Versicherungsgeschäft				2 694 202	2 848 253
F. Andere Verbindlichkeiten					
I. Abrechnungsverbindlichkeiten aus dem Rückversicherungsgeschäft			416 064		420 739
davon gegenüber verbundenen Unternehmen: 68 620 (2021: 236 844) Tsd €					
davon gegenüber Beteiligungsunternehmen[1]: 35 406 (2021: 5 725) Tsd €					
II. Anleihen	15		2 723 784		2 734 133
davon gegenüber verbundenen Unternehmen: 2 723 784 (2021: 2 734 133) Tsd €					
III. Verbindlichkeiten gegenüber Kreditinstituten	15		430		145
IV. Sanstige Verbindlichkeiten	15		31 142 411		35 998 203
davon aus Steuern: 15 268 (2021: 22 320) Tsd €					
davon im Rahmen der sozialen Sicherheit: 195 (2021: 191) Tsd €					
davon gegenüber verbundenen Unternehmen: 29 290 981 (2021: 34 758 016) Tsd €					
				34 282 690	39 153 220
G. Rechnungsabgrenzungsposten				6 548	10 567
Summe der Passiva				125 787 428	129 515 222

1_Unternehmen, mit denen ein Beteiligungsverhältnis besteht.

English Translation, German Commercial Code, Income Statement

€ thou	Tsd €	Anhangsangabe	2022	2022	2022	2021
I. Technical account	**I. Versicherungstechnische Rechnung**					
1. Premiums earned (net)	**1. Verdiente Beiträge f.e.R.**					
a) Gross premiums written	a) Gebuchte Bruttobeiträge	17	13 223 733			12 151 007
b) Ceded premiums written	b) Abgegebene Rückversicherungsbeiträge		-1 217 077			-1 134 293
				12 006 656		11 016 714
c) Change in gross unearned premiums	c) Veränderung der Bruttobeitragsüberträge		-99 289			-100 743
d) Change in ceded unearned premiums	d) Veränderung des Anteils der Rückversicherer an den Bruttobeitragsüberträgen		1 684			-1 448
				-97 605		-102 191
Premiums earned (net)	**Verdiente Beiträge f.e.R.**				11 909 051	10 914 523
2. Allocated interest return (net)	**2. Technischer Zinsertrag f.e.R.**	18			11 772	16 156
3. Other underwriting income (net)	**3. Sonstige versicherungstechnische Erträge f.e.R.**				-	-761
4. Loss and loss adjustment expenses (net)	**4. Aufwendungen für Versicherungsfälle f.e.R.**	19				
a) Claims paid	a) Zahlungen für Versicherungsfälle					
aa) Gross	aa) Bruttobetrag		-8 669 262			-7 072 006
ab) Amounts ceded in reinsurance	ab) Anteil der Rückversicherer		978 737			874 263
				-7 690 525		-6 197 743
b) Change in reserve for loss and loss adjustment expenses (net)	b) Veränderung der Rückstellung für noch nicht abgewickelte Versicherungsfälle					
ba) Gross	ba) Bruttobetrag		-193 866			-2 098 654
bb) Amounts ceded in reinsurance	bb) Anteil der Rückversicherer		-51 471			934 040
				-245 337		-1 164 614
Loss and loss adjustment expenses (net)	**Aufwendungen für Versicherungsfälle f.e.R.**				-7 935 862	-7 362 357
5. Change in other insurance reserves (net)	**5. Veränderung der übrigen versicherungstechnischen Netto-Rückstellungen**	20			47 991	68 271
6. Expenses for premium refunds (net)	**6. Aufwendungen für erfolgsunabhängige Beitragsrückerstattungen f.e.R.**				3 952	-18 901
7. Underwriting expenses (net)	**7. Aufwendungen für den Versicherungsbetrieb f.e.R.**	21			-3 312 270	-3 135 186
8. Other underwriting expenses (net)	**8. Sonstige versicherungstechnische Aufwendungen f.e.R.**				-23 164	-23 315
9. Subtotal (net underwriting result)	**9. Zwischensumme**				701 469	458 431
10. Change in claims equalization and similar reserves	**10. Veränderung der Schwankungsrückstellung und ähnlicher Rückstellungen**				485 532	-434 606
11. Net technical result	**11. Versicherungstechnisches Ergebnis f.e.R.**				1 187 001	23 826
II. Non-technical account	**II. Nichtversicherungstechnische Rechnung**					
1. Investment income	**1. Erträge aus Kapitalanlagen**	22	10 480 823			9 229 975
2. Investment expenses	**2. Aufwendungen für Kapitalanlagen**	23	-4 378 409			-1 640 778
3. Investment result	**3. Kapitalanlageergebnis**			6 102 415		7 589 197
4. Allocated interest return	**4. Technischer Zinsertrag**			-30 519		-33 875
					6 071 896	7 555 322
5. Other income	**5. Sonstige Erträge**			5 257 296		2 875 636
6. Other expenses	**6. Sonstige Aufwendungen**			-7 729 875		-5 298 616
7. Other non-technical result	**7. Sonstiges nichtversicherungstechnisches Ergebnis**	24			-2 472 580	-2 422 980
8. Non-technical result	8. Nichtversicherungstechnisches Ergebnis				3 599 316	5 132 342
9. Net operating income	**9. Ergebnis der normalen Geschäftstätigkeit**				4 786 318	5 156 167
10. Income taxes	**10. Steuern vom Einkommen und vom Ertrag**	25	-532 225			-351 963
Amounts charged to other Group companies	Konzernumlage		550 002			543 194
				17 777		191 231
11. Other taxes	**11. Sonstige Steuern**			-12 249		3 823
12. Taxes	**12. Steuern**				5 528	195 054
13. Net income	**13. Jahresüberschuss**				4 791 846	5 351 221
14. Unappropriated earnings carried forward	**14. Gewinnvortrag aus dem Vorjahr**				637 981	420 079
15. Transfer to revenue reserves	**15. Einstellungen in Gewinnrücklagen**					
To other revenue reserves	in andere Gewinnrücklagen			-500 000		-750 000
					-500 000	-750 000
16. Net earnings	**16. Bilanzgewinn**	26			4 929 827	5 021 300

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