The London School of Economics and Political Science

Endogenous risk in non-life insurance: evidence from the German insurance sector during the Interwar period

Stephan D. Werner

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Abstract

Motivated by the recent 2007/2008 Financial Crisis, this dissertation identifies endogenous risk in the German insurance sector during the Interwar sector. In the context of principal agent theory, endogenous risk is the result of a company reacting to shocks that are generated and amplified within the financial system by shifting risk from shareholders to policyholders. This dissertation provides analytical support for this interdependence on the basis of established financial as well as actuarial models and assumptions. The empirical analysis considers the German insurance sector during the Interwar period due to the presence of a pronounced business cycle, the absence of exogenous low-probability high-cost events, a consistent regulatory framework as well as available quantitative data. The econometric analysis is based on four newly compiled datasets that collect the 1924 gold account opening balances, company- as well as line-specific financial information, and stock price quotations for all publicly traded German insurance companies during the Interwar period. The dissertation finds that during the Interwar period in the German insurance sector (Ch.2), the risk of getting discontinued prior to default (3) led companies to cater dividend payout (Ch.4) and reinsurance operations (Ch.5) to an optimistic investor clientele (Ch.6), yet in contrast to the underwriting cycle (Ch.7).

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This work is dedicated to my parents.

1 Introduction: identifying endogenous risk in non-life insurance

Endogenous risk as connection between systemic risk and insurance

The then-largest global insurance group, *American Insurance Group* (AIG), was at the epicentre of the 2007/2008 Financial Crisis. The company received the largest ever bail-out when the U.S. Treasury provided emergency funds totalling USD 182.3 billion. This financial emergency funding had been necessitated by the exposure of AIG to credit default swaps (CDS) on collateralised debt obligations that its London-based unit AIG FS Ltd. had sold in the years prior to 2007. Securities lending activities also played an important role. Overall losses accumulated from these two activities to a total of USD 50 billion.[1] The fact that an insurance company was at the centre of the crisis came as a surprise to the industry. This phenomenon motivated substantial research into the relevance of the insurance sector within the internal economic and financial system as a source for instability - commonly referred to as systemic risk. Eling & Pankoke (2014) provide a meta analysis of 43 relevant academic and practitioner studies of relevance. The first finding is that there is no generally accepted definition of systemic risk. Second, the authors conclude that [t]raditional underwriting and funding and investing activities in the life, non-life, and reinsurance business make very little contribution to systemic risk and do not increase insurer vulnerability to impairments of the financial system."[2] It is found that non-traditional insurance activities "increase the vulnerability of insurance companies to the impairment of the financial system."[3] This also includes the trade in CDS contracts in which AIG had been active.

None of the analysed studies inquired into the motivation of AIG to engage in non-traditional insurance activities. A possible explanation is inferred from the 2006 annual report of AIG that provides an uncommented summary of total shareholder return generated from 2001 until 2006. This information is reproduced in Table (1).[4] This information indicates that AIG was underperforming relative to the S&P 500 as well as two peer groups. At the same time, AIG started its activities in the CDS market. This coincidence purports that senior management sought to increase shareholder returns by engaging in new business activities in the then-thriving securities markets. An additional suggestion is that

[1] See McDonald & Paulson (2015) for a recent analysis of the case. An exhaustive description of AIG business operations is provided in the "Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States" by the Financial Crisis Inquiry Commission - the FCIC Report (2011).

[2] See Eling & Pankoke (2014, p.29).

[3] Ibid.

[4] This measure is defined as the ratio

$$Total\ Shareholder\ Return = \frac{Price_{T+1} - Price_T + Dividends}{Price_T},$$

where T denotes the point in time at which the investment has been made. It is further assumed that dividends are reinvested. Total shareholder return thus needs to be regarded as a measure of capital accumulation for investors that followed a buy-and-hold with dividend reinvestment strategy and not as a direct measure of return, see Rappaport (2006).

Table 1: Cumulative total shareholder returns AIG, 2001 to 2006

	2001	2002	2003	2004	2005	2006
AIG	100.00	73.07	84.04	83.61	87.67	92.97
S&P 500	100.00	77.90	100.25	111.15	116.61	135.03
New Peer Group	100.00	86.49	109.07	126.05	155.01	179.36
Old Peer Group	100.00	88.84	111.14	134.80	164.51	196.58

Note: Cumulative total shareholder returns include received dividend payout as well as increases in the share prices. The new peer group consists of *ACE Limited*, *Aflac Incorporated*, *The Chubb Corporation*, *The Hartford Financial Services Group, Inc.*, *Lincoln National Corporation*, *MetLife, Inc.*, *Prudential Financial, Inc.*, *The Travelers Companies, Inc.* (formerly *The St. Paul Travelers Companies, Inc.*) and *XL Capital Ltd*. The old peer group consists of *The Allstate Corporation*, *The Chubb Corporation*, *CNA Financial Corporation*, *The Hartford Financial Services Group, Inc.*, *Lincoln National Corporation*, *MetLife, Inc.*, *Prudential Financial*, *Inc.* and *The Travelers Companies, Inc*.
Source: AIG Annual Report 2006 Form 10-K, p.23

decision makers expected core insurance business operations to not provide the funds necessary to meet the market and benchmark performances. AIG thus exposed itself intentionally to non-core risk due to its motivation to conform to relative shareholder expectations. This link is referred to as "endogenous risk" in the following.

The case study of AIG is neither representative nor sufficiently objective to draw general conclusions from it. The intention of this analysis is to provide a general identification of endogenous risk in non-life insurance operations. It combines an analytical discussion with an empirical assessment based on data from the German insurance market during the Interwar period. The conducted analysis confirms the hypothesis of the dissertation that is stated as follows.

Hypothesis: Joint-stock non-life insurance companies are indirectly exposed to systemic risk via endogenous risk.

The remainder of the introduction starts with a general definition of endogenous risk. Second, the particular relevance of the German insurance market during the Interwar period in this context is explained. Third, the structure of the dissertation is provided. Fourth, general contributions of the dissertation, limitations of the chosen approach as well as potential future research are outlined.

Definition: endogenous risk in corporate finance

Definition in the context of business cycles The concept of endogenous risk is introduced by Danielsson & Shin (2003) and "refers to the risk from shocks that are generated and amplified within the system".[5] It contrasts so-called exogenous risk, i.e. potential costs associated with earthquakes or other catastrophes that are not related to financial markets. The actors in this setting are traders who

[5]Danielsson & Shin (2003, p.297).

interact with each other. The price formation therefore contains a feedback mechanism of collective action and individual reaction as traders react to prices which in turn are defined by the collective action of traders.[6] The generation and realisation of endogenous risk is put into the context of business cycles by Danielsson et al. (2012). Based on an analytical model of pro-cyclical volatility, this study provides an intuitive explanation of the "leverage effect" as per Black (1976*b*) and Schwert (1989). Both studies find that episodes of high volatility are pre-dated by declines in asset prices. This phenomenon is explained by Danielsson et al. (2012, p.31) with traders unwinding positions in assets with decreasing price. This in turn triggers a vicious cycle of further decreases in market prices and deleveraging, thus causing an endogenous debt-deflation shock within the financial system. [7]The basic model of Danielsson et al. (2012) directly considers the effect of the interplay of active and passive traders within financial markets on asset returns. They show that asset prices are subject to endogenous risk and due to the pro-cyclical behaviour of active traders.

Endogenous risk in the context of principal agent theory The implicit assumption of Danielsson & Shin (2003) is that traders only consider asset returns as relevant for decision-making purposes. Changing the perspective to long-term equity investors - as current or future shareholders - moves the subject of endogenous risk into the context of principal agent theory. In this setting the management of the invested company (agent) interacts with current holders of common shares[8] and provides it with dividend payout as compensation for providing capital. A particular conflict arises from the fact that the latter group holds the right to vote in favour of discontinuing the joint-stock company given the required provisions and prerequisites in corporate bye-laws. A potential motivation for doing so would be to liquidate paid-in capital in order to refinance the investment in alternative investment opportunities. This puts the agent under the pressure to meet the expectations of the principal. The prospect of earning relatively better alternative investment returns directly translates into an increased risk for the company of being discontinued. Endogenous risk occurs in this setting if the agent increases the exposure of the company to risk in order to provide for the expected compensation. This effectively shifts discontinuation risk from shareholders to policyholders. The fact that the company is itself an alternative investment opportunity for shareholders of other companies creates the feedback process

[6]"Endogenous risk appears whenever there is the conjunction of (i) individuals reacting to their environment and (ii) where the individual actions affect their environment." See Danielsson & Shin (2003, p.302).

[7]A concept closely related to the debt-deflation explained by endogenous risk is the "Minsky financial instability hypothesis", see Minsky (1986). This model consists of three categories of borrowers: "hedge" borrowers cover debt payments by current income. "Speculative" borrowers can meet liabilities only by continuously rolling over debt. "Ponzi" borrowers expect future increases in asset value that are required to repay outstanding debt. With continuing economic expansion expectations become more optimistic. This leads to an increase of "speculative" and "Ponzi" borrowers in the economy. This causes an asset bubble. When asset prices fail to continue increasing, the latter types of borrowers will face difficulties meeting their obligations. They will start to deleverage their positions in order to limit exposure and meet current liabilities. The turning point is colloquially referred to as "Minsky Moment". The result is a vicious cycle of debt-deflation and further asset price decreases. This feedback process is dependent on the presence of endogenous risk that captures the effect introduced by the excessive leverage that is realised after the "Minsky Moment".

[8]Preference shares are not considered.

that is inherent to endogenous risk. Facing potential discontinuation, companies will seek to meet investor expectations that react to dividend payout and vice versa. This defines endogenous risk as the risk that is shifted from shareholders to fixed claimants due to endogenous causes.

Non-life insurance and endogenous risk - a simple model case The described principal-agent problem is of particular interest in the case of an unlisted private joint-stock non-life insurance company: assuming that the insurer provides a joint-stock manufacturer with insurance protection, an upswing in the business cycle will lead to increased manufacturing. This increases the profitability of the manufacturing company and allows the company to provide additional dividend payout. Increased production nevertheless also causes a faster wear and tear of machinery. Insured costs associated machines breaking down lead to decreased earnings for the insurance company. Yet, reducing dividend payout in accordance would incentivise shareholders to disinvest from the insurance company and buy shares of the manufacturer, the alternative investment opportunity. The insurer may thus adjust dividend payout to the level of the manufacturer and refinance the incurred additional costs of the cash dividend by increasing the riskiness of its operations. An insurance company can for example utilise available free reserves or seek to align earnings performance towards that of the manufacturer. This leads to a shifting of (endogenous) risk from shareholders to policyholders.

Identifying endogenous risk in non-life insurance The example provides an intuitive roadmap for the analysis of endogenous risk in non-life insurance: first, it is necessary to test whether not meeting investor expectations was indeed a possible way for companies to exit the market. Second, it requires analysis as to whether companies did adjust dividend payout to external market conditions and shifted risk from shareholders to policyholders. This, third, raises the question whether the characteristics of investor expectations - or more generally market sentiment - justify the assumption that indirect pressure was exerted on companies. The second and third question jointly identify the feedback process that is integral to endogenous risk. Fourth, the relationship between external economic conditions and the performance of non-life insurance business - expressed by the underwriting cycle - requires identification. This is necessary to establish that dividend payout strategies were indeed disjunct from the actual business performance. Fifth, corporate specific risk management offers relevant insight into the internal management of solvency. This helps to identify the way in which endogenous risk led to immediate consequences for the policyholders.

The relevance of the German insurance sector during the Interwar period

This dissertation bases the analysis of endogenous risk within insurance operations on source material and data from the German insurance market during the Interwar period, 1924 to 1935. This period is

Table 2: Market characteristics required for reduced bias in data

Required characteristic	United States		Germany
	Contemporary	Historical	Historical
Pronounced business cycle fluctuation	Yes	Yes	Yes
Coherent regulatory regime	No (harmonised)	No	Yes
Absence of exogenous shocks	No	Yes	Yes
Data availability	Ambiguous	Unknown	Yes

Note: "Contemporary" refers to the period predating and including the 2007/08 financial crisis. "Historical" refers to the Interwar period.
Source: Own considerations

chosen in accordance with Kurtz (1937), a contemporary study of the underwriting cycle between the years 1924 and 1935. The use of this market and period is justified by the advantages offered relative to possible alternatives. The differences between the German insurance sector during the Interwar period and the U.S. market, first in the recent financial crisis and second in the Interwar period as well, are summarised in Table (2).

It shows that along for relevant aspects, the historical case study of the German insurance sector provides characteristics that are necessary for reducing bias in an empirical assessment of endogenous risk.

Pronounced business cycle fluctuation The years between 1919 and 1939 feature both, a period of economic boom during the 1920s - the "Roaring Twenties" - and the economic crisis of the 1930s that is colloquially known as "Great Depression". This term relates in principal to the economic conditions in the United States. Especially in the aftermath of the financial crisis of 2008/2009, a number of studies has highlighted similarities between the present downturn and the Great Depression. Almunia et al. (2009) for example show empirically that the structural breaks between the periods of economic boom and bust, 1929/1930 respectively 2007/2008, had similar effects on an international scale, including Germany. This does not consider the responses following the individual crises since decision-makers in the recent crisis were able to derive substantial lessons-learned from the Great Depression. This is a further motivation to limit the period under consideration to the years until 1935.

In addition, the historical German insurance market features company-specific case studies that share similarities with the case of AIG. The first case, the market exit of the then-second largest insurance group, the *Frankfurter Allgemeine Versicherungs AG* (FAVAG), in August 1929 led to fundamental legal that introduced mandatory external audits for joint-stock companies. A second case study is the loss of independence of the then-oldest specialised reinsurance company, the *Kölnische Rück*, in 1932/1933. Whilst the former case is well established within the relevant literature, the latter is a novel

contribution of this dissertation.

Consistent insurance regulatory regime Although the case of AIG is predominantly seen from within the U.S. financial market, its business operations that ultimately led to its exposure to CDS contracts were transacted by its UK subsidiary. An empirical analysis of the recent 2007/2008 financial crisis hence requires a detailed analysis of individual insurance regulatory regimes and the potential opportunities for regulatory arbitrage. This is beyond the scope of identifying endogenous risk. To focus on one single regulatory system is preferred in order to avoid introducing bias due to international differences in accounting standards and regulatory regimes. This rules out the U.S. insurance market, where insurance companies were subject to state supervision. The empirical examination of the U.S. insurance market as a whole would therefore require a detailed assessment of the different state regulatory systems during the Interwar period. The German insurance market in contrast features the necessary centralised regulatory system that was codified by the *1901 Act on the Supervision of Insurance Undertakings* (German: "Gesetz über die Beaufsichtigung von privaten Versicherungsunternehmen, (Short:) "Versicherungsaufsichtsgesetz" (VAG)). This allows to rule out potential bias introduced by unconsidered differences in regulation. Although some changes were made throughout the period under consideration, the regulatory framework generally remained unchanged. This also allows to rule out exogenous shocks from sudden changes in regulation as a potential source of bias.

Absence of exogenous shocks An important empirical requirement is that the observability of any effect caused by endogenous risk. This requires the absence of bias introduced into the financial system by exogenous shocks. In non-life insurance, such shocks can originate from insured low-probability / high-cost events such as natural or man-made catastrophes. Thomann (2013) analyses the impact of the ten most expensive catastrophes in the period from 1988 to 2006 on the share prices of U.S. non-life insurance companies. Six out of ten took place in the years 2004 and 2005 and thus in the period during the financial boom period.[9] The study applies time-series methodology and finds first that catastrophes increased the expected distribution and the volatility of insurance stock returns. It second shows that the correlation with the financial market decreases (increases) if the catastrophe has no (an) effect on the overall economy. This confirms that the study of insurance share prices in this period is systematically biased by low-probability / high-cost events. Table 3 provides a list of mentionable hazards.

Although the 1923 "Great Kanto" earthquake[10] and the 1926 "Great Miami" hurricane[11] caused

[9]The covered catastrophes are Hurricane Hugo (1989), Hurricane Andrew (1992), the Northridge earthquake (1994), the 9/11 terrorist attacks (2001), Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), Hurricane Katrina (2005), Hurricane Rita (2005), Hurricane Wilma (2005). See Thomann (2013, Table 1).

[10]Yoneyama (2009) is a concise study of the effects the earthquake had on the Japanese insurance market.

[11]The 1926 Great Miami hurricane, which devastated large areas in Florida, is probably best known for causing the real

Table 3: Natural and man-made disasters, 1906-1934

Year	Name	Location	Characteristic
1906	*Courriéres*	France	Mining accident
1906	*San Francisco*	United States	Earthquake / fire
1908	*Messina*	Italy	Earthquake
1912	*Titanic*	Northern Atlantic	Naval accident
1915	*Bergen*	Norway	Naval accident
1920	*Kansu*	China	Earthquake
1921	*Spanish Flu*	*Global*	Pandemic
1923	*Great Kanto, Tokyo*	Japan	Hurricane
1926	*Great Miami, Florida*	United States	Flood
1927	*Mississippi*	United States	Fire
1928	*Alcazar Teatro, Madrid*	Spain	Hailstorm
1929	*Southern Germany*	Germany	Mining accident
1930	*Alsdorf*	Germany	Fire
1931	*Glaspalast, Munich*	Germany	Fire
1933	*Reichstag, Berlin*	Germany	Fire
1933	*Neunkirchen*	Germany	Explosion
1934	*Hakodate*	Japan	Conflagration

Source: Koch (1995, p.45)

widespread destruction, there is no evidence that German (re-)insurance companies were liable for losses incurred. No clear conclusion can be made for the 1919 Spanish flu pandemic, which happened during a period of great political and economic instability in Germany.[12] In order to take this uncertainty into account, data were collected starting from the year 1924. The records of the largest German reinsurance company, *Münchener Rück*, mention only two catastrophes: In the case of the 1931 *Glaspalast Fire,* most damages were compensated by British reinsurance companies. Due to the 1934 *Hakodate Fire, Münchener Rück* paid Japanese Yen (JPY) 95,252 out of a total JPY 20 to 30 million in total losses incurred.[13] In addition to this evidence, the *Gerling Gruppe* reported a total cost of RM 3 million for the 1933 *Neunkirchen Explosion.*[14] These, however, are individual cases of limited scope.

Data availability Whilst market data is readily available for the recent financial crisis, access to relevant company-internal information is limited due to legal considerations. This is not the case for the source material from the Interwar period that is - if still existing - available from corporate archives. For the particular case of Germany, accounting information as well as market data is available from so far unrecognised source material that was collected from the historical archives of *Allianz*, *AXA, GenRe* (formerly *Cologne Re* in Germany), *Swiss Re* (in *Switzerland* as well as formerly *Bavarian Re*

estate bubble in Florida, see Galbraith (1961). It ranks as the hurricane that caused the 10th largest insured property losses, see Cummins (2007, p.180).

[12]This event had a particular impact on the leading Swiss reinsurance company, *Schweizer Rück*, leading to a deficit of CHF 9.2 million in its life portfolio and an unreported loss of CHF 6.4 million for the business year 1921. This is the second worst internal annual result of the company after the financial losses incurred during the Great Depression in 1931. See Guggenbühl (1939, p.147), Borscheid et al. (2013, p.iv) as well as Ch.4.

[13]See Herzog (no year, p.195).

[14]This is based on information provided by *Gerling* on https:/www.hdi.de/docs/ueber_uns/gerling_chronik.pdf (last accessed 27 June, 2014).

in Germany), *Munich Re* as well as the *German Insurance Association* (German: "Gesamtverband der deutschen Privatversicherung" (short: GDV)). Further sources were collected from *Sal.Oppenheim*, *Lloyd's of London* and *Crédit Agricole* but were found to be beyond the scope of the present dissertation.

Empirical data was collected for the years from 1924 to 1935, where available. Two sources are used two establish four new and innovative datasets. The first source is the annually published collection of insurance data "Neumanns Jahrbuch der Privatversicherung im Deutschen Reich". This is the predecessor of the current annual statistics compendium published by GDV.[15] Amongst other information, this source collected all annual reports and profit-and-loss statements published by German insurance companies. It also provided sorted information on individual lines or sectors. Three datasets are based on this source: Dataset I "Gold Account" contains information on 1924 gold account financial statements, Dataset II "Company" company-specific accounting as well as profit-and-loss information and Dataset III "Line" per-company line-specific accounting and profit-and-loss information. Given the same unbalanced panel data structure, Datasets II and III are compatible.

The second source is the weekly published magazine "Neumanns Zeitschrift für das Versicherungswesen" (from 1927 onwards: "Neumanns Zeitschrift für Versicherungswesen") It provides collect stock market information and the dates for annual general meetings. It was chosen due to its outstanding reputation amongst contemporaries.[16]. Dataset IV "Share Price" contains data from this source together with relevant benchmark data obtained from other sources that are specified where appropriate.

Structure, chapter-specific findings and contributions

This dissertation is organised in the form of a monograph that features self-contained chapters in the form of research papers. Although every chapter in this dissertation offers additional insight into to multidimensional aspects of endogenous risk, they also provide individual insights as stand-alone papers. The structure of the dissertations follows the following line of argument:

> Endogenous risk is the result of shocks that are generated and amplified within the system. During the Interwar period in the German insurance sector (Ch.2), the probability of getting discontinued prior to default (Ch.3) led companies to cater dividend payout and reinsurance operations (Ch.5) in line with the business cycle (Ch.4) to an optimistic investor clientele (Ch.6), yet in contrast to the underwriting cycle (Ch.7) .

The abstract summaries of the individual chapters are:

Chapter 2 introduces the historical development, organisation and regulation of the German insurance market before and during the Interwar period. It additionally provides insights into the contemporary

[15] See Kölmel (2000, p.20).
[16] See Koch (1995, p.47) and Koch (1998, p.118).

exposures and challenges present in the German insurance market based on the case study of *Kölnische Rück*. It further supports the choice of this particular market to analyse the presence of endogenous risk in insurance operations. The chapter contributes substantial insights into the relevance of accounting principles for insurance companies, especially prior to the Great Depression period. This illustrates the limitations of asset-side analyses during the Interwar period. Second, it establishes the 1924 currency reform as an integral watershed for corporate business strategies during the Interwar period.

Chapter 3 examines the interdependence of insurance failures and the decision of shareholders to discontinue from companies. This is analysed in the context of a case-control analysis that investigates the reasons why German insurance companies exited the market during the period 1925 to 1935. An American option model for credit risk modelling provides the theoretical foundation. This approach utilises two probit regression models based on the novel hand-collected Dataset I "Gold Account". The chapter finds that the relatively modest number of insurance failures during the Great Depression is subject to "endogenous survivorship bias". In addition, a direct relationship between company discontinuations and the franchise value of a company is identified. The major contribution of this chapter is the theoretical derivation and empirical validation of this concept. Utilising an econometric approach based on insights from signal detection theory, it discusses the assessment of model fit in the case of varying dependent variables.

Chapter 4 discusses the dividend distribution decision of German insurance companies based on Dataset II "Company". During the Interwar period, insurance companies actively administered dividend payout. It is hypothesised that the actual payout pattern depended on the state of the economy. This caused a direct shift of risk from shareholders to policyholders as evidenced by a case study of *Schweizer Rück*. The chapter defines a new model of a dividend payout strategy based on the so-called dual risk model. The empirical analysis utilises the Lintner partial adjustment model on the basis of the Arrelano-Bond GMM estimator. It finds that companies engaged in risk shifting during the late 1920s as companies increased their respective target dividend payout rates in line with the economic conditions. The chapter contributes the development of an analytical process that allows to model dividend smoothing in insurance operations. In addition, the use of the Lintner partial adjustment model in the context of risk shifting.

Motivated by previous results of Abdul Kader et al. (2010), Chapter 5 addresses the ability of an insurance company to shift risk from shareholders to policyholders by means of reinsurance. The interdependence between reinsurance decision-making and shareholder value maximisation is established theoretically within the extended risk exchange model due to Borch (1986). The chapter argues that the German Interwar period provided optimal conditions for risk shifting in Germany due to the exemption of reinsurance from supervision. The properties of the dependent variable motivate an empirical

two-model approach: first, a discrete choice panel model is used to identify structural determinants of the decision not to use reinsurance. Second, a mixed model is used to analyse differences in the determinants of reinsurance demand between the Golden Twenties and the Great Depression period. Data is taken from Datasets II "Company" and from Dataset III "Line". The chapter contributes the first multi-line analysis of historical insurance operations in a major market. Econometrically, it raises awareness to the statistical properties of fractional dependent variable.

Chapter 6 tests whether insurance companies were catering to a specific optimistic investor clientele. It utilises the first hand-collected dataset of German stock market prices during the Interwar period, Dataset IV "Share Price". The chapter discusses the observed differences in insurance share prices and the Berlin stock exchange index during the Interwar period. It utilises event study methodology to analyse whether investors were first using dividend announcements as signals and second generally optimistic during the late-1920s period. Both hypotheses are confirmed by empirical estimates. The chapter contributes the first empirical analysis of share price information in Germany during the Interwar period. It also contains the first sector-specific and Germany-wide share price index of the Interwar period.

Chapter 7 discusses the internal cost of capital of German non-life insurance companies during the Interwar period. It is argued that internal costs depend on the insurance-technical performance, which motivates to focus on the relationship of the underwriting with the business cycle as a cost-determining factor. The chapter incorporates information from the novel hand-collected Datasets II "Company" and III "Line" in order to test the results of the contemporary dissertation Kurtz (1937). The chapter questions how German insurance companies were exposed to market risk during the "Golden Twenties" as well as the Great Depression of the 1930s. It shows a clear correlation between individual insurance lines and the state of the economy. In addition, it provides evidence that insurance key performance indicators suggests a negative correlation between insurance profitability and the business cycle. The chapter contributes a detailed discussion of potential bias in cost-of-capital estimates that do not take into account the specific nature of insurance-technical operations. In addition, the first empirical analysis of the correlation between the underwriting and the business cycle is provided for the period of the Interwar period.

General contribution, limitations and future research

General contributions of the dissertation This dissertation is the first to provide a detailed empirical analysis of insurance operations in Germany. From a qualitative perspective, it takes into account the contemporary regulatory environment as well as prevailing accounting standards. The scope of analysis is made possible by the collection of new quantitative datasets as well as new source

material from corporate archives of German insurance companies. In addition, this dissertation is to the knowledge of the author is the first empirical analysis of the Great Depression period in Germany that is based on disaggregated sector-specific stock market data. The overarching topic, endogenous risk, introduces new aspects to principal-agent theory. The present approach does for instance not directly focus the classical principal-agent problem of limited liability. Instead, this dissertation addresses the voting rights of shareholders as a potential cause for conflict.

Joint limitations of individual chapters This dissertation features two general limitations of particular relevance. Any chapter-specific considerations are considered in the relevant context. The first general limitation is due to the absence of contemporary benchmarks. This dissertation provides a cross-sectional analysis within the German insurance market, but is limited in providing cross-sectoral comparisons both for insurance as well as stock market analyses. With the notable exception of the Swedish fire insurance sector provided by Abdul Kader et al. (2010), there is no comparable study of other historical domestic insurance markets. When collecting empirical it was found that for example annual data on international reinsurance markets provided by the British insurance newspaper "The Review" featured substantial differences in accounting practice between countries. In order to avoid potential bias introduced from structural differences in regulatory or accounting regimes, the analysis was restricted to the German private insurance market.

Following on, the second limitation is that only German private non-life insurance companies were considered. Also, international activities of German insurers were not directly addressed given that this was not reported. Foreign companies were not considered in order to avoid potential bias from differences in regulatory regimes.[17] In addition, public-sector insurance companies were not included given that these had been subject to a different contemporary regulatory framework. Lastly, life insurance companies were not considered due to fundamental differences in the business model.

Future research This dissertation offers different motivations for future research. The concept of endogenous risk opens up a range of follow-up research paths: it offers new trajectories in actuarial ruin theory, motivates new detailed case studies such as i.e. AIG, suggests empirical research on a sector / or macro-economic national or international level. It nevertheless also motivates more practical considerations that directly follow from some of the findings in the following chapters. Ch.3 on the one hand provides new insights into credit risk modelling by the conceptualisation of "endogenous survivorship bias". Ch.7 on the other hand motivates to discuss whether current models for insurance cost of capital provide appropriate estimates.

[17] Compare Ch.4 where it is for example explained that Swiss insurance companies had to use mark-to-market valuation for accounting purposes during the Great Depression period, whilst German and U.S. companies had been provided with crisis-related specific approaches. A direct comparison would thus not be informative.

In addition, the used sources provide additional information with relevance for further research in the context of principal-agent theory. For example, data on executive and supervisory board compositions are readlily available from "Neumanns Jahrbuch der Privatversicherung im Deutschen Reich". This allows to analyse potential effects of multi-board membership or management compensation in the context of control and principal-agent theory. In addition, the analysis of changes in the ratio of paid-to-unpaid capital suggests promising insights into the role of shareholder liabilities in the context of insurance. The statistical information indicates that insurance companies used shareholder liability as an alternative source for shareholder compensation. This is similar to the observation of Froehlicher (2013, p.67) that the Swiss insurance company *Zurich* used capital dynamically in order to control a maximum dividend payout rate. This offers a new perspective on the use of partially paid share capital in general. Although highly relevant in the present context, both aspects were left for future research due to the complexity of the associated empirical analyses.

2 The German insurance market and *Kölnische Rück* during the Interwar period

2.1 *Kölnische Rück* as case study for endogenous risk

At the end of the year 1932 and in the midst of the Great Depression, the then-oldest specialised reinsurance company, *Kölnische Rück*, was facing imminent default. Only a take-over by the German insurance interest group *Rheinische Gruppe* (English: Rhinian Group) ensured the survival of the company. This is in particular a noteworthy case study as the *Kölnische Rück* had been the second largest German reinsurance company. The developments surrounding these events necessitate a closer analysis and motivate a general discussion of the historical development of the German insurance market during the Interwar period. Making direct inferences from historical case studies posits relevant caveats. Turner (2014, pp.13-15) discusses three potential dangers

1. "to remove the poetry out of financial history",
2. to "ignore or place less emphasis on the cultural, economic, legal, social, and political environment in which financial institutions and markets have operated in the past",
3. "applying modern finance theories to historical episodes can be anachronistic."

The following chapter directly considers (2) by discussing the idiosyncratic characteristics of the period. The first part provides a general discussion of the history of the Germany insurance sector. The second part establishes the case study of *Kölnische Rück* based on yet unresearched primary source material. Accompanying data is either taken from Dataset I "Gold Account", Dataset II "Company", from the data appendix provided in Kluge (2006) or from primary sources as referenced. This is based on the case study of *Kölnische Rück.*.[18] The chapter is structured into two main parts: first, the general historiographical course of events is described, starting with a discussion of relevant historiographical literature. This is followed by a description of the current knowledge of the general development of the German insurance market during the Interwar period. The case study of *Kölnische Rück* forms the second main part of this chapter: it begins with providing the events surrounding its loss of independence in 1932/1933. Following on, the effects of missing external auditing requirements as well as changes to accounting standards in the wake of the Great Depression are reflected. Finally, the case study points out the long-run costs of promoting prestige in the 1924 currency reform as an important structural cause of the company's financial distress in late-1932.

[18]The following analysis expands on this more general preliminary introductory work Werner (2009) that placed particular emphasis on the analysis of the company's performance as a part of *Rheinische Gruppe*.

The main contribution of this chapter to the existing historiography is the introduction of the case study of *Kölnische Rück*. More generally, the importance of the 1924 currency reform is established in a consistent. It is highly probable that other sectors were affected by the same circumstances. With respect to the Great Depression it is shown that key performance indicators asset portfolios of insurance companies were systematically biased. This arose from changes to accounting standards as a response to the 1931 financial crisis.

2.2 The historical development of the German insurance sector during the Interwar period

2.2.1 German insurance historiography

The historical development of the German insurance sector has found detailed consideration in a large number of historical studies, Festschriften and other publications. Comprehensive reviews of the abundant literature are provided by Wandel (1998) and more recently Wältermann (2008). The main references for the historical development of the German insurance sector are the narrative historiographies by Ludwig Arps, Arps (1965) for the period up to 1914, Arps (1976*a*) for the period from 1914 to roughly the early 1920s and Arps (1976*b*) for roughly the early 1920s until the outbreak of World War II. Additionally, Borscheid (2007) provides an analysis of the international expansion of German insurance companies following the 1924 currency reform. More recent surveys are Borscheid (2012), a collection of the accounts of global insurance history and Koch (2012), a book that collects short summaries of relevant key events as well as relevant topics of German insurance history. A detailed historical account of the *German Insurance Association* (German: "Reichsverband deutscher Privatversicherung") is provided by Ehlers (2009). The standard reference for the history of the German insurance sector during the Nazi regime and World War II, 1933 to 1945, is Feldman (2001), a study of *Allianz Group* during the Interwar period as well as World War II. In addition, selected historiographical case studies of individual companies are provided in Table (4). A summary of the large number of available but mostly placative Festschriften is available in Wandel (1998).

In the context of the present dissertation it is also necessary to incorporate contemporary secondary literature that provides information regarding business conduct and practices. The associated large body of literature is reviewed in detail by Koch (1976). The usability, however, depends on the availability of the relevant literature. One internal and undated manuscript is of particular relevance in the present context: Herzog (no year) is a collection and commentary of internal sources at *Munich Re*, which was produced by former *Allianz* member of the board Martin Herzog until the end of the 1970s. Following the production of this source the senior management decided to destroy a large amount of primary

Table 4: Selected historical insurance case studies with relevance for the German market

Company	Period	Focus	Reference
Allianz	1919 - 1945	Relationship with German Nazi regime	Feldman (2001)
Allianz / *Münchener Rück*	1910 - 1929	Relationship between companies	Kluge (2006)
Allianz	1910 - 2006	Co-operation with *Bankhaus Merck, Finck & Co.* and *Münchener Rück*	Pohl (2011, p.47-52)
Agrippina, Colonia Feuer	1817 - 2007	Historical formation of AXA *Germany*	Pohl (2011, p.53-65)
Aachener Feuer	1824 - 2009	Historical formation of *Generali Germany*	Pohl (2011, p.66-73)
Frankfurter Allgemeine (FAVAG)	1865 - 1929	Company profile	Eggenkämper et al. (2004)
FAVAG	1924 - 1929	Bankruptcy scandal and take-over by *Allianz*	Feldman (2002)
Kölnische Rück	1924 - 1935	Quantitative performance and business strategy	Werner (2009)
Münchener Rück	1880 - 1997	U.S. business operations	Kölmel (2000, pp.227-268)
Münchener Rück	1924 - 1935	Quantitative performance and business strategy	Werner (2009)
Münchener Rück	1880 - 2003	Co-operation with *Bankhaus Merck, Finck & Co.* and *Allianz*	Pohl (2011, p.39-46)
Münchener Rück	1880 - 1980	General historiography	Bähr & Kopper (2015)
Mutzenbecher Insurance Group	1870s - 1930s	Historical development and ultimate failure of insurance group run by Hermann Mutzenbecher	Schröder (2008)
Wiener Phoenix	ca.1920s - 1937	Bankruptcy scandal and political crisis in Austria	Feldman (2002)
Wiener Phoenix	1822 - 1937	Historiography of the then-largest European life insurer, defaulted in 1937 due to fraud	Lembke (2016)

Note: Although *Wiener Phoenix* was a Austrian life insurance company, it featured substantial business operations in Germany.

source material under the assumption that the historical analysis was concluded.[19]

Six contemporary studies are of particular relevance in the present study: a concise introduction to the general business circumstances is provided by the contemporary textbook Manes (1935). Contemporary accounting principles and practices are discussed in Lengyel (1927), a detailed contemporary guidance to insurance accounting written by the editor of the internationally renowned Austrian insurance yearbook "Assekuranz-Jahrbuch", Professor Samuel Lengyel[20]. A commentary on the German regulatory system is given by Moldenhauer (1903). The special aspects of reinsurance regulation and operations are provided in Hermannsdorfer (1931) respectively von Hollitscher (1931). Additionally the contemporary doctoral dissertation Kurtz (1937) provides relevant insight by analysing the underwriting cycle of the Interwar period using statistical arguments.

2.2.2 The general development of the German insurance market from 1919 to 1935

The following paragraph provides a concise overview of the historical developments affecting the German insurance market during the Interwar period. References are made to more detailed historiographical analyses where relevant. The general course of events is provided in Table (5).

The end of World War I and the 1924 currency reform The onset of World War I had a lasting impact on the German insurance sector. German insurance companies in general and especially the globally leading reinsurers were affected by the conflict as they were locked out of international markets.[21] At the end of 1923, the German economy was in general turmoil due to a quickly accelerating devaluation of the domestic currency, the Papermark.[22] This implied an artificially low cost of capital, which triggered a wave of foundations of private joint-stock insurance companies. In the two years 1922 and 1923 alone, a total of 192 reinsurance companies were founded, only a fraction of which survived the highly successful currency reform of 1924, which almost immediately ended the inflationary period in Germany.[23]

Increased market pressure during the "Roaring Twenties" Following the 1924 currency reform the German economy experienced a short spell of recovery colloquially referred to as the "Golden Twenties".[24] The German insurance sector entered a period of intense competition and the development of many new insurance products as described by Arps (1976*b*). Premium income and overall profitability remained at an unprecedented low level.[25] Persisting general market pressures promoted consolidation

[19] See Bähr & Kopper (2015, p.11).
[20] See Koch (1998, p.235) as well asFroehlicher (2013, pp.25-27).
[21] Compare in particular Borscheid (2007), Borscheid (2012, p.106) Arps (1976*b*, pp.16;19;34) and for the case studies *Allianz* and *Münchener Rück* Kölmel (2000).
[22] A detailed account of this episode is provided in Feldman (1997) and Holtfrerich (1986).
[23] See Gilles (1987, p.99) and for a contemporary analysis Hermannsdorfer (1931).
[24] Ritschl (2002) provides a thorough analysis of the macro-economic development in Germany until 1934.
[25] Compare with Kurtz (1937).

Table 5: Schematic chronological development of the German insurance market, 1901-1935

Year	Event	Relevance for insurance sector
1901	Insurance supervisory law	Consistent regulatory framework, applicable throughout period under consideration.
1914 to 1918	World War I	Lock-out from international markets.
1919 to 1924	Inflationary period	Devaluation of Mark-denominated investments, wave of speculative reinsurance foundations
1924	1924 currency reform	Introduction of new Reichsmark, leads to immediate economic stabilisation
1924 to 1928	Golden Twenties	Market consolidation, amalgamation.
1929	FAVAG collapse	Collapse of second-largest German insurance group leads to mandatory external auditing
1931	German banking crisis	Large-scale financial crisis - exposure of insurance limited by regulatory changes
1931 to 1933	World economic crisis	Global economic downturn, also known as "Great Depression" in the United States
1933 to 1935	"Machtergreifung"	National Socialist Party seizes political power
1934-1939	Cartellisation	Reorganisation of the German insurance sector

and amalgamation within the sector.[26] The German supervisory office was actively promoting take-overs, especially of companies that had been founded after 1919.[27] Whether acquisitions were motivated by rational considerations or by the sole intention to prevent competitors from acting first remains unclear. The largest merger occurred in 1927 when the expanding *Allianz* took over the largest German accident and liability insurer, *Stuttgarter Verein*.[28]

Prestigious company failures prior to the Great Depression period Even larger insurance groups were affected by pressure arising from rampant competition. Kluge (2006) provides evidence for distress in the prominent case of the *Münchener Rück* and *Allianz und Stuttgarter Verein*. This study shows in particular that the largest German reinsurer was effectively cross-subsidising losses in other business arrangements by the highly profitable strategic reinsurance treaty it had with *Allianz*. The default of the second largest group, FAVAG, in 1929 predated the similar but uncorrelated later failures of prominent German corporations and banks during the financial crisis of 1931. This failure was mostly attributed to management mistakes and fraud[29], which in turn also caused the German legislation to introduce the requirement of external audits for joint-stock companies in 1932.[30] Although constituting the largest and most prominent, the case of FAVAG was not the only failure of an insurance company prior to the Great Depression. *Vaterländische und Rhenania* had provided credit insurance via its subsidiary *Vaterländische Kredit* and was acquired by *Nordstern Allgemeine* in 1929 at the brink of insolvency and after a pronounced decrease in premium volume. The banking crisis of 1931 led to further record losses, which caused *Rheinische Gruppe* - a group of insurance companies led by the *Nordstern Allgemeine*, *Aachen-Münchener* and *Colonia Feuer* - to fully take over the share capital of *Vaterländische und Rhenania*.[31] Another insurance group of particular size, *Mutzenbecher Gruppe,* which had mostly been active in marine and transport insurance, succumbed to financial distress in 1932. The group holding company *Versicherungs-Gesellschaft Hamburg* was liquidated in this year and the second-largest company, *Albingia*, sold to the British insurer *Guardian Assurance*.[32] The founder and General Director until 1932, Franz Mutzenbecher, did nevertheless not refer to the Great Depression as the main reason for the default but to mistakes made during the 1920s by his brother in marine insurance operations.[33] The oldest reinsurance company, *Kölnische Rück*, also lost its independence to *Rheinische Gruppe* in 1932, under circumstances that suggest closer analysis.

[26] Case studies are provided in Arps (1976*b*, pp.51-54), Wältermann (2008), Pohl (2011) and Koch (2012).
[27] See Ruge (2001, p.35).
[28] See Borscheid (2012, p.107).
[29] This most prominent case study is examined in detail by Feldman (2002) and Modert (2004).
[30] Compare Alsheimer (1988).
[31] Compare Striezel (1976).
[32] See Koch (1995, p.279).
[33] See Mutzenbecher (1941).

The Great Depression period and beyond Although the German economy had entered into recession in 1928, it was not until a major banking crisis in summer 1931 that the Great Depression started in Germany.[34] As a response to the financial crisis the government issued a number of emergency decrees. German insurance companies were especially affected by the *Fourth emergency decree of 8 December 1931* ((German original, translated by the author:) "Vierte Notverordnung vom 8. Dezember 1931"), which reduced the nominal interest rate on all outstanding governmental debt from 8% to 6%. It also extended the protection against enforcement of payments and increased the maturity of mortgages. Especially the latter led to sharp criticism from the insurance sector.[35]

Further crisis legislation also affected the insurance sector in a positive way. The *Decree about the Simplification of Accounting Standards of 15 December 1931* ((German original, translated by the author:) "Bilanzierungserleichterungs-Verordnung vom 15. Dezember 1931") changed the general accounting principles.[36] It enabled insurance companies to value strategic assets by the purchasing price and not by the market value. All long-term investments in the asset portfolios of insurers were hence not affected by the substantial drop in market prices. Companies in countries where mark-to-market valuation remained in use, such as Switzerland, faced a much larger exposure to the financial turmoil of the Great Depression period.

There is no consensus regarding the question as to how the Great Depression affected insurance companies. Arps (1976*b*, pp.60-62) as well as Borscheid (2012, p.51) argue that the onset of the Great Depression especially led internationally operating companies to lose market shares. With respect to the actual performance, Gerathewohl (1982, p.748), however, postulates that insurance companies were in general performing exceptionally well in Germany. This is backed by the finding of Kurtz (1937) that the general underwriting performance was not correlated with the business cycle during the 1930s. This is contrary to the opinion expressed by Bähr & Kopper (2015, p.140), who state that the Great Depression period was marked by an increase in the number of insurance defaults. This lack of consensus indicates that further research is required.[37]

When the Nazi Party seized political power in 1933, the German insurance sector became gradually integrated into a new German economic order. The most relevant case study of insurance operations during the Nazi regime is provided by Feldman (2001) for *Allianz*. The market leader took over the implicit patronage for the whole sector. The German insurance market was ultimately reorganised from

[34]The 1931 financial crisis and the Great Depression in Germany have found considerable research attention. A selection of important general treatises not covering insurance are James (1987), Eichengreen (1996) and Ritschl (2002).

[35]The General Director of *Gotha Versicherung*, Hans Ullrich, outlined and commented on the recent developments at the 2nd annual general meeting of the German Insurance Association on 15 December 1931. Compare Ullrich (1931).

[36]The decree temporarily repealed §56 of the German Insurance Supervisory Law (Versicherungsaufsichtsgesetz) that dealt with the valuation of assets. It was overridden by §261 of the German Code of Commerce (Handelsgesetzbuch) that itself had been changed on 19 September 1931.

[37]Compare Ch. 3 and Ch.7.

1935 onwards, along the paradigms set out by the new regime.[38]

2.3 *Kölnische Rück* during the Interwar period

2.3.1 The loss of independence of *Kölnische Rück* in 1932/1933

The oldest active reinsurer, *Kölnische Rück*, lost its independence at the turn of the years 1932 and 1933. The first indicator for potential financial distress at *Kölnische Rück* nevertheless dated back to summer 1931, when a shareholder revision of the company's books was conducted.[39] The 1931 financial report had disclosed a reduction of RM 500,000 in free reserves together with a decreased dividend rate of 6% relative to 14% in the previous year. This caused suspicion amongst shareholders[40] and motivated the review. The results were in particular critical of how the company had accounted for the share buy-back activities that had been exercised by the company in the previous year. Due to their nature as partly paid-in name shares, the revisors argued that the buy-backs should have been accompanied with reductions in shareholder liabilities. Furthermore, it was noted that the financial statement of *Kölnische Rück* did not comply with the accounting rules detailed in the *Decree about the Simplification of Accounting Standards*. These issues were forwarded to the directors and the Supervisory Board of the *Kölnische Rück* on 22 August 1931. The Directors Grünwald and Bloch were able to dispel any criticism[41], although it would be found out in the later course of events that the concerns addressed by the shareholders were of detrimental relevance.

In summer 1932 the supervisory board of the company became aware of the reduced credit worthiness of one of the main shareholders of the company, the investment trust *Iduna-Holding*. It held partly paid-in shares of *Kölnische Rück* in the nominal value of RM 1.128 million with a pay-in rate of 25%. This amounted to 11% of all shares issued [42] as shown in Figure (1), or to callable shareholder liabilities of RM 846,000. The business model of the trust, however, was to raise capital in order to invest in other companies. Its dividend payout therefore was a direct derivative of the returns generated from underlying stocks. Following the financial crisis of 1931, *Iduna-Holding* had to reduce its capital stock from RM 23 million to RM 2 million.[43] These circumstances put the company's

[38] See Feldman (2001, p.196).

[39] See Historical Archive of General Re Germany. Rechungswesen Bilanzierungsunterlagen 1930 II.4 No.5040/1, *File note regarding the commission of the shareholder revision of 22 June 1931*, no page.

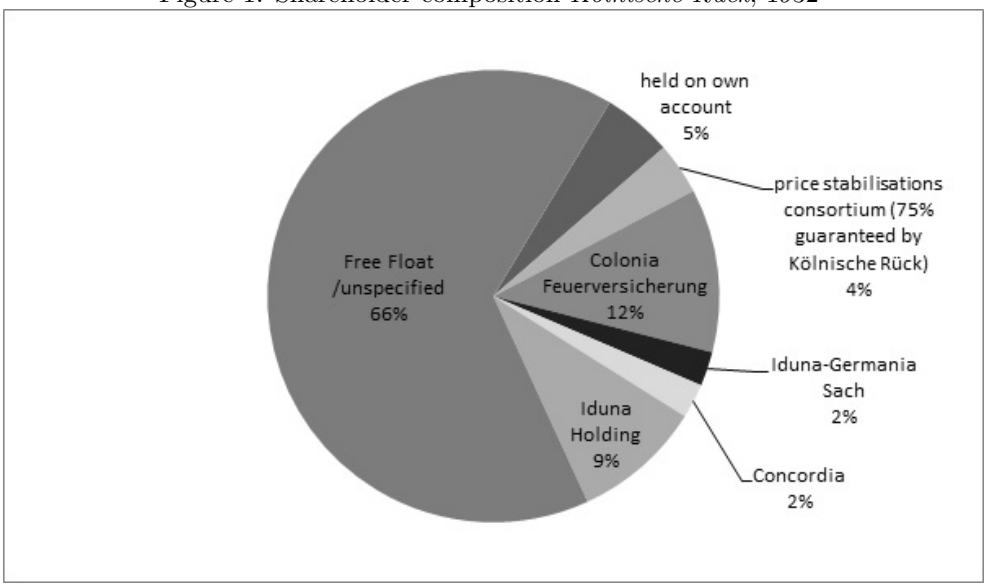
[40] "The concerns, which had already been expressed amongst business insiders against the business strategy of *Kölnische Rück* for years, increased following the publication of the statement of account disclosing the reduction of free reserves by RM 500,000 and recommended a dividend of only 6% relative to 14% in the previous year." [German original, translation by the author:] "Die Bedenken, welche in Fachkreisen schon seit Jahren gegen die Geschäftspolitik der *Kölnischen Rück* laut wurden, verstärkten sich nach Herausgabe des Rechnungsabschlusses, der eine Minderung der offenen Reserven um 500.000 RM auswies und eine Dividende von nur 6 v.H. gegenüber 14 v.H. im Vorjahre vorschlug." See Historical Archive AXA Germany. *Internal Memoirs Christian Oertel*, p.159.

[41] See Historical Archive of General Re Germany. *Letter Grünwald to Hans C. Leiden of 24 June 1931. Subject: remarks of the Misters der of the shareholder revision commission*, no page. See also Werner (2009, pp.56-57).

[42] Including the shareholding of the affiliated non-life insurance company *Iduna-Germania Sachversicherung*.

[43] See Historical Archive of General Re Germany. Protokollbuch Kölnische Rückversicherungs-Gesellschaft vom 05.03.1926 bis 07.12.1933, No. 5005/1. *File note regarding Supervisory Board Meeting on 30 June 1932*, p.167 (attached).

Figure 1: Shareholder composition *Kölnische Rück*, 1932



Note: Composition as of 29 November 1932.
Source: Historical Archive of General Re Germany. Einlage Protokollbuch Kölnische Rückversicherungs-Gesellschaft, *Notes regarding the meeting of the President of the German Insurance Supervisory Office with General Director Oertel of Colonia on 29 December 1932*, p.3

ability to meet its liabilities in the case of a call of capital by *Kölnische Rück* into serious question and led the supervisory board of the company to conduct another special internal revision into the financial situation.[44] This report concluded that the company was effectively illiquid as well as insolvent. Its available cash deposits of RM 300,000 - some of which were held abroad - did not match RM 970,000 in short-term bank liabilities. Additional debts of RM 5,328,993.68 were also getting due in the medium run, effectively causing the company to be insolvent.[45] It especially revealed a number of highly unprofitable reinsurance arrangements in domestic casualty and liability but especially in French motor reinsurance contracts. [46] Director Robert Pferdmenges of *Sal.Oppenheim* - house bank as well as important stakeholder - immediately informed the executives of the insurance group *Rheinische Gruppe*[47] about the situation. [48] This group decided to avert the default of the company due to two reasons: first, *Colonia Feuer* was exposed to the default of *Kölnische Rück* given that it was invested in 12% of the reinsurer's capital as evidenced by Figure (1). Second, it was assumed that an important direct competitor, *Schweizer Rück,* was interested in increasing its market share in the German direct

[44]See Historical Archive of General Re Germany, Protokollbuch Kölnische Rückversicherungs-Gesellschaft. *Record of the Supervisory Board meeting of 30 June 1932*, no page.
[45]See Historical Archive AXA Germany. Köln. Rück Akte National. *Report regarding the revision of Kölnische Rück*, no page.
[46]See Historical Archive of General Re Germany. Einlage Protokollbuch Aufsichtsratssitzungen der Kölnischen Rück. Nr. 5005/4. *Notes regarding the meeting of the President of the German Insurance Supervisory Office with General Director Oertel of Colonia on 29 December 1932,* p.3.
[47]The most important companies within this very heterogeneous insurance interest group were the composite insurance companies *Colonia* in Cologne, *National* in Stettin and *Aachener und Münchener* in Aachen.
[48]See Historical Archive of General Re Germany. *Notes regarding the meeting of the President of the German Insurance Supervisory Office with General Director Oertel of Colonia on 29 December 1932,* Einlage Protokollbuch Aufsichtsratssitzungen der Kölnischen Rück. Nr. 5005/4, p.2.

life insurance sector. The senior management at *Rheinische Gruppe* therefore expected the Swiss competitor to take over the life insurance company *Concordia Leben* in the subsequent liquidation of *Kölnische Rück*.[49] Representatives of *Rheinische Gruppe* met with the Insurance Supervisory Office on 30 November 1932 and successfully obtained the approval for the recapitalisation.[50] Four days later a financial action plan was finalised, the Directors of *Kölnische Rück* notified and put on leave on the very same day. Walther Schmitt of *Aachen-Münchener,* one of the revisors in 1932, became the new interim Director of the company.[51] The recapitalisation plan was presented to the shareholders at an extraordinary general meeting on 29 December, 1932. A total of RM 5,070,000 was used for necessary adjustments to the asset portfolio as well as to set up new free reserves of RM 505,085. The new nominal capital of RM 8 million with a pay-in rate of 25% was fully provided by *Rheinische Gruppe*. This restructuring plan thus meant that current shareholders would trade the nominal value of their investment against the ability to walk away from their existing shareholder liabilities. Faced with this choice, shareholders accepted the proposed restructuring plan. This caused the company to become a dependent subsidiary of *Rheinische Gruppe*.

2.3.2 The realisation of financial distress at *Kölnische Rück*

The restructuring plan of December 1932 required asset value adjustments for outstanding depreciation on real estate investments (RM 250,809.12) as well as write-downs on open claims (RM 1,303,216.17) respectively for other assets (RM 669,127.38).[52] The following sub-paragraph takes into consideration the write-downs conducted in the course of the restructuring in December 1932. It is shown that financial distress had not been due to immediate effects of the Great Depression. First, the relevance of the FAVAG default on changes in accounting standards is established. Second, changes to accounting principles in response to the 1931 Financial Crisis are introduced and discussed. Fourth, the dependence of *Kölnische Rück* on shareholder liabilities is shown to have originated from the new requirement for external auditing as well as correctly applying new accounting principles.

The case of FAVAG and the absence of external auditing in Germany until 1932 This build-up of hidden liabilities at *Kölnische Rück* had been promoted by the absence of external auditing and unanticipated changes to accounting standards. Regarding the former, external auditing for German

[49] Ibid.

[50] Following the circular of 10 March 1927 by the Supervisory Office, every purchase of more than 10% of share capital in an insurance company had to be approved first. See Lengyel (1927, p.44). During this period the Supervisory Office nevertheless actively promoted take-overs. See Ruge (2001, p.35).

[51] See Historical Archive of General Re Germany. Protokollbuch Kölnische Rückversicherungs-Gesellschaft vom 05.03.1926 bis 07.12.1933, No. 5005/1, *Protocol of the board meeting of 3 December 1932 and Protocol of a meeting between the Chairmen of the Board of Kölnische Rück with the Directors of the company on Saturday, 3 December 1932*, no page.

[52] Additional revaluation requirements originated from impaired mortgages of RM 27,040.75 and from restructuring costs of RM 95,067.10. See Historical Archive of General Re Germany. No.5283/9. *Preliminary report of profit and loss account Kölnische Rück as of 29 December 1932,* p.5.

joint-stock companies had been under discussion since the 1924 currency reform. The introduction of a new stable currency in 1924 had led to an increase in the cost of equity. The U.S. financial market with its strict requirement for external auditing was perceived as a potential additional source of capital. One of the discussed measures to increase the appeal of German insurance companies was the introduction of similar external auditing.[53] A commission was formed in order to assess the necessity and potential realisation of a reform. It nonetheless decided against such a reform, arguing first that the careful auditing of a larger German corporation would require an excessive amount of additional work and associated costs. Second, the number of trained auditors was assumed to be insufficient to meet the demand generated by introducing compulsory auditing requirements.[54]

The default of FAVAG in 1929 finally led to a shift in paradigms. Following the death of the company's long-term General Director Paul Dumcke, the new management conducted an internal revision of the financial position. Information was leaked to newspapers that the company had systematically published incorrect balance sheet information by hiding debt from insurance-unrelated risky business operations, which finally caused the take-over by *Allianz*.[55] As a consequence, three senior executives and members of the management board were put on trial and convicted to long prison sentences in February 1932.[56] Additionally, German insurance companies were made subject to external auditing by Art. 55 VAG as augmented by the *Law to change the law regarding private insurance companies* of 3o March 1931 ((German original, translated by the author:) "Gesetz zur Änderung des Gesetzes über die privaten Versicherungsunternehmen vom 30. März 1931".[57] Insurance companies that had been exempt from supervision were now made subject to the accounting standards required by the VAG, together with the necessity for external auditing and the adherence to the accounting rules detailed in the *Decree regarding the supervision of domestic private reinsurance companies of 2 December 1931* ((German original, translated by the author:): "Verordnung über die Beaufsichtigung der inländischen privaten Rückversicherungsunternehmen vom 2. Dezember 1931").[58] External auditing finally became mandatory on 19 September 1931 with the passing of the *Decree of the President regarding stock corporation law, banking supervision and a tax amnesty of 19 September 1931* ((German original, translated by the author: "Verordnung des Reichspräsidenten über Aktienrecht, Bankenaufsicht und eine Steueramnestie vom 19. September 1931"). This suggests that, even if the supervisory board had not conducted a special internal revision given the reduced quality of shareholder liabilities, the shortfall in asset valuation would nevertheless have become obvious at latest during the new mandatory

[53]These discussions took place in 1924 at the *33rd Annual Meeting of Lawyers* ((German original, translated by the author: "33. Deutscher Juristentag"). See Alsheimer (1988, p.16).
[54]See Alsheimer (1988, p.18).
[55]See for a general account Modert (2004).
[56]See Feldman (2002, p.62) and Modert (2004, p.33).
[57]See Alsheimer (1988, p.23).
[58]See Modert (2004, p.35).

external revision of the company in 1933 for 1932 accounts. From this perspective, the timing of events was therefore indirectly dependent on the earlier default of FAVAG, but independent from the 1931 Financial Crisis.

Accounting requirements for insurance companies before and during the Great Depression

The banking crisis of summer 1931 led the legislator to change accounting rules for the asset portfolios of insurance companies. This practice was intended to limit the debt deflation pressure of falling market prices on insurers as typical hold-to-maturity investors. It had found its first successful application in the United States during the 1907 Financial Crisis and was again used in 1914 as well as during the economic recession from 1918 until 1921[59]. U.S. state insurance supervisory offices, co-ordinated by the National Association of Insurance Commissioners (NAIC), again temporarily applied accounting changes in 1931. U.S. insurance companies were, for instance, allowed to use a stock market index of 103.2 points instead of actual 57.7 points and a bond price index of 95.1 points instead of an actual 72.5 points on 31 December 1931. This measure proved to be highly successful.[60]

Until 1923 all German private joint-stock companies active in commerce and industry were subject to the accounting requirements detailed in §40 and §261 of the German *Code of Commerce* ((German:) "Handelsgesetzbuch" (HGB)).[61] The purchasing price was defined as the minimum and the market price as the maximum accounting value. This implied that insurance companies could report profits if market prices were high, but could limit losses if otherwise given that the value was bounded by the purchasing price. This approach caused artificially inflated exchange prices especially during the German hyperinflation period until 1923. Consequently, an amendment to VAG Art. 55(a) of 16 July 1923 required insurance companies to use the average market price of the last six calendar months of the business year, excluding the highest and lowest quotation. The use of the last quoted market or purchasing price was permitted only if this resulted in a lower valuation compared to the standard method.[62] This change exposed companies to fluctuations in their mark-to-market valuation and

[59] See Magrath (1934, p.281).

[60] See Magrath (1934, pp.289-290).

[61] Art. 40 HGB: "When establishing the inventory and the balance, all assets and debts are to be set to the value at the point in time for which this accounting takes place." (German orginal, translated by the author:) "Bei Aufstellung des Inventars und der Bilanz sind sämtliche Vermögensgegenstände und Schulden nach dem Wert anzusetzen, der ihnen in dem Zeitpunkt beizulegen ist, für welchen die Aufstellung stattfindet." See Lengyel (1927, p.116).

Art. 261 HGB: "Financial assets and other investment products that feature an exchange or transaction value are to be accounted using the exchange or selling price realised at the point in time for which the balance applies. The accounting is to take place in two separated balance positions. The first balance position ("purchasing values") is to report the amount of purchasing or production prices of financial assets and other investment products. The second balance position ("excess values") is to report the excess amount of the exchange or selling price at the point in time relevant for the production of the accounts exceeding the purchasing and production price of financial assets and other investment products." (German orginal, translated by the author:) "Wertpapiere und sonstige Vermögensanlagen, die einen Börsen- und Verkehrswert haben, sind zu dem Börsen- und Verkaufspreise des Zeitpunktes, für den die Aufstellung der Bilanz erfolgt, in die Bilanz einzustellen. Die Einstellung in die Bilanz hat in zwei getrennten Bilanzposten zu erfolgen. Der eine Bilanzposten (Beschaffungswerte) hat den Betrag der Anschaffungs- und Herstellungspreise der Wertpapiere und sonstigen Vermögensanlagen und der zweite Bilanzposten (Überwerte) denjenigen Betrag auszuweisen, um den der Börsen- oder Verkaufspreis des Zeitpunktes für den die Aufstellung der Bilanz erfolgt, den Anschaffungs- und Herstellungspreis der Wertpapiere und sonstigen Vermögensanlagen übersteigt." See Lengyel (1927, p.86).

[62] § 55(a) VAG: "Securities featuring an exchange or market price may not be valued within the statement of accounts

Table 6: Asset portfolio valued as strategic, 1932

Valuation of asset portfolio as strategic	Companies	Full	Partially	Not
Life	53	30	14	9
Non-Life incl. reinsurance	34	7	8	19

Note: The survey was anonymous and not representative.
Source: Ullrich (1931, pp.16-18)

to the 1931 banking crisis in Germany. The supervisory office limited contagion via this accounting transmission channel by the *Decree about the Easing of Accounting Standards of 15 December 1931* ((German original, translated by the author:) "Bilanzierungserleichterungs-Verordnung"). It temporarily reinstated the requirements of the original HGB §261 for strategic investments and thus reduced the pressure of decreasing market values on the balance sheets.[63] The condition that assets had to be "strategic" was, however, not clarified. This caused considerable confusion amongst insurers. Based on a small survey, 30 out of 53 life insurance companies declared the whole asset portfolio as strategic due to the nature of life insurance as buy-and-hold investment in illiquid assets. Given the increased need for liquid funds, only seven out of 34 non-life insurers declared the complete asset portfolio as strategic. Table (6) provides the results of a short internal survey presented to the 1931 general assembly of the German Private Insurance Association (German: "Reichsverband der Privatversicherung") and illustrates the general confusion amongst companies.[64] Ullrich (1931, p.22) further recommended that

> it should be avoided to rest the calculation of annual balances on inappropriate politics on prestige, but rather to ensure the intrinsic strength of the corporation by means of substantial write-offs, strong reserves and a careful dividend policy.[65]

This uncertainty regarding appropriate accounting requirements together with the absence of external revisions therefore provided companies with unintended opportunities to hide losses.

using a higher price than the exchange or market prices of the point in time for which the balance applies. If the price exceeds the average price derived from the first exchange quotations of the last six calendar months of the business year, only the average price may be used as a maximum, or the purchasing price if it does not exceed the exchange or market price. The highest as well as the lowest price are not to be taken into account when calculating the average price." (German original, translated by the author:) "Wertpapiere, welche einen Börsen- oder Marktpreis haben, dürfen in dem Rechnungsabschluß in keinem Falle zu einem höheren Preis eingesetzt werden, als dem Börsen- oder Marktpreise des Zeitpunktes, für welchen die Bilanz aufgestellt war. Übersteigt dieser Preis den Durchschnittspreis, welcher sich aus den ersten Börsenpreisen der letzten sechs Kalendermonate des Geschäftsjahres ergibt, so darf höchstens dieser Durchschnittspreis eingesetzt werden, oder der Anschaffungspreis, insoweit dieser den Börsen- oder Marktpreis nicht übersteigt. Bei der Berechnung des Durchschnittspreises ist der höchste und der niedrigste Preis unberücksichtigt zu lassen." See Lengyel (1927, p.33).

[63] See in general Ullrich (1931, p.13).

[64] See Ullrich (1931, pp.16-18).

[65] (German original, translated by the author:) "Des weiteren möchte ich dringend dazu raten, bei der Aufstellung der Jahresbilanzen keine unangebrachte Prestigepolitik zu treiben, sondern durch kräftige Abschreibungen, starke Rücklagen und eine vorsichtige Dividendenpolitik für die innere Stärkung der Gesellschaften zu sorgen." See Ullrich (1931, p.22).

Table 7: Reported and market value asset portfolio *Kölnische Rück*, 1924 to 1935

Year	Market value	Reported value	Difference
1924	4,053,368.14		
1925	4,252,253.48		
1926	4,479,403.52		
1927	5,363,492.48	5,043,562.20	+ 319,930.28
1928	14,090,714.27	13,439,921.71	+ 650,792.56
1929	9,314,743.68	8,790,186.36	+ 524,557.32
1930	11,216,370.60	10,602,351.84	+ 614,018.76
1931	10,514,259,91	12,733,914.39	- 2,219,654.48

Note: All values in Reichsmark.
Source: Dataset II "Companies", Historical Archive AXA Germany. Köln. Rück Akte National, *Germany Report regarding the revision of Kölnische Rück*

Increased dependence on shareholder liabilities - the approach of *Kölnische Rück* to asset valuation *Kölnische Rück* was amongst the seven non-life companies that valued its whole asset portfolio as strategic. This caused the demand for write-downs of approximately RM 2 million in 1932 and also wiped out the hidden reserves of the company. Much in contrast to *Münchener Rück,* the company had not made use of the 1924 currency reform to build up hidden reserves. [66] *Kölnische Rück* built up relevant hidden reserves throughout the late 1920s in its securities portfolio. Reported and market values for the year 1924 to 1935 are provided in Table (7). This indicates that the company had maintained a relatively constant amount of at least RM 500,000 as hidden reserve from 1928 until 1930. This was nevertheless lost due to the decrease in market values of non-strategic assets, which ultimately increased the dependence of the company on shareholder liabilities as a source-of-last-resort for liquid funds.

2.3.3 Reasons for structural distress - the role of prestige

The default of the second largest German insurance group, *Frankfurter Allgemeine Versicherungs AG* (FAVAG) in August 1929 marked a decisive development in the German insurance sector. Contemporary commentators as well as later researchers stressed the relevance of a business strategy that rested upon the promotion of prestige. The following line of argument shows that the failure of FAVAG shares similarities with the motivations for the business decisions that ultimately led to *Kölnische Rück* losing its independence in 1932. This established in particular the relevance of the 1924 currency reform on which later business strategies depended upon.

[66] In 1920, the largest German reinsurance company had invested 6 million Goldmark, followed with an additional 25 million Goldmark in 1921. In 1924 it owned a total of 48 residential and commercial property units in Munich alone. When faced with the question of how to value this, it was decided to account investments at only 60 per cent of the total value of commercial and 25 per cent of residential real estate in the 1924 gold account statement. See Herzog (no year, pp.812-813).

"Putting prestige first" at FAVAG The earlier failure of FAVAG was related to a business strategy that was "putting prestige first".[67] From 16 August until 19 August 1929, a series of newspaper articles had made public the dire financial situation of the group. These articles made well-informed accusations of reporting fraud and mismanagement. Kurt Schmitt, General Director of *Allianz*, and Wilhelm Kisskalt of *Münchener Rück* agreed to take over the complete direct underwriting portfolio of FAVAG on 20 August 1929 and founded *Neue Frankfurter Allgemeine Versicherungs-AG* on 21 August 1929. This averted a substantial crisis within the German insurance sector.[68] The main reason for the company's distress was found in the fact that FAVAG had been heavily engaged in business outside of its core competence:

> FAVAG had collapsed because of a speculative mix of bad decisions in the field of indirect insurance, banking, activities inappropriate for an insurance company, an inorganic concern structure, and conflation of the concern's interests with the personal enterprises of the directors. In the process FAVAG had accumulated very high debts - including short-term debts in Switzerland, England, and the Netherlands - for the financing of long-term projects. German supervisory institutions, both governmental and private, had obviously failed to do their job.[69]

An expert commission investigated the causes of the collapse and concluded that one motivation for the company to engage in non-core business activities originated from an undercapitalisation that could be traced back to the 1924 currency conversion. Director Kurt Schmitt of *Allianz* explicitly mentioned the relevance of the 1924 gold conversion in the collapse of the company:

> The excessively high demands on the capital resources of the company necessarily arose from the exaggerated conversion to gold of *Frankfurter Allgemeine*. The decision to enter into dangerous financial engagements also arose from the effort to master these difficulties, which in the last analysis led to the collapse of the *Frankfurter*.[70]

In conclusion, contemporary commentators traced the later financial distress back to the interest of the senior management to "put prestige first.[71]

[67] Feldman (2002) and Modert (2004) examine the course of events in detail, whereas Gerathewohl (1982, p.746 Fn.444) and Koch (2012, p.273) are exemplary for how the case of the FAVAG is generally perceived as a historically singular event in the literature.

[68] Bähr & Kopper (2015, pp.37-38) argues that the take-over by *Allianz* illustrated the relative strength of the German insurance sector given that event the default of the second largest group had not necessitated the intervention by the regulator.

[69] See Feldman (2001, p.22).

[70] See Feldman (2001, p.22).

[71] "There was only one gold currency reform. Later the very same process was called recapitalisation. Those who forewent in 1924 to "put prestige first", those who chose reason as the first option proven right in subsequent years. Favag did not choose this path. Many went with it. This is the reason for us to conclude that the gold account balance should have featured five million Reichsmark less than what actually was reported." (German original, translated by the author:) "Eine Goldumstellung gab es nur einmal. Weiterhin hieß der gleiche Vorgang Sanierung. Wer 1924 darauf verzichtete das

"Putting prestige first" at *Kölnische Rück* This link between the 1924 currency conversion, questionable business practices and later financial distress was also attributed to *Kölnische Rück*. Contemporary commentators blamed the financial distress of the oldest reinsurance company on the business strategy of the executive management. Both Director Wilhelm Kisskalt of *Münchener Rück*[72] and Director Christian Oertel of *National Versicherungs AG*[73] stressed the personal responsibility of the Directors. In addition, Wilhelm Kisskalt was generally critical of the internal financial conditions of reinsurance companies. He rested his opinion on the take-over of *Düsseldorfer Rück* in 1929 as a subsidiary of FAVAG by *Münchener Rück* in concert with *Allianz*.[74] Christian Oertel described especially Gruenwald as not well regarded amongst colleagues. He especially pointed out the role of prestige in the decision surrounding the currency conversion in 1924 that turned out to be a defining moment for the structural problems of *Kölnische Rück*:

> If *Kölnische Rück* continued to lose out on its German business throughout the previous years and was about to lose its reputed position, then this was in first place due to the personality of Mr Gruenwald, who was not well regarded amongst the German colleagues due to his exalted behaviour and who engaged into the mistake of a fateful prestige policy. *Kölnische Rück* for instance believed that it had to disclose its share capital as high as possible in the gold conversion (1:1), even if the necessary intrinsic values were not present due to loss of business during the inflationary period and the losses incurred during the war years. It was hoped that a rapid business recovery would set in that would allow to align balance values with actual actual time values. Instead, business disappointments materialised. Some connections and interests abroad as well at home turned out to be unsatisfying and very expensive. In any case, the gap caused by the gold conversion could not be filled.[75]

This motivates to analyse the direct effect of the 1924 currency conversion on the business operations of Kölnische Rück during the Golden Twenties period.

'Prestige voranzustellen', wer dem Verstand die Vorhand gab, dem gab die spätere Zeit recht. Die Favag wählte diesen Weg nicht. Mit ihr gingen viele. Deswegen wollen wir uns mit der Feststellung begnügen, dass die Goldbilanz ein um etwa 5 Millionen GM [Goldmark] niedrigeres Kapital ausweisen musste." See Modert (2004, p.32).

[72] See *Bähr & Kopper (2015, p.142)*.

[73] See Historical Archive AXA Germany. *Internal Memoirs Christian Oertel*, pp.156-190.

[74] Compare Herzog (no year, p.793).

[75] (German original, translated by the author:) "Wenn die Kölnische Rück vor allem im deutschen Geschäft in den letzten Jahren mehr und mehr ins Hintertreffen kam und im Begriff stand, ihre angesehene Position zu verlieren, so war das in erster Linie der Persönlicheit von Herrn Gruenwald zuzuschreiben, der sich infolge seines gezierten Benehmens im Kreise der deutschen Kollegen allgemeiner Unbeliebtheit erfreute und in den Fehler einer verhängnisvollen Prestigepolitik verfiel. So glaubte die Kölnische Rück, bei der Goldumstellung (1:1) ein möglichst hohes Aktienkapital ausweisen zu müssen, auch wenn dafür nach dem Geschäftsschwund der Inflationszeit und den Geschäftsverlusten der Kriegsjahre die entsprechenden materiellen Innenwerte nicht vorhanden waren. Man hoffte, daß rasch eine Wiederanreicherung der Geschäfte eintreten werde, womit dann die Bilanzbewertungen mit den tatsächlichen Zeitwerten in Übereinstimmung gebracht werden könnten. Statt dessen kamen geschäftliche Enttäuschungen. Manche Verbindungen und Interessen im Ausland wie im Inland erwiesen sich als unbefriedigend und sehr kostspielig. Jedenfalls konnte der bei der Goldumstellung entstandene Hohlraum nicht ausgefüllt werden[.]" See Historical Archive AXA Germany. *Internal Memoirs Christian Oertel*, p.158.

Accounting the value of pre-1924 assets and capital following the 1924 currency reform

In line with the 1924 currency reform the *Decree regarding the gold accounts* of *28 December 1923* ((German original, translated by the author:) "Verordnung über die Goldbilanzen vom 28. Dezember 1923" required German companies to set up a specific balance of accounts denominated in Goldmark – the *Goldmark opening balance* ((German original, translated by the author:) "Goldmarkeröffnungsbilanz"). The main problem was that the market value of assets held by German corporations was uncertain after four years of war and another four years of political instability and inflation. This was in particular true for the valuation of the capital stock of joint-stock companies. The decree required that it be calculated as the total asset value net of liabilities denominated in Dollar-pegged Goldmark (GM) or post-reform Reichsmark (RM). This practice was far from accurate and gave joint-stock companies the implicit freedom to deliberately choose the value of the respective capital stock.[76] Joint-stock insurance companies were required to evaluate the book value of assets purchased before the war or during the hyperinflation period. Although the devaluation of the *Papermark* had caused artificially low cost of capital, capital raised between 1914 and 1923 was not by definition worthless in 1924. This is further supported by the case of *Gerling Grup*pe, which came into existence during the immediate years after World War I and established itself as one of the strongest German insurance groups due to aggressive M&A activities prior to 1924.[77]

Promoting prestige through the 1924 currency reform - the example of *Kölnische Rück*

Kölnische Rück had not increased its capital during the inflation period. In addition, senior management had decided to keep its capital stock constant by following a conversion rate of 1:1 against 1923 as well as 1913 values.[78] It is of specific interest that the *Kölnische Rück* was the only reinsurance or transport insurance company of considerable size applying this conversion rate. The decision to apply a 1:1 conversion was only followed by eight companies out of a sample of 271 as shown by Table (8). It shows that *Kölnische Rück* was the oldest as well as the largest company to apply this rate. It was followed by *Friedrich Wilhelm Leben*, a life insurance company that had been taken over by the *Gerling Konzern* in 1922. It can be assumed that this company was still in possession of pre-war assets. The third largest, *Agrippina,* was a specialised transport insurance company that most likely had access to foreign currencies during the inflationary period. Two other companies, *Kraft VAG* and *Brandenburger Spiegelglas*, were both subsidiaries of *Allianz* and highly specialised companies - the former on motor, the latter on glass insurance - of limited size. Three other specialised reinsurance companies, *Minerva*, *Mercur* and *Bayerische Rück,* also applied this conversion rate. The first two were subsidiaries of *Kölnische Rück* and and were merged into the latter in 1928. The last company,

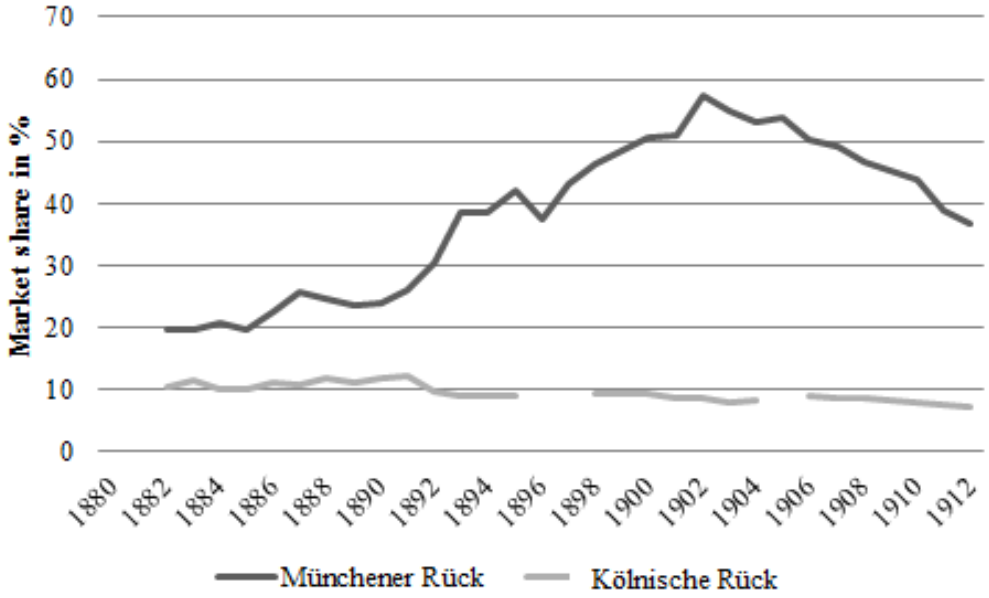
[76] See Opel (2007, pp.142-143).
[77] See Koch (2012, p.269).
[78] Data is taken from Dataset I "Gold Account".

Table 8: German companies applying a 1:1 conversion rate, by size

Year of Foundation	Total asset value	Name	Line	Capital stock 1913	1923	1924	Group affiliation
1846	28,837,630	*Kölnische Rück*	Reinsurance	9	9	9	*Kölnische Rück*
1866 (1922)	26,124,839	*Friedrich Wilhelm*	Life	6	6	6	*Gerling*
1844	11,388,001	*Agrippina*	Transport	3	3	3	*Agrippina*
1886	9,266,599	*Minerva*	Reinsurance	4	4	4	*Kölnische Rück*
1911	4,763,744	*Mercur*	Reinsurance	2.4	2.4	2.4	*Kölnische Rück*
1918	2,685,266	*Kraft VAG*	Motor	-	1	1	*Allianz*
1911	2,523,257	*Bayerische Rück*	Reinsurance	1	1	1	*Schweizer Rück (1924)*
1864	1,469,454	*Brandenburger Spiegelglas*	Glass	0.6	0.6	0.6	*Allianz*

Note: Total asset value in GM and of year 1924. Capital stock in GM.
Source: Dataset I "Gold Account"

Figure 2: Development market share *Kölnische Rück*, 1880 - 1913



Note: German market share in gross premiums earned relative to total market premiums.
Source: Kluge (2006, p.238 Table II)

the specialised reinsurer *Bayerische Rück* was soon to be taken over by *Schweizer Rück* in 1924. This suggests that *Kölnische Rück* was amongst the few companies that chose to promote its reputation through the decision to value its pre-1924 capital.[79]

Comparing pre-war to post-war business development The pre-1914 prestige of *Kölnische Rück* rested upon its excellent market share and profitability. Before 1914, the company had established itself as the second strongest reinsurer in the German market. It maintained a constant market share of roughly 10%, even when its main competitor started to lose market share after 1903 as shown in Figure (2). The onset of World War I meant that the formerly leading German companies were locked

[79]Conversion rates deemed too optimistic were not limited to the 1:1 rate. This was merely the most extreme case. FAVAG, for instance, chose a conversion rate of 12.5:1.

Table 9: Premium income French reinsurance companies, 1928

Company name	Foundation	Gross premium income
Soc. An. de Réassurances	1884	173,083,270
Atlantide Réassurances	1890	443,566
La Réassurances Nouvelle	1904	55,602,909
Havraise de Réassurances	1905	84,557,516
Cie Européenne	1913	113,507,023
Française de Réassurances	1916	173,282,647
Parisienne de Réassurances	1916	17,967,927
La Polaire	1917	28,946,688
Seine et Rhône	1917	13,400,100
National Réassurances	1918	102,542,865
Océanide	1918	32,293,800
Les Réassurances	1919	130,601,21
Générale de Réassurances	1920	33,862,360
La France Réassurances	1921	22,855,735
Le Consortium M.D.P.	1924	1,091,460
National Crédit et Ré.	1924	69,598,180
Cie de Co. & de Réassurance	1926	8,469,669
Sum founded pre-1914		427,194,293
Sum founded post-1914		634,912,642
Sum Total		1,062,106,935

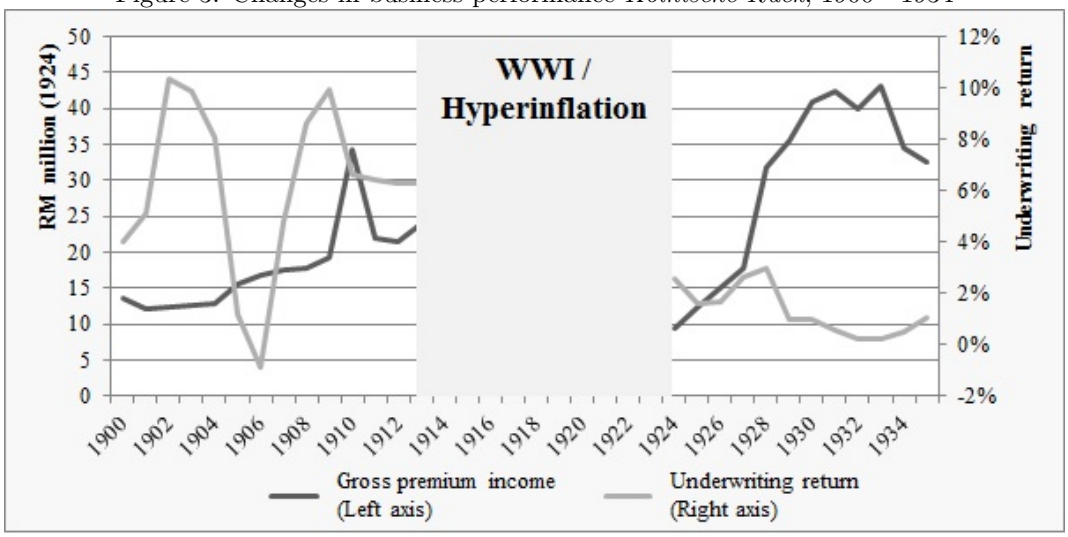
Note: Gross premium volume in French Franc for business year 1928.
Source: The Review, 8 November 1929, p.1126

out of international markets.[80] For *Kölnische Rück* this development led to an immediate decrease in underwriting profits from over GM 60,000 in 1913 to the value of GM 20,000 in 1924. The lock-out of the dominating German companies motivated the foundation of specialised reinsurance companies in countries that had relied on reinsurance protection from Germany. As shown in Table (9) for example, of the 17 French companies active in reinsurance in 1928, 12 had been founded after 1914. These new companies collected approximately 60% of gross premium volume in France. This stands evidence for the problems of *Kölnische Rück* to reclaim its pre-war position in the now highly competitive French market.

The response on the domestic market was an expansion in premium volume from 1924 onwards. Profitability did not follow this trend, indicating that now contracts were underwritten that yielded higher incurred losses relative to pre-war standards as shown in Figure (3). Whilst gross premium volume increased substantially during the 1920s, the profitability of the underwriting business - expressed as the underwriting return - did not return to the high pre-war trend which had only been temporarily interrupted by the expenses necessitated by the 1906 San Francisco earthquake. Even in the absence of low-probability / high-cost events, underwriting returns remained close to an average of about 2% with a drop in 1929, probably associated with the failure of FAVAG.

[80] Compare in particular Borscheid (2007).

Figure 3: Changes in business performance *Kölnische Rück*, 1900 - 1934



Source: Kluge (2006, p.240 Table II)

The follow-up costs of the 1924 currency conversion decision The ex-ante decision to maintain pre-war capital levels was not matched by a a return to the profitable business conditions of the pre-World War I period. It is therefore of particular interest to measure the cost of the decision to maintain pre-war capital levels. This is done by comparing the actual payout to shareholders with a counterfactual scenario, in which - all else equal - *Kölnische Rück* followed the same conversion strategy as its main competitor, *Münchener Rück*. Starting from GM 30 million in 1913 the latter company raised capital so that it featured a total of PM 120.75 million at the end of 1924. It decided to apply a 10:1 conversion rate to reduce its capital to RM 12.075 million with a pay-in rate of 25%. This translates into a conversion rate of 2.5 from pre-1914 to post-1924 capital. This ratio is more comparable to the case of *Kölnische Rück* since the company had not chosen to increase its capital between 1913 and 1924.

Comparing actual historical payout to shareholders with the theoretical amount based on the counterfactual scenario that the company had applied a 10:1 conversion rate instead allows to quantify the opportunity costs of the decision to use a 1:1 conversion rate. Two relevant key performance indicators also warrant consideration. The first is the return on equity (ROE) that measures the dividend payout received per initial capital employed per period, or

$$ROE = \frac{Dividend\,payout}{Capital\,employed}. \tag{2.1}$$

Only the paid-in amount is considered in case of partly paid-up name shares. This indicator was commonly reported in the annual statement and is therefore considered as an important indicator. It measures the shareholder return on investment and therefore the nominal cost of capital rate of the insurance company. The Denominator and the numerator both depend on the discretion of the

Table 10: Counterfactual analysis divided payout by Kölnische Rück, 1926 to 1931

Year	Earnings	ROE	Actual (1:1)					Counterfactual (12:5.1)				Absolute difference	
			Capital	Paid-in	Dividend	ROE	DPR	Capital	Paid-in	Dividend	DPR	Dividend	DPR
1926	320	12%	9,000	1,800	216	12%	68%	3,600	720	86	27%	130	41%
1927	576	20%	9,000	1,800	360	20%	63%	3,600	720	144	25%	216	38%
1928	1,207	15%	12,200	3,050	458	15%	38%	4,880	1,220	183	15%	275	23%
1929	558	12%	12,200	3,050	366	12%	66%	4,880	1,220	146	26%	220	39%
1930	560	12%	12,200	3,050	366	12%	65%	4,880	1,220	146	26%	220	39%
1931	353	6%	10,000	2,500	150	6%	42%	4,000	1,000	60	17%	90	25%
Total	3,574				1,916		54%			765	21%	1,151	32%

Note: Surplus, capital, capital paid-in and dividend paid are denominated in thousand RM. The assumed conversion rate reports the exchange of 1913 capital into 1924 capital. The chosen counterfactual rate was applied by *Münchener Rück* in 1924. The counterfactual dividend paid amount is rounded. Totals are undiscounted.

Source: Dataset I "Gold Account", Dataset II "Company"

company and its shareholders who agree on the proposed dividend payout or new capital raises at the annual general meeting.

The second KPI is the dividend payout ratio (DPR), which expresses the amount of dividend payout per net earnings per period, or

$$DPR = \frac{Dividend\,payout}{Net\,earnings}. \tag{2.2}$$

It measures the utilisation of net earnings for shareholder compensation and features a stochastic element in the form of net earnings that is absent in the case of the purely deterministic ROE.

If the management board of a company is interested in maintaining a stable and consistent ROE, i.e. in excess of the 8% nominal interest offered by contemporary German sovereign debt, any changes to the employed capital need to be matched by a likewise change in dividend payout. These changes become directly observable in the DPR as the company expends more (less) on dividend payout relative to net earnings in the case of increased (decreased) capital employed. Applying different conversion rates during the 1924 Currency Reform featured the same effect: companies applying a lower conversion rate decreased the reported level of capital employed and thus required a lower DPR to finance a desired ROE, i.e. in excess of 8%. In the present case, the opportunity cost of choosing a 1:1 conversion rate can be measured by comparing the performance indicators reported for *Kölnische Rück* with the counterfactual values based on the hypothesis that the company had - all else equal - used the conversion rate of *Münchener Rück.* The results are provided in Table (10). Between 1926 and 1931, *Kölnische Rück* disclosed total undiscounted earnings of RM 3.57 million. It utilised RM 1.9 million or a DPR of 54% for dividend payout cashflows. If the company had applied the conversion rate of *Münchener Rück* whilst maintaining the actual ROE rate, it would have distributed only RM 756,000 or a DPR of 21%. This shows a difference of RM 1.151 million - or an absolute difference in DPR of 32% - that had been paid in excess. Hence, *Kölnische Rück* spent nearly a third of its total earnings

between 1926 and 1931 due to its application of the 1:1 conversion rate. This is even more relevant as dividends were paid out in cash, meaning that the company was subject to a constant drain on liquidity throughout the late 1920s. The counterfactual comparison shows the substantial impact the 1924 decision had on the business operations of the company during the Golden Twenties.

2.4 Similarities of FAVAG and *Kölnische Rück*

The first part of the present chapter outlined the historical developments in the German insurance sector during the Interwar period. It provided an overview over relevant historiographical work. With particular relevance in the present context, a prevailing disagreement regarding the effect of the Great Depression on German insurers was identified.

The second part was dedicated to the case study of *Kölnische Rück*. It first showed the historiographical circumstances of its take-over in December 1932 / January 1933. The identified demand for write-downs was associated with the absence of external revisions as well as the wrongful application of new accounting principles in the wake of the 1931 Financial Crisis. It was also demonstrated that the overall liquidity shortage of the company was dependent on its intention to promote prestige during the 1924 currency reform. This mirrored identical considerations at FAVAG. This company defaulted in August 1929 and led to the introduction of mandatory external revisions for insurance companies. The application of an overly optimistic conversion rate in 1924 was shown to fall short of the actual market conditions in Germany as well as France, a market where *Kölnische Rück* was especially active in. In contrast, it caused a total undiscounted aggregate opportunity cost of RM 1.151 million in cash dividends. Of the recommendations made by Ullrich (1931, p.22) to avoid "inappropriate politics of prestige" in favour of promoting "the intrinsic strength of the corporation by means of substantial write-offs, strong reserves and a careful dividend policy", *Kölnische Rück* effectively violated all. The immediate of the 1931 Financial Crisis appeared to be of less relevance for the insurance market in general and the cases of FAVAG and *Kölnische Rück* in particular. First, the emergency accounting changes - a proved method to counter debt-deflatory processes in insurance - biased reported asset portfolio values. Second, although *Kölnische Rück* lost its independence during the Great Depression, this can not be immediately associated to the economic crisis. Although doubts regarding the credit worthiness of an important shareholder motivated the internal revision, it is very likely that the questionable liquidity and solvency position would have also been identified in the then-mandatory external revisions. This allows to conclude from a business historical perspective that the German insurance sector was more negatively affected by the conditions of the Golden Twenties than the Great Depression period.

3 Determinants of market exit in the German insurance sector during the Interwar period

3.1 Measuring default in the German Interwar insurance market

Ensuring the ability to meet policyholder liabilities is one of the main paradigms in insurance supervision.[81] Monitoring companies on a continuous basis is nevertheless a complex task even during period of relative economic stability.[82] Further complexity is introduced by the finding of Hayn (1995) that losses are less likely to be perpetrated in accounting data due to shareholder activities. This occurs if shareholders pre-emptively discontinue companies before losses can be realised. This leads to the hypothesis that market exit statistics of companies feature a similar "endogenous survivorship bias". This is in particular relevant for the German insurance market during the Interwar period given that this might explain the relatively low number of actual defaults during the Great Depression. The econometric assessment is conducted on the basis of a two-step case-control study that features an unconditional and a conditional generalised linear model specification applying a probit link function (probit regression). Data is taken from the 1924 *Goldmark opening balance* ((German original, translated by the author:) Goldmarkeröffnungsbilanz) of insurance companies as reported in *Neumanns Versicherungsjahrbuch*. This dataset is referred to as Dataset I "Gold Account" in the following. Default information is collected from the dedicated sections in the editions from 1925 to 1935 of *Neumanns Versicherungsjahrbuch*.

The chapter is structured as follows: first, the historical background statistics of insurance market exits are presented. Second, the concept of "endogenous survivorship bias" is introduced in the context of structural as well as first-passage credit risk models. Third, the econometric model is specified including a detailed discussion of the selected predictor variables as well as an introduction. Fourth, the novel hand-collected dataset is described that provides the empirical foundation of the analysis. Fifth, model estimates are provided and discussed. The following conclusion provides a connection between the findings and modern credit risk modelling approaches.

This analysis contributes new empirical, methodological and theoretical insights to the present literature. First, it establishes the relevance of 1924 *Gold opening account balance* data for the analysis of the Interwar period as a whole. This motivates a further cross-sectional analysis covering different industrial and commercial sectors during the same period. Second, a new econometric approach is introduced that is based on the use of different specifications of predicted variables in the context of a pre-defined predictor model. This is motivated by similar approaches in signal detection theory and

[81] See in general Farny (2006, p.100) and for a contemporary analysis Moldenhauer (1903, pp.69-75).

[82] Cummins et al. (1995) analyse the accuracy of the risk-based capital formula for non-life insurance companies that was adopted by the National Association of Insurance Commissioners (NAIC) in the United States during the early 1990s. Based a large data set covering the United States in the period from 1989 to 1993 the study examined potential determinants of default. The main finding is that the predictive accuracy of the formula is low.

offers a new interpretation of the receiver-operating characteristics curve, or C-statistic. Third, this chapter provides relevant insight on structural credit risk modelling.

A main limitation in empirical terms is that time-dependent variables could not be included due to data concerns. This further motivates similar studies on different sectors during the Interwar period.

3.2 Historical background: corporate defaults during the Interwar period

The economic history of the German Interwar period can be broadly classified into two sub-periods: starting with the 1924 currency reform, the German economy experienced a short spell of economic expansion that was fuelled by foreign lending. Starting in 1928, the economy started to slip into a recession. Until Summer 1929, the German insurance industry underwent a strong amalgamation process, which ended with the *de facto* default of the then-second largest German insurance group, *Frankfurter Allgemeine Versicherungs AG* (FAVAG). It was taken over by the largest, *Allianz*, in order to avoid a substantial crisis in the insurance market. In 1931, a major banking crisis triggered an economic depression that was comparable in magnitude with the U.S. Great Depression. In 1933, slow recovery set in and with the seizure of political power by the German National Socialist Party a gradual centralisation of the German market economy was initiated.

Market statistics indicated that only few German insurance companies defaulted during the Interwar period including the Great Depression. Table (11) reports the absolute amount of market exits from the German insurance sector from 1925 until 1935. During the period from 1925 to 1935, only 17 companies defaulted. Of these eight companies defaulted before the take-over of FAVAG and nine afterwards. In addition, only one company was liquidated by the German insurance supervisory office, in 1925. This suggests that insurance companies did not face an increased default risk during the Great Depression period. In contrast to the number of 17 defaults in total, however, the total number of market exits nevertheless amounted to 124 during the Interwar period. This means that only 13.7% of all company market exits can be explained by default. 68 companies were taken over and 43 companies were voluntarily discontinued. Both event types predominated during the late 1920s with 54 companies being taken over and 34 being discontinued. A total of 14 respectively 9 exited the market during the Great Depression period of the 1930s and after the default of FAVAG. Overall, the number of market exits peaked in 1926, a year that was marked by economic expansion. Only 1931, the year of the banking crisis, stands out with a post-1930s maximum of 12 companies. Comparing the per-period default ratio shows that the occurrence of company defaults was evenly distributed across both periods. Take-overs and discontinuations, however were more than three times more likely to occur during the pre-1931 period than during the following Great Depression years. This raises the question as to whether there is a causal link between defaults and discontinuations / take-overs. Companies that had

Table 11: Market Exits by Year and Event

Year	N (Sample)	Default	Liquidation	Taken over	Discontinuation	Market Exit
1925	271	2	1	14	6	23
1926	248	3	0	15	11	29
1927	219	0	0	15	7	23
1928	196	1	0	6	8	15
1929	181	2	0	4	2	8
1930	173	1	0	2	0	3
1931	170	4	0	4	4	12
1932	158	2	0	0	1	1
1933	157	0	0	0	0	0
1934	157	2	0	4	3	9
1935	148	0	0	4	1	1
Total		17	1	68	43	124
GT		8	1	54	34	98
GD		9	0	14	9	26
Ratio		0.89	N/A	3.86	3.78	3.77

Note: Count data of market exits are reported by year and type of exit. "GT" denotes the Golden Twenties period from 1925 to 1929 whilst "GD" represents the Great Depression period from 1930 to 1935. "Total", "before 1931", "1931 onwards" are the sum of all events taking place either in the full period, Golden Twenties and or Great Depresson. The per-period default ratio ist defined as the event count before 1931 relative to the event count including and after 1931.
Source: von Neumanns Versicherungsjahrbuch, 1926 to 1936.

exited the market during the "Roaring Twenties" due to other reasons than default would not show up in any statistic during the Great Depression period, thus implying that contemporary statistics of market exits were systematically biased. This hypothesis motivates an empirical analysis of potential interdependences between the different types of market exit and the underlying determinants. The hypothesis of the following chapter therefore is that companies that either were discontinued or taken over share determining characteristics with companies that defaulted.

3.3 Endogenous survivorship bias

3.3.1 The structural credit risk model by Merton (1974)

An important question arising from the hypothesis is how company defaults and discontinuations are interrelated. This is analytically explored on the basis of credit risk modelling in general and of structural default models in particular. The latter were originated by Merton (1974) and define the default event as the point in time when the value of assets drops to a pre-defined barrier level relative to the value of the company's liabilities. Under a set of additional assumptions,[83] Given the probability

[83]The assumptions are:
"A.1 there are no transaction costs, taxes, or problems with indivisibilities of assets.
A.2 there are a sufficient number of investors with comparable wealth levels so that each investor believes that he can buy and sell as much of an asset as he wants at the market price.
A.3 there exists an exchange market for borrowing and lending at the same rate of interest.
A.4 short-sales of all assets, with full use of the proceeds, is allowed.
A.5 trading in assets takes place continuously in time.
A.6 the Modigliani-Miller theorem that the value of the firm is invariant to its capital structure obtains.

space $(\Omega, \mathbb{P}, \mathbb{F})$ Merton (1974) assumes that the asset value of a company follows a geometric Brownian motion under the real-world probability measure, or

$$dA_t = (\mu_A A_t - D_t)\, dt + \sigma_A A_t dW_t^A, \tag{3.1}$$

where $A \in \mathbb{R}_0^+$denotes the log-normally distributed non-negative asset value, μ_A the instantaneous expected rate of return on the firm per unit of time, $D \in \mathbb{R}_0^+$ the non-negative payout to shareholders per unit of time, σ_A the volatility of the asset value and W^A the increments of a standard Brownian motion. Merton (1974) furthermore assumes that companies are funded by capital $c \in \mathbb{R}_0^+$ as well as non-positive debt or liabilities $L \in \mathbb{R}_0^-$ so that

$$A_t = c_t + L_t. \tag{3.2}$$

In the case of insurance companies, L is represented by the actuarially fair premium income representing the expected net present value of future insurance losses. In contrast to a standard bond, where the company is paid the notional at the beginning of the contract, insurance companies receive the notional in regular instalments as insurance premiums. In accordance with Garven & Pottier (1995)[84], the non-negative face value of a bond $K \in \mathbb{R}_0^+$ with strictly positive maturity $T \in \mathbb{N}_0^+$ is equal to the expected future insurance losses incurred L under the real-world probability measure with maturity T, which in turn is equal to the (undiscounted) insurance premium p earned continuously until T under the real-world probability measure, or

$$K = L\,(t, T) = \mathbb{E}^{\mathbf{P}} \left[\int_t^T p dt \right].$$

The maturity of the option is equal to the maturity of the liability until which the company earns premiums. If the asset value is below the value of liabilities at maturity T the company is defined to be in default. Any potential earlier default is not taken into account by the model. The value of liabilities at time $t < T$ can be inferred as the value of a risk-free bond minus the value of a shortened European put option, or

$$L\,(V_T, t) = \min\,(A_T, K)^+ = A_T - (A_T - K)^+\,. \tag{3.3}$$

A.7 the Term-Structure is "flat" and known with certainty. I.e., the price of a riskless discount bond which promises a payment of one dollar at time T in the future is $P\,(T) = \exp\,[-rT]$ where r is the (instantaneous) riskless rate of interest, the same for all time."

See Merton (1974, p.450).

[84]Garven & Pottier (1995, p.253) postulates that strategies optimising the risk-return profile for principals, in this case shareholders, might lead to inefficient risk-return profiles for policyholders as the agents of the company. This analysis is based on a model identical to Merton (1974) without explicitly refering to it. The main difference is the definition debt as the liabilities of the company towards policyholders.

The value of the put option thus captures the credit risk component of the debt / liability relative to an identical but risk-free alternative debt. If the asset value falls below the value of face value of outstanding debt / liabilities at maturity T the company is in default.

3.3.2 Extensions: the Black & Cox (1976) first-passage model and the Cramér-Lundberg model

The basic specifications laid out in Merton (1974) are extended and generalised by a number of important studies. Sundaresan (2013) provides an exhaustive summary of the large body of related literature. Black & Cox (1976) introduce the concept of debt covenants into the model, which are based on published accounting data of a company. This allows for the implementation of a stochastic default time τ in addition to the pre-determined debt / liability maturity T. This non-negative default time $\tau \in \mathbb{N}_0^+$ is a stopping time, is conditional on a pre-defined non-negative barrier level $b \in \mathbb{R}_0^+$and defined as

$$\tau = \inf \{t \in [0;T] \,|A_t < b\}, \tag{3.4}$$

or the point in time t, at which the asset value A_t for the first time falls below the barrier level b. This so-called first-passage model approach uses European barrier options to model the credit risk component.

In the particular case of insurance companies, it needs to be taken into account that premiums are earned over time. In the insurance-related analysis of default - or ruin - probabilities, Equation 3.2 is changed to

$$A_t = c + pt + L_t, \tag{3.5}$$

where capital $c = A_{t=0}$ is constant and premiums $p \in \mathbb{R}_0^+$ are earned at a constant rate per time unit. Assuming that $L_t \in \mathbb{R}_0^-$ is a non-positive random variable following a compound Poisson process, equation 3.5 represents the standard Cramér-Lundberg model of actuarial ruin theory.[85] Both parameters are based on accounting information. Adding dividend payout $D(t,T)$ leads to the dividend maximisation problem under the first-order condition of a constant ruin probability.[86]

3.3.3 The results of Hayn (1995) and the abandonment option

In this context default solely depends on the fundamentals of the company and not on any decision taken by the shareholders. Hence, the empirical finding of company discontinuations in the German Interwar insurance market can not be analysed in the context of structural default modelling, as default

[85]The model itself is developed by Lundberg (1903) / Lundberg (1909) and Cramér (1930). The historical development of the Cramér-Lundberg model is provided by see Borch (1967).

[86]Shareholder compensation in the form of dividend payout is introduced by De Finetti (1957) into the context of ruin theory.

is solely conditional on the ratio of assets to liabilities. The discontinuation of a company at time $\omega \in \mathbb{N}_0^+$can, however, be thought of as an American option model, where the put option is prematurely exercised by shareholders. Company defaults can hence only take place if the American put option is not exercised prior to technical default at time T or τ. This interpretation goes back to Robichek & Van Horne (1967) who understand the abandonment of a project as an option to end it. From an accounting perspective, Hayn (1995) investigates the informational content of balance sheet losses, which are assumed to be biased by this "liquidation option". Based on the analysis of U.S. Compustat and CRSP data for the years 1962 to 1990 it is found that effects associated with shareholders disinvesting from a company lead to a downward bias on the return-to-earnings ratio. This is due to the fact that losses in earnings are less likely to be perpetrated, thus leading to bias in the informational content of accounting data. The use of the American option model is first suggested in this context by Myers & Majd (1990). An empirical test of the validity of the model is conducted by Berger et al. (1996). Their analysis of 20 years of U.S. balance sheet data taken from Compustat shows strong evidence that the option is considered by investors and priced into the equity value of companies.

3.3.4 Endogenous survivorship bias

The findings of Hayn (1995) relate to the accounting information observed from surviving companies. This limits the analysis of why investors made use of the abandonment option. The early exercise of an American option is only rational if the stock is paying dividends and if the execution leads to a pay-off that is larger than the value of the option.[87] For simplicity it is assumed that the company does not default in the time interval (t, T). If the shareholder exercises the put option, the right to earn dividends $D(t, T)$ from the underlying asset is lost in favour of earning returns $r \in \mathbb{R}$ on an alternative risk-free investment opportunity $P(r(t, T)) \in \mathbb{R}_0^+ = \exp[r(T - t)]$.[88] This suggests that the net present value of dividend income should be less than the net present value of alternative investment returns[89] The resulting definition of the discontinuation time $\omega \in \mathbb{N}_0^+$ is

$$\omega = \min\left[t \in [0; T] \,|D(\omega, T) < K(1 - P(\omega, T))\right], \tag{3.6}$$

where the return on the strike price K invested in the risk-free investment alternative $P((t, T)) = \exp[-r(T - t)]$ is defined as $K\left[P(1 - P(\omega, T))^{-1} - 1\right]$. The present value follows as $P(t, T)\, K\left[P(t, T)^{-1} - 1\right] = K[1 - P(t, T)]$.[90] It follows that dividends have to be qual or larger than alternative income in order

[87] See for example Hull (2006, Ch.11).

[88] This generalises the concept of the risk-free interest rate to any type of return generated by alternative assets perceived as risk-free. This follows the rationale of Margrabe's formula as per Margrabe (1978).

[89] See Deutsch (2009, p.91).

[90] Note that for simplicity of notation the added value of the right to not exercise the option is assumed to be exogenous. See Deutsch (2009, p.91).

to ensure $\omega = 0$, or

$$\omega = 0 | D(\omega, T) \geq K(1 - P(\omega, T)).$$

This establishes the direct trade-off between risky dividend payout and alternative risk-free investment return. The equation changes in accordance if the assumption is relaxed that the company does not default in the time interval (t, T). In the context of Hayn (1995), shareholders discontinue companies experiencing losses. This is consistent under the assumption that unobserved losses are associated with companies failing to provide sufficient dividend payout, which leads to discontinuation. Thus, a direct link between accounting data and observed company exits is established.

3.3.5 State-dependent numeraire dynamics

The decision to exercise early also depends on the dynamics of the risk-free alternative investment opportunity set. Assuming a constant dividend payout D, a risk-neutral shareholder would disinvest during times of relatively high alternative investment opportunities, which in turn is usually attributed to periods of economic expansion. This requires to relax the assumption A.7 of Merton (1974) [91] and to allow for a time-varying alternative risk-free alternative investment return r_t that is directly related to the possuible states of the world. Assume that the dynamics of the risk-free stochastic return r_t are described by a continuous-time one-factor Vasicek model [92] as

$$dr_t = \kappa(\mathbb{E}[r] - r_t)\, dt + \sigma_r W_t^r, r(0) = r_0, \tag{3.7}$$

where $\kappa \in$is the speed of mean reversion, $\mathbb{E}[r]$ is the expected long-term through-the-cycle interest rate known to shareholders, σ_r the instantaneous constant volatility of the return on the alternative investment. This process is assumed to define the state-dependent interest rate $r(s)$ and the world to take states $s \in S$ with possible realisations $S \in [0, 1, 2]$. The states $s = 1$ and $s = 2$ denote economic expansion and depression and $s = 0$ represents economic periods of relative moderation. Let the states be fully described by the dynamics of the alternative investment return r_t so that

$$s = \begin{cases} 0 & if\, r_t \equiv \mathbb{E}[r] \\ 1 & if\, r_t \gg \mathbb{E}[r] \\ 2 & if\, r_t \ll \mathbb{E}[r] \end{cases}, \tag{3.8}$$

[91] This assumption allows for an exclusive focus on the dynamics of the risk instead of the term structure and its relaxation does not lead to a loss of generality. See Merton (1974, p.455).

[92] See Brigo & Mercurio (2006, Ch. 3.2.1) as well as Wüthrich & Merz (2013, pp.41-64) for a discrete-time one-factor specification.

indicating that $r(1)$ denotes a state of relatively large alternative investment returns such as the Golden Twenties. In contrast, $r(s) = r(2)$ denotes a state of relatively low alternative investment returns such as the Great Depression. It follows that the price of the investment opportunity is $P(1) > P(0) > P(2)$. Alternative investment returns close to the long-term through-the-cycle expectation $r(s) = r(0)$ identify periods of relative moderation such as the for example more recent periods. It follows that the stopping time ω increases (decreases) if the world moves from state $r(0)$ to state $r(1)$ (decrease: $r(2)$), or

$$\frac{\partial \omega}{\partial r} \begin{cases} > 0 & if\, r(0) \to r(1) \\ < 0 & if\, r(0) \to r(2) \end{cases}.$$

The dynamics of this state transition solely depend on the stochastic alternative investment return that can be offset by the deterministic dividend decision of the company. In addition, the variance of r_t until maturity T is defined as

$$Var(r) = \frac{\sigma_r^2}{2\kappa}\left(1 - e^{-2\kappa(T-t)}\right),$$

where the first term on the right-hand side denotes the long-term variance given that $\lim_{T\to\infty}\left[1 - e^{-2\kappa(T-t)}\right] = 0$. Assuming a direct relationship between investment opportunity set and the business cycle, the speed of mean-reversion κ represents the persistence of the state transition process - or the business cycle - and σ_r the intensity of the maximum in state $r(1)$ as well as the minimum in state $r(2)$.

Therefore, the stopping time ω is a function of the returns earned on the investment opportunity set and are state-dependent. This represents that shareholders value investments in relative terms and respond to changes in alternative investments, i.e. by exercising the American put option on an investment that is relatively underperforming.

3.3.6 The disparity of defaults and discontinuations

The underlying stochastic dynamics are not empirically observable. The only information available is the nature of the market exit. This event is represented by the indicator function $\mathbf{1}_{EVE}(i) = \{0; 1\}$taking the value 1 for company i. Let the sample space be defined as $\Omega \in \{\neg EVE; EVE\}$, where EVE denotes all observations associated with a company market exit and $\neg EVE$ observations with a non-exit. This will occur if a company leaves the market.

In accordance, the analysis of company discontinuations in the context of credit risk modelling yields two important insights: it is shown first that the event "default" $DEF \in EVE$ can only take place if no prior discontinuation $DIS \in EVE$ has happened. This also holds true for the event "liquidation", $LIQ \in EVE$, representing the revoking of the operating concession by the supervising office due to the

company breaching regulatory debt covenants. A company can hence only default or become liquidated if shareholders have not wound-up the company first. Given the order of market exit types this introduces "endogenous survivorship bias" since only companies that were not previously discontinued by shareholders can default. Second, the default of company directly depends on the fundamentals of the company, which are the asset value A_t including the liability value $L(t,T) = K$. In contrast, a company discontinuation depends on the set of investment opportunities for the shareholders, namely the deterministic dividend payout $D(t,T)$ and the state-dependent alternative investment opportunity $P(r(t,T))$. The relevance of the latter shows that the decision to discontinue a company is endogenous to market dynamics. This illustrates the "endogeneity" of the survivorship bias. Lastly, the observed event "take-over", $M\&A \in EVE$, is also related to shareholder decision-making. In this case, current shareholders are assumed to be presented with a price for the investment c_T* that exceeds the net present equity value until maturity c_T so that $Goodwill = c_T^{\star} - c > 0$.

It is thus possible to assign every observed type of market exit to a particular defined state of the Merton / first-passage model, or

$$\mathbf{1}_{EVE}(i) = 1\, if \begin{cases} \mathbf{1}_{DEF}(i) = 1, & if\, \omega > \tau \geq T | A_t < K\,(Merton\, model) \\ \mathbf{1}_{DEF}(i) = 1 \cup 1_{LIQ}(i) = 1, & if\, \omega > \tau < T | A_t < b\,(Black\&Cox\, model). \\ \mathbf{1}_{DIS}(i) = 1, & if\, \omega < \tau \geq T \\ \mathbf{1}_{M\&A}(i) = 1, & if\, c_T* > c_T \end{cases} \tag{3.9}$$

The same logic applies to the absence of an event, represented by the indicator function $\mathbf{1}_{\neg EVE}(i) = \{0;1\}$taking the value 1, or

$$\mathbf{1}_{\neg EVE}(i)\; if = \omega > \tau \geq T | A_t < K. \tag{3.10}$$

This mapping allows to make general inferences on the underlying dynamics causing the different types of market exits and to circumvent the problem that important variables, such as the asset value A_t, are unobservable in reality. The following empirical analysis directly considers the reported types of market exits as realisations of the latent dynamics in order to show statistically significant differences in the determinants for defaults, discontinuations, take-overs as well as survival.

3.4 Model specification: forecasting insurance market exit

3.4.1 Related literature

The study of market exit determinants is subject to managerial research. Amongst others, Balcaen et al. (2012) argue that a voluntary liquidation - or discontinuation - is the more efficient market exit strategy for companies. It reduces direct and indirect opportunity costs arising from bankruptcy filings and associated court proceedings. Based on a dataset of 6,118 distress-related market exits in Belgium during the period 1998 to 2000, this study applies a two-step nested logit regression approach. Determinants for in-court (involuntary) and out-of-court (voluntary) defaults were analysed first. Second, the study focuses on voluntary market exits exclusively to identify determinants of two possible types of market exit: discontinued or take-over. The study finds that voluntary exits are more probable for companies with higher cash provisions, lower leverage, unsecured debt and group affiliation. Voluntary liquidations conditional on not defaulting increase in probability with higher cash provisions or secured debt as well, smaller size and no group affiliation. Balcaen et al. (2012) is in part motivated by Bhattacharjee et al. (2009), who consider the relationship between defaults or take-overs and the business cycle. No other forms of market exit find consideration. Based on a dataset of all listed UK companies from 1965 to 2002 the study concludes that firm age and size are important determinants for survival, whilst higher liquidity promotes acquisitions and increased leverage determines defaults. When using the U.S. business cycle it is furthermore shown that company take-overs are more probable during periods of economic expansion, whereas contraction leads to an increased probability of default. This is the first study to take into account macroeconomic factors in this context.

Several studies consider market exit in the insurance sector. Ranger-Moore (1997) analyses the effect of 'age' and 'size' on the failure rate of New York life insurance companies in the period from 1813 until 1985. It is found that the 'size' reduced the risk of failure in general, whilst 'age' increased the probability that market exits occurred especially during times of economic turmoil. It is argued that these negative effects are attributable corporate "obsolescence" whereby "internal processes increase organizational inertia."[93] The fact that 'age' does not have to be equivalent with 'size' has also been debated and confirmed within actuarial ruin theory.[94] BarNiv & Hathorn (1997) focus on the difference between take-overs and defaults and compare characteristics of U.S. non-life insurance companies that had exited the market during the period 1984 to 1992. It is found that 54 to 80 percent of all companies that had been taken over were of sound solvency. Companies that defaulted were smaller and performed less well. This finding is confirmed by Cummins & Xie (2008), who consider the take-over decision from the perspective of the acquiring company in the U.S. property / liability insurance market during

[93] See Ranger-Moore (1997, p.904).
[94] See Borch (1967) for a thorough discussion of the discourse.

the period 1994 to 2003. The relevance of size implies that the available surplus of a company plays a particular role in differentiating between the possible outcome of shareholders disinvesting.

3.4.2 Model specification

Two generalised linear models employing a probit link function (probit regression) are used in the present context to analyse the probability for market exit. This two-model approach is comparable to Balcaen et al. (2012) with the exception that data on companies not exiting the market are also considered. The first model takes into account the unconditional probability of market exit. The second model focuses on the determinants for the different forms of market exits conditional on having exited the market. Hence, a conditional probit regression model finds application.[95] The general advantages of probit / logit regression analyses in the present setting are described in de Haan & Kakes (2012). An ordered probit model is not applicable due to the violation of the necessary proportionality assumption. This also rules out the use of a multinomial probit model.[96] Due to the properties of the indicator function $\mathbf{1}_{EVE}(i)$, its expectation is equal to the probability of exiting the market, or

$$\begin{aligned} \frac{1}{N}\sum_{i=1}^{N}\mathbf{1}_{EVE}(i) &= \mathbb{E}\left(\mathbf{1}_{EVE}(i)\right) \\ &= \mathbb{P}\left(\mathbf{1}_{EVE}(i)=1\right)\in\mathbb{P}. \end{aligned} \tag{3.11}$$

The probability of a non-event is due to proportionality

$$1-\mathbb{E}\left(\mathbf{1}_{EVE}(i)\right)=\mathbb{P}\left(\mathbf{1}_{EVE}(i)=0\right)\in\mathbb{P},$$

thus defining the probability set $\mathbb{P}$. The empirical event probability can then be calculated by integrating over all i. This motivates the use of a generalised linear model employing a probit link function. The likelihood function follows from the typical form[97]

$$\begin{aligned} \mathbb{P}\left[\mathbf{1}_{EVE}(i)=1\right] &= \mathbb{P}^{\star}(z_i>0) \\ &= \Phi(\beta_0+\beta\mathbf{x}+\epsilon_i), \end{aligned}$$

[95] This approach is comparable to a conditional logit regression model as per Greene (2012, Ch.18.2.3).

[96] The underlying assumption for the application of a multinomial probit model is that all events may happen to all of the sample companies. This, however, contrasts the chosen two-stage set-up by implying that surviving companies could feature an estimated positive probability of experiencing a form of market exit. See also Balcaen et al. (2012, p.959) for a similar line of argument.

[97] The model specification is taken from Koop et al. (2007, p.204).

where β_0 denotes the intercept, $\mathbf{x}$ the set of predictor variables with the associated coefficients β and ϵ the normally distributed error term, with $\mathbb{E}[\epsilon] = 0$. The dependent variable is the probability of a predicted event $EVE^{\star}$ given that company i has experienced an event and is represented by the indicator function $\mathbf{1}_{EVE^{\star}}(i)$. The continuous latent variable $z_i \in \mathbb{R}$ is introduced so that

$$\mathbf{1}_{EVE^{\star}}(i) = \begin{cases} 1 & if\, z_i \geq 0 \\ 0 & if\, z_i < 0 \end{cases}. \tag{3.12}$$

The error term is assumed to be independent and normally distributed and $\mathbb{E}(\epsilon) = 0$. It is not individually calculated but embedded in the company-specific variance of the prediction. This implies that a larger error term would likewise increase the standard error of the prediction. The normal cumulative distribution function $\Phi(\cdot)$ indicates that z_i is normally distributed[98] and can thus be interpreted as a z-score, which allows to derive the predicted probability $\mathbb{P}(EVE^{\star})$. We can thus redefine Equation (3.12) in terms of probabilities, or

$$\mathbf{1}_{EVE*}(i) = \begin{cases} 1 & if\, \mathbb{P}(EVE^{\star}) \geq 50\, per\, cent \\ 0 & if\, \mathbb{P}(EVE^{\star}) < 50\, per\, cent \end{cases},$$

where an event is predicted if its probability is equal to or larger than 50%, or $z_i = 0$.

The first unconditional probit model directly considers the probabilities of the company-specific events$\{LIQ, DEF, DIS, M\&A, \neg EVE\}$. The model seeks to differentiate between exiting and surviving companies. The second conditional probit model estimates the probabilities of the conditional events $\{LIQ, DEF, DIS, M\&A\}$. This approach seeks to separate the different ways of market exit given that the company had experienced an event. The model fit is assessed on the basis of the area under the receiver-operating characteristics curve also known as concordance or *c*-statistic, see Hosmer & Lemeshow (2013, pp.173-181). This approach is motivated by signal detection theory, where the *c*-statistic is regarded as an indicator of how well a model can differentiate between signal (events) and noise (non-events). Percentage results are rated based on an ordinal system as proposed by Hosmer & Lemeshow (2013, p.177), which is reproduced in Table (12). The scale suggests that results ranging from 50% to 100% indicate the increased ability to separate exiting from surviving companies.

[98] This differentiates the probit from the logit model, where a logistic distribution is used. In general it can be said that "other distributions, particularly the logistic, could be used just as easily. We assume the normal purely for convenience. The logistic and normal distributions generally give similar results." See Greene (2012, Fn.9, p.828). The probit regression was chosen due to its prevalent use within signal detection theory, compare Wickens (2002).

Table 12: Interpretation of c-statistic

c-Statistic	Discrimination
$= .500$	None
$.500 - .700$	Poor
$.700 - .800$	Acceptable
$.800 - .900$	Excellent
$.900 \leq$	Outstanding (extremely rare)

Source: Hosmer & Lemeshow (2013, p.162)

3.4.3 Exiting the insurance market: dependent variables

Market exit A company is said to exit the market if it is delisted from the German trade register. This event is represented by the set variable $EVE \in \Omega$. The set variable $\neg EVE$ denotes the absence of an event or the survival of the company. The possible events leading to market exit are default $DEF \in EVE$ or liquidation $LIQ \in EVE$, take-over $M\&A \in EVE$ as well as (voluntary) discontinuation $DIS \in EVE$. In line with the above theoretical considerations, default can only occur if a company was neither taken-over or discontinued.

Default or liquidation The ultimate ruin as the cause of market exit is denoted by $DEF \in EVE$. A default has occurred if the company has filed for bankruptcy and was delisted as a result. In contrast, the involuntary liquidation of a company, denoted by $LIQ \in EVE$, occurs if the supervisory office assumes that the default of a company is imminent, i.e. because regulatory debt covenants have been violated.

Take-over If the company ensures its ability to meet its liabilities towards policyholders but fails to provide for shareholder compensation it falls short of generating sufficient shareholder value. Not meeting investor-specific profitability expectations can cause shareholders of a company to disinvest from the company. If the company is sold and purchased by other investors, it is said to experience the event take-over or $M\&A \in EVE$. In this case it is assumed that the taken-over company's liabilities is also purchased, indicating that no credit event is taking place.

A potential reason for a take-over is that the underwriting portfolio of the taken-over can be integrated into the existing portfolio of the acquiring company, thus promoting economies of scale and scope.[99] Alternatively, Jensen (1986), Jensen (1988) and Shleifer & Vishny (1988) argue in the context of corporate control theory that a potential take-over motivation is a current relative under-performance of the affected company. This is attributed to managerial inefficiency and could be optimised by a change of ownership.[100]

[99] A thorough discussion of take-over motivations is presented in Cummins & Xie (2008).

[100] This is less obvious in the life insurance sector, where profitability was correlated with the probability of being taken over. See Cummins & Xie (2008, p.32).

Discontinuation If company shareholders decide to disinvest from the company they have the option to wind up - or discontinue - the company. This is also referred to as voluntary liquidations or discontinuations. Provided that the statutes of the respective joint-stock company contain the relevant legal foundation, shareholders have the authority to pass a resolution that the company be wound up orderly. If the necessary majority of shareholders is found, the company will be discontinued and the excess of assets over liabilities paid out to the shareholders. The market exit "discontinuation" is denoted by $DIS \in EVE$ and associated with the failure of the company to provide current or expected profitability given sufficient solvency. This requires that the company still features sufficient assets that can be liquidated and distributed to debtors and lastly shareholders.

The determinants of voluntary liquidations by shareholders have so far not found wide-spread recognition in related research. Balcaen et al. (2012, p.951 Fn.3) attribute this to the "difficulty to obtain the necessary data for a large sample of exiting firms."

3.4.4 Independent variables

Focusing on observable company determinants for market exit is required given that the dynamics leading to the default of an insurance company are unobservable. Time-invariant variables are used since counts of market exist are collected over the whole period from 1925 to 1935 without taking into account time effects. The chosen set of predictors is assumed to be relevant for shareholders and consists of the franchise value FRV of a company, the (time-invariant) size CAP and the line-specific regulatory framework a company $LINE$.

Franchise value The age of a company is found to be an important determinant for market exit by Bhattacharjee et al. (2009) and Ranger-Moore (1997). It does not have direct and quantifiable relevance for the solvency of a company from an accounting perspective. This follows the reasoning of Ranger-Moore (1997). Age is a non-monetary value and can be associated with other factors such as brand recognition or reputation. In general, the non-monetary corporate franchise value is defined as "any element of market capitalisation in excess of statutory net assets" by Exley & Smith (2006, p.238). This study argues that the non-quantifiable value is seldom considered in the perception of insurance, which in turn leads to a downward bias in commonly applied performance indicators. This motivates the inclusion of franchise value as denoted by FRV.

Comparable considerations played a detrimental role in the undercapitalisation of FAVAG as well as *Kölnische Rück* following the 1924 currency reform.[101] Due to the notable differences in the perception of capital raised prior to 1914 and after, the variable $FRV \in \{0, 1\}$ denotes, whether a company was founded prior to 1914, so that

[101] Compare Ch.2.

Table 13: Capital conversion rate

Conversion rate	Obs	Mean	Med	Std Dev	Min	Max
If $FRV = 1$	98	28.747	10.00	55.965	0	380.25
If $FRV = 0$	176	333,967	62.50	3,813,279	0	50,000,000
(Conversion 1913 to 1924)	271	213,207	25.00	3,047,795	0	50,000,000
IF $FRV = 1$						
Capital increased (1913 to 1923)	76	32.002	10.614	60.313	0	380.25
Capital not increased (1913 to 1923)	22	17.500	3.642	1,304	.6	150
Overall (1913 to 1924)	98	7.603	2.499	18.804	.24	150

Note: The conversion rate of 0 indicates that the company was either founded between 1923 and 1924 or listed as mutual before 1924. The observed differences between mean and median value suggest a non-linear effect of the absolute value converted. This motivates the use of the median in the following. "Conversion 1913 to 1924" denotes the conversion rate of capital reported in 1931 to capital reported in 1924. RM = Reichsmark
Source: A special edition of "Neumanns Jahrbuch der Privatversicherung im Deutschen Reich" published in 1925 reported the available gold account balances of German private insurance companies. Dataset I "Gold Account".

$$FRV_i = \begin{cases} 1 & if\, company\, i\, was\, founded\, before\, 1914 \\ 0 & if\, company\, i\, was\, founded\, after\, 1914 \end{cases}. \tag{3.13}$$

This approach does not consider that older companies might have raised capital after 1914. The value $FRV_i = 0$ identifies companies that only had access to post-1914 capital. This choice of a binary predictor variable is based on the finding that company founded pre-1914 assigned a larger relative value to its shareholdings than company that had been founded after 1914.

The aggregate conversion rates are provided in Table (13). The reported median rate of 25:1 illustrates that German insurance companies were valuing 1923 capital substantially lower than 1914 capital. Companies founded after the onset of World War I had raised capital denominated in Papermark. The applied median conversion rate of 63:1 was more cautious. This suggests that post-1914 capital was considered of inferior quality and contrasts the median conversation rate of 10:1 by companies founded before 1914. The differences between pre-1914 and post-1914 are further reflected in capital raised by companies founded before 1914 that raised capital between 1913 and 1924. In this case, a median conversion rate of 10.6:1 was reported. The 22 companies maintaining pre-war capital levels throughout the years 1914 to 1924 used a relatively smaller median conversion rate of 3.6:1. The lowest median of 2.5:1 is reported for the conversion of pre-World War I (1913) into post-currency reform (1924) capital.

Firm capital The findings of Balcaen et al. (2012), Bhattacharjee et al. (2009), Ranger-Moore (1997) and BarNiv & Hathorn (1997) indicate that the size of a company is an important determinant for

Table 14: Change in capital, 1926 to 1935

Variable	Obs	Mean	Med	Std Dev	Min	Max
$\Delta Capital_{it}$	1,078	.08	.00	.61	0	10

Note: The rate of change in capital, denoted by $\Delta u_{it} \in \mathbb{R}$, is defined as

$$\Delta u_{it} = \frac{Capital_{it}}{Capital_{it-1}} - 1, t \in [1927; 1935]\,.$$

Source: Dataset II "Company"

Table 15: Summary statistics $EQU1924$

Variable	Obs	Mean	Med	Std Dev	Min	Max
$Capital\,(1924)$	271	1,563,842	600,000	3,259,451	1,470	30,000,000

Source: Dataset II "Company"

market exit. This is consistent within the context of insurance.[102] For the most part of regulatory history, the absolute size of an insurance company was perceived as an important determinant of its solvency, with relative risk-related considerations starting to take precedence only in recent years.[103] The definition of company size is also the associated with shareholder decision-making in the context of principal-agent theory. Increased firm capital also increases the amount or face value of shares that are available for purchase. This increases the cost associated with controlling the required majority of votes required to discontinue the company due to the relatively stronger and more developed partnerships with internal and external stakeholders.[104]

The time-invariant capital endowment is therefore an important predictor for market exits. The assumption of time-invariance is confirmed in Table (14), showing that capital increases or decreases were rare events in the German insurance sector during the Interwar period. The disadvantage of this control variable is that mutual companies can not be considered. The large difference in mean and median of the resulting non-negative variable, $Capital\,(1924) \in \mathbb{R}^+$, provided in Table (15), suggests that capital was non-normally distributed. The non-negative log-transform, denoted $CAP \in \mathbb{R}^+$ will thus be used as predictor variable and is defined as

$$CAP_i = log(Capital\,(1924)_i). \tag{3.14}$$

Supervision The German regulatory system of the Interwar period distinguished the level of supervision between different lines of insurance business. Companies that exclusively engaged in transport insurance and/or reinsurance were exempt from supervision.[105] Furthermore, companies registered

[102] Compare Borch (1967). Note also that this does not take in consideration any risk associated with holding more assets.
[103] Compare Sandström (2007).
[104] See Balcaen et al. (2012, p.957).
[105] Compare Ch.5, Moldenhauer (1903, pp.69-73) and Hermannsdorfer (1931).

as non-life insurance companies were not allowed to operate in life insurance and vice versa. It was argued that both had to be separate due to the volatile nature of the former and the relevance as long-term savings alternative of the latter.[106] In order to control for the degree of regulation specific to line $k \in K$, the ordinal variable $LINE$ is defined by

$$LINE_{ik} = \begin{cases} k = 1 & if\, company\, i\, is\, active\, in\, Non - Life\, insurance \\ k = 2 & if\, company\, i\, is\, active\, in\, Transport \\ k = 3 & if\, company\, i\, is\, active\, in\, Transport + Reinsurance \\ k = 4 & if\, company\, i\, is\, active\, in\, Reinsurance \\ k = 5 & if\, company\, i\, is\, active\, in\, Life\, insurance \end{cases} . \tag{3.15}$$

This variable proxies the degree of external control over a company. It attaches qualitative value to the prudence of its business plan and thus the company's exposure to insurance risk. Additionally, it proxies the opportunity costs associated with liquidating the liabilities of an insurance company in the case of a discontinuation. Life insurance is used as the reference due to the high degree of regulation associated with it. The model intercept β_0 is thus conditional on the coefficient of life insurance. General regulated non-life insurance companies were subject to a relatively lower level of supervision. The unregulated reinsurance and transport insurance line of business serve as contrast. Mixed transport and reinsurance companies are also included to test the qualitative value attached to diversified business operations.

3.5 Data

The study is set up as a case-control study. Company-specific information is taken from balance sheet information published by German insurance companies after the currency reform of 1924 ("Goldmark-eröffnungsbilanz"). Accounts for 313 companies were provided in a special issue of "Neumanns Jahrbuch der Privatversicherung im Deutschen Reich" published in 1925. 42 Companies were not mentioned in later editions, reducing the total number of companies to 271.[107] This sample was tracked over the period from 1925 until 1935. Companies that remained listed in the 1936 edition of "Neumanns Jahrbuch der Privatversicherung im Deutschen Reich" were classified as surviving companies or $i \in \neg EVE$. The source, an annually published compendium, provided an overview of company foundations, fusions, mergers, discontinuations and defaults ((German original:) "Gründungen, Verschmelzungen, Bestand-

[106] Moldenhauer (1903, pp.100-103)

[107] It should also be noted that *Gerling Gruppe* operated through subsidiaries that featured individual brand names but did not declare individual accounts. Those 20 companies were collectively discontinued as individual brands in 1936 due to purely internal reasons. They are therefore excluded. The shortened names of these companies are: *Baltische*, *Bayerland*, *Elbe&Saale*, *Köln-Berliner*, *Köln-Düsseldorfer*, *Köln-Bremer*, *Köln-Frankfurter*, *Köln-Hagener*, *Kronprinz*, *Köln-Krefelder*, *Mittelländische Feuer*, *Mosel und Saar*, *Niedersächsische Feuer*, *Oberbadische Feuer*, *Sächsisch-Thüringische*, *Schwäbische Feuer*, *Südwestdeutsche VAG*, *Zukunft Leben (ex Heracles)*, *Rheinische Versicherungs-AG* and *Rheinische Feuer.*

Table 16: Summary Statistics Dataset I "Gold Account"

Variable	Name	Obs	Mean	Med	Std Dev	Min	Max
Predicted Variables							
EVE	Event	271	.458			0	1
DEF	Defaulted	271	.055			0	1
LIQ	Liquidated	271	.003			0	1
DIS	Discontinued	271	.162			0	1
$\{DEF, LIQ, DIS\}$		271	.221			0	1
$M\&A$	Taken over	271	.240			0	1
Predictor Variables							
FRV	Franchise value	271	.361			0	1
CAP	ln(capital)	271	12.913	13.305	1.974	7.293	17.217
	Lines	Obs / of total	Mean*				
$k = 1$	Non-Life	100 / .369	.390			0	1
$k = 2$	Trans	55 / .203	.545			0	1
$k = 3$	Trans & Reins	27 / .099	.519			0	1
$k = 4$	Reinsurance	50 / .185	.580			0	1
$k = 5$	Life	39 / .144	.308			0	1

Note: Standard deviation omitted for binary variables. The data reported include the case of FAVAG. * indicates that mean is conditional on the occurrence of an event, or $EVE = 1$.
Source: Dataset I "Gold Account"

sübertragungen, Auflösungen und Konkurse") as a dedicated section. In addition, the 1930 issue also contained a special "summary of defaulted companies" (German: "Verzeichnis der aufgelösten Versicherungsgesellschaften") for the years between 1913 and 1928. Companies that exited the market were listed as either discontinued ((German original:) "Auflösung"), defaulted ((German original:) "Konkurs"), liquidated ((German original:) "Liquidation") or merged ((German original:) "Übernahme"). In the latter case, only companies with abandoned brand name were counted. The year of market exit was chosen as the date when the company was de-listed from the official trade register.

3.5.1 Summary statistics

Summary statistics in Table (16).

A total of 45.8% of the sample companies exited the market, 24.0% of the sample was taken over, 5.5% defaulted, 16.2% was discontinued and 0.3% - one company - was liquidated[108]. In addition, 36.1% of all companies had been founded before 1914 and 63.9 % after the onset of World War I. The mean reported 1924 capital value was equal to an absolute amount of RM 1.6 million. In addition, the relative majority of 39.0% was registered in non-life insurance lines. 20.3% and 18.5% were listed as specialised transport respectively reinsurance companies and 9.9% as active in both unsupervised lines. Life insurance was represented by 14.4% of the sample.

Companies active in the registered lines featured a mean probability of market exit of 30.8% in the

[108]That (compulsory) liquidations are rare events is also evidenced by Balcaen et al. (2012, p.953 Fn.4) who find that only 4 out of 6,118 observations were associated with this event.

Table 17: Results unconditional probit model

Predicted Event	EVE		$M\&A$		$DEF + LIQ$		DIS	
FAVAG included	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*
Non-Life	.404	.382	.175	.181	.450	.340	.205	.206
	(.259)	(.260)	(.264)	(.264)	(.515)	(.539)	(.417)	(.417)
Trans	.499	.496	-.122	-.120	.037	.0241	1.040**	1.040**
	(.282)	(.282)	(.297)	(.297)	(.574)	(.588)	(.400)	(.400)
Trans & Rein	.404	.398	-.159	-.157	-.028	-.0653	.957*	.957*
	(.337)	(.338)	(.359)	(.359)	(.682)	(.703)	(.449)	(.449)
Rein	.811**	.817**	.146	.145	.777	.815	.932*	.932*
	(.293)	(.294)	(.298)	(.298)	(.521)	(.536)	(.423)	(.423)
FRV	-.470*	-.487*	-.255	-.251	.291	.264	-.863**	-.863**
	(.189)	(.190)	(.197)	(.197)	(.325)	(.348)	(.319)	(.319)
CAP	-.192***	-.202***	.002	.004	-.226**	-.276***	-.180**	-.180**
	(.047)	(.047)	(.048)	(.0484)	(.071)	(.077)	(.057)	(.0567)
Constant	2.084***	.221***	-.696	-.728	.741	1.318	.758	.758
	(0.625)	(.632)	(0.651)	(.654)	(.914)	(.964)	(.775)	(.775)
c-statistic	.738	.742	.584	.584	.788	.830	.831	.831
PseudoR^2	.127	.135	.012	.012	.132	.178	.227	.226
N	271	270	271	270	271	270	271	270

Note: Standard errors in parentheses. Life insurance treated as reference.
* p< .05 ** p< .01 *** p< .001
Source: Dataset I "Gold Account"

case of life and 39.0% in the case of non-life insurance. Mixed transport and reinsurance companies featured a relatively lower probability of 51.9% relative to specialised transport with 54.5% as well as reinsurance with 58.0%. This supports the assumption that regulation increased the resilience of a company during the Interwar period and that mixed transport / reinsurance companies benefited from diversification.

3.6 Model results

3.6.1 Unconditional model results

The results of the unconditional probit regression model are provided in Table (17). A direct comparison of the c-statistic indicates that the chosen model correctly predicts 83.1 % of all events DIS,

Table 18: Predicted probability unconditional probit model

	Marginal effect	
Line	$DEF + LIQ$	DIS
Life	.011	-.072
	(.019)	(.048)
Non-Life	.021	-.099*
	(.029)	(.048)
Trans	.012	-.240**
	(.017)	(.081)
Trans & Rein	.009	-.226**
	(.017)	(.087)
Rein	.044	-.221*
	(.058)	(.090)
N	270	270

Note: CAP=12.898. Standard errors in parentheses. Marginal effects capture the discrete impact of FRV changing from $FRV = 0$ to $FRV = 1$ on the predicted variable. Observations associated with FAVAG are excluded from the sample.

* p< .05 ** p< .01 *** p< .001

Source: Dataset I "Gold Account"

independently of the inclusion of FAVAG. This confirms that based on the Hosmer-Lemeshow scale as per Table (12) FRV, CAP and $LINE$ provide "excellent" predictions for discontinuations. Default and liquidations are in comparison correctly predicted in 78.8% of the sample. The exclusion of FAVAG from the sample increases the c-statistic to 83.0 % and above the "excellent" threshold. Overall, 73.8% (74.2% without FAVAG) of all outcomes can be predicted by the used set of independent variables. In contrast, only 58.4 % are predicted correctly in the case of a take-over. This leads to the further conclusion that company discontinuations were relatively well predictable based on 1924 information. The same is found for company defaults and liquidations, but needs to be rejected in the case of discontinuations. With the notable difference of take-overs, size CAP features a consistently statistically significant negative sign. This indicates first that the size of a company was overall reducing the probability of market exit regardless of type, yet with the expection of take-overs. This directly relates to the second finding that the overall insignificance of parameter estimates for this type of event suggests that taken-over companies shared similar determinants with survivors.

The non-linearity inherent to the probit model prohibits a meaningful direct interpretation of the coefficients. Sign and significance nevertheless postulate that capital was significantly negatively correlated with the exception of take-overs. This supports the assumption that capital endowment increased the durability of a company. To analyse the multivariate relevance of franchise value and insurance line of business, conditional marginal effects of a one-unit increase in FRV on the predicted probability $\mathbb{P}(EVE^{\star})$ - or $\partial\mathbb{P}(EVE^{\star})/\partial\mathbf{1}_{FRV}$ are provided in Table (18). The marginal effects of franchise value FRV are not significantly different from zero in the case of defaults and liquidations. In

Table 19: Results conditional probit model

Event	$M\&A$		$DEF + LIQ$		DIS	
FAVAG included	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*
Non-Life	-.313	-.229	.333	.205	.059	.062
	(.461)	(.467)	(.616)	(.636)	(.504)	(.504)
Trans	-.923*	-.922	-.426	-.458	1.151*	1.151*
	(.469)	(.471)	(.689)	(.700)	(.501)	(.501)
Trans & Rein	-.890	-.876	-.414	-.478	1.139*	1.139*
	(.548)	(.553)	(.782)	(.798)	(.569)	(.569)
Rein	-.921	-.970*	.396	.430	.826	.825
	(.481)	(.486)	(.621)	(.631)	(.516)	(.516)
AGE	.391	.517	.693	.629	-.973*	-.968*
	(.328)	(.343)	(.396)	(.418)	(.393)	(.394)
CAP	.194**	.228**	-.225**	-.277**	-.073	-.072
	(.071)	(.074)	(.086)	(.092)	(.073)	(.073)
Constant	-1.741	-2.152*	1.254	1.860	-.022	-.029
	(.948)	(.981)	(1.136)	(1.198)	(.994)	(.995)
c-statistic	.762	.773	.760	.792	.775	.773
PseudoR^2	.154	.185	.118	.147	.183	.179
N	124	123	124	123	124	123

Note: Standard errors in parentheses. Life insurance treated as reference.
Source: Dataset I "Gold Account"
* p< .05 ** p< .01 *** p< .001

the case of discontinuations FRV reduced the predicted probability in all lines but life insurance. The effect ranges from -24.0 (±8.1) % in transport to - 9.9 (±4.8) % in non-life insurance and is in particular pronounced in unregulated lines. In addition, franchise value is shown to reduce the probability of discontinuations across lines. At the same time no statistically significant effect can be measured in the case of defaults / liquidations. This confirms that franchise value FRV was relevant for shareholders, but did not directly increase the solvency of the company. Differences in the magnitude and significance of the parameter results across lines also suggest that shareholders were substituting regulatory rigor with franchise value: whilst the effect of franchise value was insignificant and relatively small for life and non-life insurance, the magnitude increased substantially for unregulated insurance lines.

3.6.2 Conditional model results

The unconditional model fails to provide accurate predictions for take-overs. This is due to the fact that companies affected shared more similarities with companies that did not experience an event. Take-overs thus followed a different rationale than other possible events. In order to confirm this, only the set EVE is considered in the following. The variables of interest are thus $1_{M\&A}(i)$, $1_{LIQ}(i) + 1_{DEF}(i) = 1_{LIQ+DEF}(i)$ and $1_{DIS}(i)$. The model is conditional given that all remaining companies are elements of EVE. Results are provided in Table (19). Again, the omission of FAVAG from the sample does not lead to substantial differences in the parameter estimates. The c-statistic

Table 20: Predicted probability conditional probit model

	Marginal effect		
Line	$M\&A$	$DEF + LIQ$	DIS
Life	.158	.102	-.216
	(.106)	(.104)	(.119)
Non-Life	.180	.129	-.228*
	(.115)	(.091)	(.101)
Trans	.198	.052	-.358**
	(.126)	(.046)	(.126)
Trans & Rein	.199	.050	-.358**
	(.127)	(.060)	(.126)
Rein	.196	.161	-.350**
	(.122)	(.100)	(.133)
N	123	123	123

Note: $CAP = 12.164$. Standard errors in parentheses. Marginal effects capture the discrete percentage impact of FRV changing from $\mathbf{1}_{FRV}(i) = 0$ to $\mathbf{1}_{FRV}(i) = 1$. Observations associated with FAVAG were omitted from the sample.

Source: Dataset I "Gold Account"

* p< .05 ** p< .01 *** p< .001

is within the range between 76.2% and 79.2% and thus falls short of the "excellent" threshold. The signs of the calculated coefficients indicate that capital increased the probability of the event being a take-over and reduced the probability of default. The signs for the effect of franchise value FRV confirm a decrease in the probability of discontinuation, but an increase in the case of a take-over or default. Being active in any line apart from life insurance decreased the probability of a take-over. Unregulated specialised transport and reinsurance as well as mixed transport/reinsurance companies were more likely to be discontinued. The effect of company size CAP varies substantially between types of market exit. It features a statistically significant positive relations with the event take-over. This is consistent with the results of the unconditional model and confirms that companies subject to M&A activities shared determining characteristics with survivors. The events default and liquidation feature a statistically significant negative relation, suggesting that increased size CAP effectively protected companies from experiencing these types of events.

With respect to franchise value FRV it is necessary to analyse conditional marginal effects as provided in Table (20). Coefficients associated with experiencing default or take-over are not significantly different from zero. Increased franchise value led to a substantial reduction in the probability of becoming discontinued. It ranged from a point estimate of -22.8% (±10.1%) in non-life to 35.8% (±12.6%) in transport insurance as well as mixed transport and reinsurance. Effects are statistically significant for all lines except life insurance. Franchise value FRV was an important determinant in the shareholder decision to discontinue a company. This finding is consistent with the results of the unconditional

Table 21: Event-specific predicted probabilities, conditional model

	Take-over		Default & Liq.		Discontinuation	
$\mathbf{1}_{FRV}$	0	1	0	1	0	1
Life	.700***	.923***	.082	.109	.191	.025
	(.140)	(.074)	(.085)	(.123)	(.119)	(.033)
Non-Life	.616***	.884***	.117	.152	.208**	.029
	(.092)	(.071)	(.061)	(.093)	(.075)	(.028)
Trans	.345***	.693***	.032	.046	.609***	.208
	(.090)	(.130)	(.031)	(.045)	(.093)	(.119)
Trans & Rein	.363*	.709***	.031	.044	.604***	.205
	(.141)	(.161)	(.040)	(.060)	(.138)	(.140)
Rein	.328**	.676***	.168*	.211*	.480***	.127
	(.100)	(.113)	(.076)	(.101)	(.109)	(.075)
N	96	27	96	27	96	27

Note: $\overline{CAP} = 12.164$. Standard errors in parentheses. Average marginal effects capture the percentage probability of experiencing an event, or $1_{EVE}(i) = 1$. FAVAG was omitted from the sample.
* p< .05 ** p< .01 *** p< .001
Source: Dataset I "Gold Account"

model given that the magnitude of the effect increased with decreasing level of regulation.

In the particular case of the conditional model it is also necessary to take into account the nested structure of the conditional events. This follows from the fact that a company can only default or become discontinued if it has not been taken over previously. The associated schematic decision tree takes the form

$$\mathbf{1}_{EVE} \begin{cases} 0 \\ 1 \quad if \begin{cases} \mathbf{1}_{TAK} = 1 \\ \mathbf{1}_{TAK} = 0 \quad \Leftrightarrow \mathbf{1}_{DEF+LIQ} + \mathbf{1}_{DIS} = 1 \end{cases} \end{cases}.$$

The events $DEF+LIQ$ and DIS are thus not only conditional on EVE, but also on $M\&A$. Conditional average probabilities are provided in Table (21), which represents the probability of a company to experience a particular event. Across all lines, older insurance companies of average size were most likely to be taken over. This ranges from 92.3 ($\pm$7.4) for life insurance to 67.6 ($\pm$11.3) % for reinsurance. Companies with less franchise value FRV were more likely to be taken over if they had been active in supervised lines. Reinsurance, mixed and transport insurance companies were on average more likely to be discontinued. The respective predicted probability ranges between 48.0 ($\pm$ 7.4) % for the former and 60.9 ($\pm$ 9.3) % for the latter. Predicted probabilities for the event $DEF + DIS$ are not significantly different from zero with the exception of reinsurance. It is nevertheless obvious that companies with relatively higher franchise value FRV were more likely to default or become liquidated. This leads to the conclusion that the franchise value FRV is most relevant for events that incorporate the active decision-making process of either investors in the case of take-overs, or shareholders in the case of

discontinuations.

3.7 Conclusion: the role of shareholder expectations in credit risk modelling

The preceding chapter related the abandonment option of shareholders to the concept of "endogenous survivorship bias" in credit risk modelling. Results of an unconditional model specification showed that company taken-overs shared determinants with surviving companies. This suggested that purchasing investors / companies were not "catching falling knives" during the market consolidation period of the late 1920s. It was in addition evidenced that company size was an important determinant with respect to shareholder actions. This, however, could also be due to the increased difficulty of aligning less concentrated shareholdings in order to obtain the majority required for a voluntary liquidation. It was shown that the franchise value of a company mattered as it significantly decreased the probability of being discontinued across both model specification. It nevertheless did not reduce the probability of default and therefore had little effect on the overall solvency of a company. Effects associated with franchise value were identified as an important determinant for shareholders. This is consistent with the observation of Ch.2 that the intention of *Kölnische Rück* to promote its reputation in 1924 directly translated into an increased opportunity cost of shareholder compensation.

This analysis provided more general evidence for the applicability of the American put option extension to structural credit risk models. This suggests that the findings are not only limited to the specific case of the German Interwar insurance market. The underlying considerations apply to the business structure of a private joint-stock company in general. The presence of "endogenous survivorship bias" is therefore a potential source of bias in all portfolios that contain securities issued by private joint-stock companies. Not taking into account possible discontinuations leads to bias in the definition of a portfolio-specific credit model and should therefore be regarded as a relevant source of model risk.

4 Risk shifting by dividend payout in the German insurance market during the Interwar period

4.1 The relevance of risk shifting by dividend payout

The balance sheets of insurance companies feature specific characteristics that distinguish this industry from others within the financial service sector. This is due to the uncertain nature of insurance liabilities, given that their expected present value is dependent on a multitude of actuarial considerations. During the Interwar period, shareholders placed particular emphasis on the dividend payout as an indicator for the financial situation of a company. In general, however, companies are free to administer their dividend payout. This in turn provides a direct channel for shifting risk from shareholders to policyholders by releasing internal funds as dividend payout. The empirical evidence of the Interwar period allows to investigate the influence risk shifting in both the Great Depression period as well as the Golden Twenties. This chapter argues that although risk shifting occurred in two different ways, both were realisations of the same underlying principles. Based on an econometric analysis of the dividend payout dynamics, the chapter concludes that companies increased dividend payout during the late 1920s to the disadvantage of overall solvency positions. Insurance companies therefore actively shifted risk from shareholders to policyholders.

This chapter is structured as follows: the first part introduces the historical circumstances of the Interwar period. It establishes that German joint-stock companies generally administered dividend payout during the Interwar period. In addition, the case study of *Schweizer Rück* in 1931 exemplifies how risk shifting occurred as a consequence of the Great Depression. The second case study identifies the aggregate opportunity costs associated with dividend compensation in the German insurance market. This leads to the hypothesis that companies risk shifting in periods of economic prosperity follows the same rationale as during period of economic crisis. Second, the theoretical relationship between the insurance business model and risk shifting by dividend payout is established. A dividend reserve process is established in the context of ruin theory, which allows for a joint interpretation of both historical case studies. Third, the empirical model is specified in line with the Lintner partial adjustment model as per Lintner (1956). Fourth, the relevant data as taken from Dataset II "Company" is introduced and historical idiosyncrasies are discussed. Fifth, the results of the empirical analysis are provided and interpreted in relation to Interwar and Postwar benchmarks from the United States.

This analysis contributes to the existing literature theoretically as well as empirically. First, it establishes the relevance of dividend payout for risk shifting in insurance. It additionally introduces a new direction for actuarial research within ruin theory by introducing the dividend reserve process based on the dual risk model. Major limitations of this chapter are the relative scarcity of available

comparative data especially of other business sectors in Germany. In addition, the dividend reserve process is introduced theoretically without a detailed consideration in the context of ruin theory. This is intentionally left for future research, given that it does not immediately contribute to the purpose of the dissertation. Finally, the chosen empirical approach might not be appropriate for the analysis of current business data due to the changed relevance of dividend payout cashflows. Lambrecht & Myers (2012) together with observations from the 2007/2008 Financial Crisis nevertheless suggest that the chosen framework remains valid when also taking into account, for example, share buyback programmes. The deficiencies mentioned are assumed to motivate future research in economic history as well as insurance economics.

4.2 Historical background: insurance accounting during the Interwar period

This part investigates patterns of risk shifting in the insurance sector during the Interwar period. It first identifies that the main paradigms of the seminal study Lintner (1956) also found application by German non-life insurance companies. This also includes a detailed discussion of the nature of hidden reserves in general and a dedicated dividend reserve in particular. Following on, the case study of *Schweizer Rück* illustrates contemporary risk shifting during the Great Depression period. This is based on the general availability of relevant source material. As a second aggregated case study, potential risk shifting is identified in German market data for the Golden Twenties. This motivates the hypothesis that risk shifting was present in this sub-period.

4.2.1 Dividend strategies of German non-life joint stock insurance companies

During the Interwar period, German non-life joint-stock insurance companies actively administered dividend payout in order to reduce speculation and provide for a relative stability in shareholder compensation. Lengyel (1927) provides relevant evidence for this:

> Generally speaking, the dividend policy of joint-stock companies is conservative. This means that the management of these companies is dedicated to, if possible, paying out a constant or only mildly fluctuating dividend over the years. Jumps in the dividend level of individual years could easily make insurance shares the focus of speculation. This reason motivates companies to follow a conservative dividend payout policy and to maintain the normal dividend level. It is, however, in the nature of things that success can vary between the different years. In order to compensate for business results of good and bad years, to secure dividend stability, a part of the surplus realised in good years is retained for the purpose to raise dividends in bad years to the same level as in normal years. This earmarked reserve

[...] is the dividend reserve. Following the previous statements, it appears to be unnecessary to state that based on the decision of the general assembly, any free reserve could also be utilised for the purpose of the dividend policy like a dedicated dividend reserve that was built up in advance for this purpose. It also has the same economic effect regardless of whether the company utilises the dedicated dividend reserve or any other free reserve in the interest of dividend stability.[109]

This quote first suggests that companies were generally pursuing a dividend policy with principles similar to the main paradigms identified by Lintner (1956).[110] Based on interviews of senior managers at 28 firms chosen from an initial sample of 600 large companies in 1955, the study draws the following four conclusions concerning of dividend payout strategies:

(i) Managers believe that firms should have some long-term target payout ratio.

(ii) In setting dividends, they focus on the change in existing payouts, not on the level.

(iii) A major unanticipated and non-transitory change in earnings would be an important reason to change dividends.

(iv) Most managers try to avoid making changes in dividends that stand a good chance of having to be reversed within the near future.[111]

Only paradigm (iii) does not find a corresponding match in the introductory quotation. It can nevertheless be assumed that an unanticipated change in earnings, i.e. due to a low-probability high-cost event, will motivate a reduction in dividend payout. It can thus be assumed that insurance companies administered dividend payout cashflows in accordance with the findings of Lintner (1956).

4.2.2 Contemporary considerations regarding dividend administration from hidden reserves

Although Lengyel (1927) mentions the necessity to form a dedicated dividend reserve for the purpose of administering shareholder compensation none of the joint-stock companies that had accounts published

[109] "Die Dividendenpolitik der Aktiengesellschaften ist in der Regel konservativ, d.h. die Leitungen sind bestrebt, von Jahr zu Jahr womöglich gleichbleibende und nur mäßig schwankende Dividende zu bezahlen. Sprunghafte Abweichungen in der Dividendenhöhe der einzelnen Jahre können die Aktien der betreffenden Gesellschaft leicht zum Gegenstand der Spekulation machen. Aus diesem Grunde verfolgen die Gesellschaften in der Regel eine konservative Dividendenpolitik und suchen das einmal erreichte Dividendenniveau zu behaupten. Es liegt aber in der Natur der Dinge, daß der Erfolg in den verschiedenen Jahren eben verschieden ist. Zum Ausgleich der Geschäftsergebnisse guter und schlechter Jahre, zur Sicherung der Dividendenstabilität wird oft ein Teil des Reingewinns guter Jahre zu dem Zwecke im Unternehmen zurückbehalten, um in Jahren mit ungünstigen Geschäftsergebnis aus diesen Rücklagen die Dividende auf die Höhe normaler Jahre zu bringen. Die mit dieser Zweckbestimmung aus zurückbehaltenen Gewinnen gebildete Reserve ist die Dividendenreserve. Nach den bisherigen Ausführungen ist es wohl überflüssig zu sagen, daß auf Beschluß der Generalversammlung jede freie Reserve zu Zwecken der Dividendenpolitik genau so herangezogen werden kann, wie eine von vornherein mit dieser Zweckbestimmung gebildete besondere Dividendenreserve. Es ist auch völlig von der gleichen wirtschaftlichen Wirkung, ob eine Gesellschaft im Interesse der Dividendenstabilität die besondere Dividendenreserve in Anspruch nimmt oder irgendwelche sonstige freie Reserve opfert." Lengyel (1927, p.119)

[110] A general introduction to this study is provided by Baker (2009). See also Marsh & Merton (1987) and Marsh & Merton (1986) and in general, Garrett & Priestley (2000) and Garrett & Priestley (2012). Lambrecht & Myers (2012) provide an analytical proof of the model based on utility theory.

[111] See Marsh & Merton (1987, pp. 5-6) and Marsh & Merton (1986, p.488).

in "Neumanns Jahrbuch für die gesamte Versicherungswissenschaft" between 1926 and 1935 had disclosed such a reserve. It was in contrast perceived to be one of the purposes of hidden reserves to be used for dividend stability purposes. Lengyel (1927) was, in general, objective towards the use of hidden reserves, given that undisclosed profit and loss caused bias in reported accounts:

> In the normal course of a business, the periodic interim balance can certainly serve the purpose of income recognition. Success is nevertheless a dynamic phenomenon of a business. It is supposed to express the fluctuations of an undertaking. If, however, the business results of the previous years are balanced internally by means of hidden reserves and the balance sheet does not correctly mirror the actual variations of the business results due to changing arbitrary valuation principles, the balance does not serve the offsetting of assets and liabilities as well as the recognition of income and thus completely loses any reasonable purpose.[112]

Hidden reserves especially enabled the executive management of a company to cover up bad business decisions. This would limit the ability of shareholders to serve as a controlling instance as was postulated by two leading German contemporary accounting textbooks, includingSchmalenbach (1919):

> Although it is not legitimised by law but by custom and interpretation, it is considered to be allowed to hide profits at will in order to release these in the case of decreasing profitability, again at will. A corporation that experiences signs of decline and that – from a business management perspective – should under all circumstances be prevented from tapping into capital funds is not prohibited from pretending economic health by mean of releasing hidden reserves.[113]

The second textbook, Berliner (1911), which is paraphrased by Lengyel (1927, p.120), came to a similar conclusion:

> Berliner, himself not in principle an adversary of hidden reserves, states that hidden reserves provide the opportunity to cover unexpected losses that would otherwise have reduced substantially the dividends of that year; shareholders therefore sometimes do not become

[112](German original, translated by the author:) "Im normalen Verlaufe eines Geschäftes kann die periodische Zwischenbilanz sicherlich nur der Erfolgsermittlung dienen. Der Erfolg ist aber eine dynamische Erscheinung des Wirtschaftsbetriebes. Er soll die Schwankungen des Wirtschaftsbetriebes zum Ausdruck bringen. Wenn aber durch latente Reserven die Geschäftsergebnisse der vergangenen Jahre intern ausgeglichen werden und die Bilanz durch wechselnde, willkürliche Bewertungsprinzipien die tatsächlichen Schwankungen der Geschäftsergebnisse nicht richtig wiederspiegelt, so dient sie weder der Vermögensverrechnung, noch der Erfolgsermittlung und verliert völlig jeden vernünftigen Zweck." See Lengyel (1927, pp.119/120).

[113](German original, translated by the author:) "Zwar nicht durch das Gesetz selbst, aber durch Gewohnheit und Auslegung hinreichend legitimiert, gilt es als erlaubt, Gewinne nach Belieben zu verstecken, um sie bei nachlassender Rentabilität, wiederum ganz nach Belieben, als Gewinn auszukehren. Einer Unternehmung, bei der sich Niedergangserscheinungen melden und die, betriebswirtschaftlich gesehen, unter allen Umständen daran gehindert werden sollte, aus dem Kapitaltopfe sich zu speisen, wird es nicht verwehrt, durch Auskehrung stiller Reserven Gesundheit vorzutäuschen." As quoted by Lengyel (1927, p.120, Fn.1) without page reference.

> aware of the losses. By doing so, a director who is responsible for bad deals can secretly make up for the losses caused by him, but with funds that belong to shareholders. He could present himself as an able business man whilst he would deserve to be judged differently. That is the effect of hidden reserves, which has already been utilised by many a direction.[114]

This indicates that the administration of dividends based on hidden reserves could be used by companies to provide false signals to investors and policyholders. In order to limit this practice Lengyel (1927, pp.120-121) suggested the introduction of a dedicated dividend reserve:

> If [...] the principle of dividend stability is brought forward in favour of hidden reserves, it has to be replied that the instrument for dividend stability should be a sufficiently disclosed dividend reserve, which is earmarked to balance the dividend without disrupting the recognition of income.[115]

4.2.3 Risk shifting during economic crisis: the example case of *Schweizer Rück* in 1931

There is no known source material regarding the considerations of a German insurance company with respect to its dividend payout strategy. A case study with available primary sources is the Swiss reinsurance company *Schweizer Rück*.[116] In the course of the 1931 Financial Crisis, the then-largest global reinsurance company found itself heavily exposed to price decreases at the securities in the United States. In total, *Schweizer Rück* had to manage write-downs of CHF 40.9 million in 1931, or approximately 10% of its total asset portfolio in 1930.[117] These had to be accounted for by means of mark-to-market principles, using market values of December 1931. The Swiss supervisory office mandated the use of this approach in order to maintain the informative power of insurance balance sheets.[118] This approach differed approaches used in other countries, i.e. Germany or the United States. This was also explicitly mentioned by *Schweizer Rück* in its 1931 annual statement:

[114](German original, translated by the author:) "Berliner, der kein grundsätzlicher Gegner der stillen Reserven ist, sagt selbst, daß stille Reserven die Möglichkeit geben, unerwartete Verluste zu decken, die sonst die Dividende des Jahres um ein erhebliches herabdrücken würden; die Aktionäre erfahren dann manchmal gar nichts von dem Verlust. Ein Direktor, der schlecht Geschäfte auf dem Gewissen hat, kann auf solche Weise den von ihm angerichteten Schaden heimlich, aber mit dem Gelde der Aktionäre wieder gutmachen, und als tüchtiger Kaufmann dastehen, während er ganz anders beurteilt zu werden verdiente. Das ein ein Effekt der stillen Reserven, den sich schomanche Direktion zunichte gemacht hat." As quoted by Lengyel (1927, p.120) without page reference.

[115](German original, translated by the author:) "Wenn [...] für die stillen Reserven der Grundsatz der Dividendenstabilität ins Treffen geführt wird, so muß dem entgegengesetzt werden, daß das Instrument der Dividendenstabilität eine angemessene offene Dividendenreserve sein soll, die berufen ist, den Ausgleich der Dividende ohne Störung der Erfolgsermittlung herbeizuführen." SeeLengyel (1927, pp.120-121).

In this context Lengyel (1927, pp.119/120 Fn.1) also provided a quote by a standard British accounting textbook to back his argument: "The whole question (of the Secret Reserves) is a most difficult one, but in general it is thought that the more straightforward practice of accumulating a substantial Reserve Fund, and having recourse to that Reserve Fund for the equalisation of dividends, is to be preferred, as being considerably less liable to abuse." See Dicksee & De Montmorency (1911, p.268).

[116]See also Werner (2009) and Straumann (2013).

[117]See Straumann (2013, p.291) and, for a more detailed account, Werner (2009, pp.53-56).

[118]See Historical Archive of Swiss Re. Protokollbuch Ausschuss-Sitzungen der Schweizer Rück. Bd.10. Nr.10.107 960. *Protocol of the board meeting of 27 April 1932*, p.178. See also Werner (2009, p.53).

> The extraordinarily strong decline in prices that occurred at the investment market and that affected the best categories of obligations, has caused write-downs corresponding to the size of our business operations. In conformity with legal accounting requirements and in difference to simplifications granted to insurance companies in other countries, December prices found application in the valuation of our assets as well as for foreign currency holdings [...].[119]

At the board meeting held to discuss the matter of asset write-downs, the magnitude of disclosed losses was addressed as well as the potential impact this had on the dividend payout. Regarding the former issue the board agreed to not fully disclose the magnitude of necessary write-downs. It was decided to use the financial reports of the Swiss non-life insurer *Zurich* as a benchmark for reporting write-downs in the comparable magnitude of CHF 16 million.[120] The remaining write-downs were financed from various internal sources. The hidden reserves of the company were reduced from CHF 84 million in the previous year to CHF 46 million in 1931.[121] The company also reduced the dedicated "catastrophe" reserve from CHF 16 million to CHF 10 million, which was also published in the annual balance statement. This reduced the ability of the company to refinance losses incurred by natural catastrophes. General Director Emil Bebler argued that the current market condition resembled a catastrophe:

> We have to invest the premium as well as the loss reserve, part of which is the catastrophe reserve; we have suffered losses on the investments offsetting the assets forming these reserves. These investments have decreased, and [...] hence the use of a reserve dedicated for catastrophes, and it is a catastrophe, is justified.[122]

At the same time the board also had to decide on the amount of cash dividend to be distributed. It was in particular discussed whether the return on equity[123] of 30% since 1915 was to be continued given the

[119](German original, translated by the author:) "Die ausserordentlich starken Kursrückgänge, welche am Anlagemarkt eintraten und wodurch die besten Kategorien von Obligationen in Mitleidenschaft gezogen wurden, haben der Grösse unseres Geschäfts entsprechende Abschreibungen zur Folge gehabt. In der Bewertung unserer Anlagen sind in Gemässheit der gesetzlichen Bilanzierungs-Vorschriften, abweichend von den in andern Ländern den Versicherungs-Gesellschaften gewährten Erleichterungen, die Dezemberkurse zur Anwendung gelangt, desgleichen für die fremden Valuten [...]." Annual Statement *Schweizer Rück* 1931, p.4.

[120]See Historical Archive of Swiss Re. Protokollbuch Ausschuss-Sitzungen der Schweizer Rück. Bd.10. Nr.10.107 960, *Protocol of the board meeting of 27 April 1932*, p.179.

[121]See Guggenbühl (1939, pp.369, 371-372), an internal financial account of *Schweizer Rück*. It should be noted that the amounts published by Straumann (2013, p.292) are incorrect. It declares a reduction in hidden reserves from CHF 33.7 million to CHF 4.4 million. Whilst the former amount is correct, it represents dedicated reserves. The latter amount is incorrect and given by Guggenbühl (1939, p.372) as CHF 14.4 million. Other internal funds that were released in order to refinance the incurred write-downs were the "Zillmer reserve" of nil (1930: CHF 15,160,000) "open reserves" of CHF 30,000,000 (1930: 33,500,000) and "balance carried forward" of CHF 1,590,000 (1930: CHF 826,000).

[122](German original, translated by the author:) „Die Prämien- sowohl als die Schaden-Reserve, zu welch letzterer die Katastrophen-Reserve gehört, müssen wir anlegen; auf diesen den Gegenposten der Reserve bildenden Anlagen haben wir die Verluste erlitten. Diese Anlagen haben sich vermindert [...] [so]dass die Heranziehung einer für Katastrophen vorgesehenen Reserve, und um eine Katastrophe handelt es sich, sich verantworten lässt." See Historical Archive of Swiss Re. Protokollbuch Ausschuss-Sitzungen der Schweizer Rück. Bd.10. Nr.10.107 960, *Protocol of the board meeting of 27 April 1932*, p.182. See also Werner (2009, p.54).

[123]Nominal amount of dividends paid relative to capital employed.

adverse circumstances. The internal consensus went in favour of this in order to promote the prestige of the company. This discussion was succinctly summarised by the member of the board Dr. Sulzer:

> Given the realised large losses, a certain [dividend] reduction would, regardless of the amount of reserves available, correspond to a natural feeling. In contrast the executive personalities highlight the prestige of the company that would require maintaining the dividend. The question of prestige is regarded only in so far as justified as it has an advertising effect for the future. [...] If it is indeed to be assumed that a dividend reduction would limit us in the development of our technical business, if cedents on the other hand confronted us with greater trust, this aspect had to be assigned such a high relevance, then the request would be to maintain the dividend.[124]

In conclusion, the case study of *Schweizer Rück* provides valuable insight into the shareholder-related internal decision making at an insurance company during the Interwar period. A first conclusion is that the executive management used the financial results of *Zurich* as a benchmark for their own publication. Second, the company dealt with the extraordinary circumstances imposed by the 1931 Financial Crisis by releasing CHF 6 million of internal funds associated with the loss reserve. This shows that any reserve could be used for the purpose of dividend stabilisation. At the same time CHF 6.15 million were distributed as dividends following a reported profit of CHF 9.28 million. Thus *Schweizer Rück* effectively obscured to external investors that it actively shifted risks from shareholders to policyholders by releasing internal funds.

4.2.4 Risk shifting during economic crisis: Dividend payout patterns in Germany during the Interwar period

The most notable difference between the experiences of *Schweizer Rück* and German insurance companies was that the latter did not have to use mark-to-market accounting principles following the 1931 Great Depression period. Therefore German companies were not required to account for write-downs of comparable magnitude. Apart from the release of internal funds, companies could also change the utilisation of present income cash flows in order to refinance current shareholder compensation. In contrast to the case study of *Schweizer Rück*, this pattern of behaviour would be observable on aggregate from reported information on dividend payout and net earnings. An important indicator in this regard

[124] German: "Bei den eingetretenen großen Verlusten dürfte, auch wenn die Reserven noch so groß sind, eine gewisse Reduktion einem natürlichen Gefühl entsprechen, demgegenüber wird von den leitenden Persönlichkeiten in den Vordergrund gestellt das Prestige der Gesellschaft, welches eine Beibehaltung der Dividende erfordert. Die Prestigefrage betrachtet man nur insofern als berechtigt, als sie werbend für die Zukunft wirkt. [...] Wenn tatsächlich anzunehmen ist, dass eine Dividendenreduktion uns in der Entwicklung des technischen Geschäfts hemmen würde, dagegen die Zedenten bei Festhalten am bisherigen Dividendensatz uns mit grösserem Vertrauen entgegentreten werden, wenn dieser Punkt effektiv ein so grosses Gewicht beizulegen ist, so würde die Forderung die Beibehaltung der Dividende sein." See Historical Archive of Swiss Re. Protokollbuch Ausschuss-Sitzungen der Schweizer Rück. Bd.10. Nr.10.107 960. *Protocol of the board meeting of 27 April 1932*, p.189. See also Werner (2009, p.55).

Figure 4: Dividend payout pattern during the Interwar Period, 1926 to 1935

Note: The dividend payout ratio is the ratio of dividends paid per unit of net earnings.
Source: Dataset II "Company", see also Ch.4.5

is the dividend payout ratio DPR, which represents dividends paid per unit of net earnings. Figure (4) provides the median[125] and mean aggregate DPR per year for German insurance companies. The indicator reached its maximum in the year 1928 with a median (mean) of 50.33% (44.33%). With the onset of the recession in the German economy in 1928, the aggregate DPR started to decrease until 1935. The year of the 1931 Financial Crisis marked the minimum with a median of 31.0% (33.0%). Although the mean aggregate DPR recovered to a value of 38.78% until 1935, the median remained constantly low at about 32.5% during the years 1934 and 1935. This was due to bias from outliers in the last two years. The reduction in medium DPR suggests that the share of non-paying companies increased in the German market. The development of the aggregate dividend rate - as the ratio of dividends paid per unit of capital employed - is shown in Figure (5).

Aggregate dividend rates peaked in 1928 with a median (mean) of 8.7% (8.8%). Results for 1930 were nevertheless of similar magnitude with a median (mean) of 8.0% (8.6%). A recovery during the years 1932 and 1933 followed. For the years 1934 and 1935, this indicator developed in contrast to DPR, as the median remained relatively constant between 7.25% and 7.5%, whilst the mean declined from 7.5% to 6.5%. This suggests that the amount of non-paying companies did not increase but that the dividend rate of paying companies decreased in average. Putting DPR and dividend rate in a direct relationship allows to analyse the effective cost of capital from dividends. The cost of dividend

[125]The possibility that outliers might bias the mean requires the use of the robust median.

Figure 5: Dividend rate during the Interwar period, 1926 to 1935

Note: The dividend rate is the ratio of dividends paid per unit of capital employed.
Source: Dataset II "Company", see also Ch.4.5

compensation is defined as the relative amount of income that companies had to utilise per dividend rate, or as

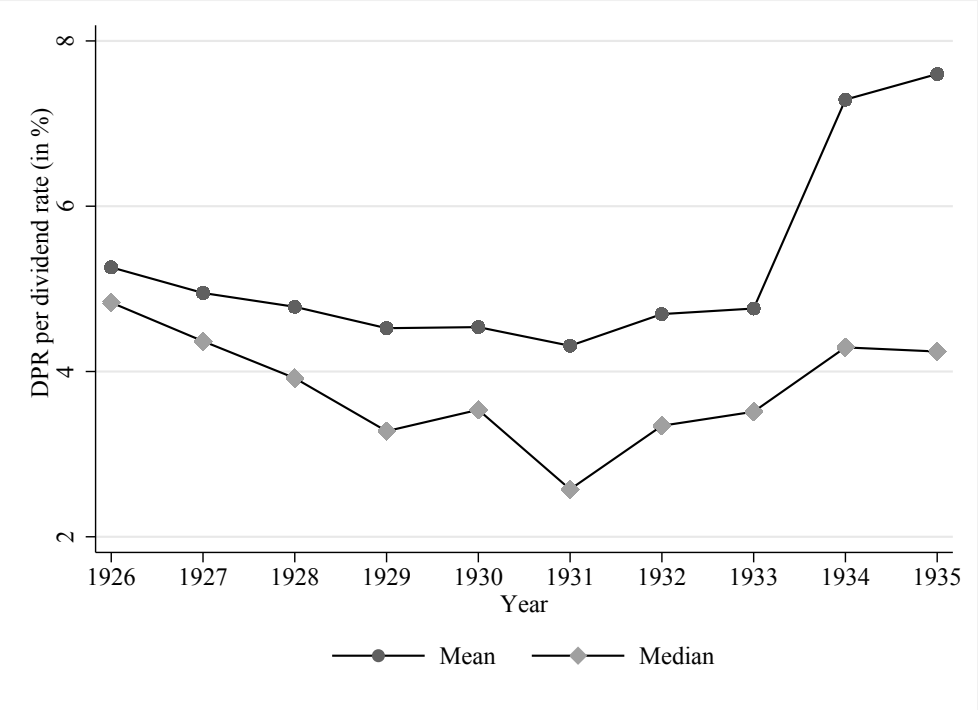
$$Utilisation\,rate = \frac{DPR}{dividend\,rate} = \frac{\frac{dividend\,paid}{net\,earnings}}{\frac{dividend\,paid}{capital\,employed}}.$$

It represents the opportunity cost that insurance companies are facing when paying out dividends. It is provided in Figure (6).

Both, median and mean aggregate values indicate a counter-cyclical pattern. The median (mean) utilisation rate gradually decreased from a peak in 1926 of 4.82% (5.26%) to a through in 1931 of 2.57% (4.3%). Whilst mean values were again biased by outliers in the years 1934 and 1935, the median utilisation rate recovered back to pre-crisis standards by 1934. The cost of dividend compensation was therefore relatively low during the immediate years of the Great Depression, 1931 to 1933. It increased back to pre-crisis levels in the years 1934 and 1935 that were marked by economic recovery.

Periods of a relatively increased utilisation rate are not necessarily associated with risk shifting activities. It is ,for example, possible that an insurance company holds funds in excess of its calculated reserve requirements. The associated investments expose the company to further risks such as for example market, interest rate or credit risk. Under these circumstances, risk-averse companies with sufficient reserves will cause an increase in the utilisation rate. Separating such activities from actual risk shifting activities is the purpose of this chapter. The working hypothesis is therefore that German

Figure 6: Utilisation rate during the Interwar period, 1926 to 1935



Note: The cost of shareholder compensation is the dividend payout ratio per unit of dividend rate.
Source: Dataset II "Company", see also Ch.4.5

insurance companies were shifting risk during the Interwar period.

4.3 Managing the dividend payout - risk shifting in insurance investor relations

The internal dividend payout process of an insurance company needs to be modelled in order to analyse differences in dividend payout patterns. This is necessary for clarifying the connection between the case study of *Schweizer Rück* that shows risk shifting in an economic crisis period, and the experiences of the German insurance sector during the "Golden Twenties". The following part first introduces recent contributions in relevant literature are discussed that are based on observations from the 2007/2008 Financial Crisis. Second, the profitability / stability trade-off inherent to the operations of a private joint-stock non-life insurance company is presented. Third, the relevance of this trade-off is shown in the context of investor-related risk shifting. Fourth, a theoretical dividend reserve process is introduced that takes into account the characteristics of dividend strategies observed.

4.3.1 Basic non-life insurance cash flow decomposition

Insurance companies exchange the promise of taking over the financial costs of a realised uncertain event in the future against the regular reception of up-front premiums. The insurance company reports

Table 22: Schematic insurance income statement

Cashflow		
Income	**Expenses**	
Gross premium earned		
	Premiums ceded to reinsurance	
		Net premium earned
	Operating cost (net) losses incurred	
		Underwriting income
Investment income		
		Net operating profit
	Added to surplus Tax, depreciation management compensation, etc.	
		Dividends

the results of its business activity on an annual basis. The associated schematic accounting cashflow is provided in Table (22). During the pre-defined accounting period the company uses premiums earned net of reinsurance to offset operating costs and to pay for losses incurred in this period. Adding up underwriting and investment income forms the net operating profit. Solvency - or *stability* - is one of the main criteria of firm strength in insurance. Using earnings to form additional reserve funds reduces the default or ruin probability. Net operating profit after transfer to reserves, taxes, depreciation and management as well as supervisory board compensation is paid out as dividend to shareholders. The ability to compensate shareholders defines the *profitability* from an investor perspective. It is important to note that this *profitability / stability* trade-off in managing the allocation of funds to reserves or the release to shareholders is inherent to the general business model of private joint-stock companies during the Interwar period as well as the 2007/2008 Financial Crisis.

4.3.2 Risk shifting by dividend payout

The fundamental business strategy of an insurance company is to maximise *profitability* while maintaining constant *stability*.[126] A pareto-optimal solution to the *profitability / stability* trade-off is nevertheless not straightforward to achieve. This is due to the fact that shareholder liabilities are limited to the capital employed. On the contrary, policyholders - or debtors in general - face potential liabilities that are only bounded by the specifications of the underlying insurance contract. This constitutes the classical principal agent conflict between the "fixed claimant" policyholder, the principal "shareholder"

[126] Compare amongst others Schulenburg & Oletzky (1998), Oletzky (1998), Maguhn (2007) and Friese (2013).

and the intermediary agent "insurer".[127] According to Smith & Warner (1979) risk shifting occurs from four major sources of conflict of which two - *claim dilution* and *asset substitution*[128] - are relevant from a *stability* perspective only. Both sources are focused within the body of literature that especially considers topics of business organisation.[129]

Risk shifting in the present context occurs directly from the conflict caused directly by *dividend payment* and indirectly by *underinvestment*.[130] The former describes the trade-off between increasing dividend payout and maintaining sound reserve funds. This implies *underinvestment* in future funds required for i.e. advancing business operations. The example of *Schweizer Rück* shows that insurers could, on the one hand, increase dividend payout by releasing funds from reserves. This occurs independently from current income in cashflows and therefore might not be observable. The example of the utilisation rates of German insurance companies indicates, on the other hand, that companies could tap into cash flows to reserves in order to increase the amount distributed to shareholders. In this case, the company directly increase the utilisation of current net earnings and is therefore observable. So far no study has considered the *profitability* perspective, i.e. the conflict between principal and agent within the context of insurance.

4.3.3 Theoretical assessment of insurance dividend payout strategies

Insurance companies have discretion over gross premium income and dividend payout cashflows. Costs associated with claims incurred are of stochastic nature. This is the basic specification of the Cramér-Lundberg model as developed[131] by Lundberg (1903) / Lundberg (1909) and Cramér (1930). The basic interaction of the initial wealth or capital, deterministic premium income and stochastic claims payments is analysed in the context of the surplus process of an insurance company. This model was extended to include shareholder compensation in the form of dividend payout by De Finetti (1957). This seminal study initiated extensive research into optimal dividend payout strategies in the context of the Cramér-Lundberg model and non-life insurance. An exhaustive literature review is provided by Avanzi (2009).

A straightforward and well-documented dividend strategy in the Cramér-Lundberg model is the so-called barrier strategy. If the surplus surpasses a predetermined minimum amount, the excess will be paid out as dividend. This strategy effectively prohibits risk shifting. The conditions necessary for optimality of this strategy are exponentially exponentially distributed claims and a lower barrier than

[127] The agent is in stricter terms the "executive management of the insurer". See in particular Jensen & Meckling (1976).
[128] See Smith & Warner (1979, p.118).
[129] Compare in particular Garven & Pottier (1995), Garven & Lamm-Tennant (2002), Abdul Kader et al. (2010) and for a general overview Mayers & Smith (2013). This is discussed in detail in Ch.5.
[130] See Smith & Warner (1979, pp.118-119).
[131] Compare Borch (1967) for the history of the model and the field.

the initial capital of the company.[132] The main advantages of this strategy are its simplicity as well as that it generates a dividend cash flow stream that is time-consistent and mathematically optimal in the framework of mathematical optimisation. The main disadvantage is that the generated dividend cash flow itself is a function of the stochastic claims process and is therefore not deterministic. The unrealistic characteristics of this results are remarked by Borch (1967, p.450) / Borch (1974, p.284), where a utility-based approach offered as an alternative. Motivated by the lack of realism of the barrier strategy, Avanzi & Wong (2012) propose a deterministic mean-reverting dividend strategy that compensates optimality for realism. This model, however, has the disadvantage that dividend payout is not under direct control by the executive management.

4.3.4 Modelling the dividend reserve process

Let the administered dividend payout strategy of a private joint-stock insurance company be represented by the so-called dual risk model .[133] It has found recent application to dividend optimisation problems by Ng (2007), Ng (2009) as well as Avanzi et al. (2007).[134] Contextually, the dual risk model is generally thought of as a representation of pension funds, annuity or venture capital firms[135]. Outside of actuarial studies, the model is also commonly used in queueing theory[136]. The basic mathematical properties of the dual risk model are readily available and are provided in Asmussen (2003, Section 5.2), Ng (2009) and in detail in Ng (2007, Section 4.1).

Let the dividend reserve process $Y(t) \in \mathbb{R}_0^+$ be defined by

$$Y(t) = y - Dt + E(t), \tag{4.1}$$

where $y = Y(0)$ defines initial funds at time $t = 0$ where $t \in T$. The stochastic income $E(t) \in \mathbb{R}_0^+$ is added to the reserve and deterministic constant dividend payout cashflow $D \in \mathbb{R}_0^+$ is paid out simultaneously. Both cashflows are denominated in monetary units. The dividend growth rate $g \in \mathbb{R}_0^+$represents the percentage change in relative dividend payout or

$$g(t) = \frac{D_t}{D_{t-1}} - 1 \tag{4.2}$$

and is assumed to be normally distributed. In the present context it is a constant. Given that the

[132]Compare Borch (1963) (identical to Borch (1974, pp.225-234)), Gerber (1969), Bühlmann (1970), Avanzi (2009), as well as Gerber & Shiu (2004) for the Brownian motion model, and Gerber & Shiu (2006) for the compoung Poisson model used to represent the claims process.

[133]Important theoretical introductions to this model are provided by Cramér (1955, Section 5.13), Seal (1969, pp.116-119), Takács (1967, pp.152-154) and Bowers et al. (1997, p.424).

[134]A dual model perturbed by a diffusion process is furthermore used in Avanzi & Gerber (2008), whereas Albrecher et al. (2008) considers tax payments when the surplus reaches a running maximum.

[135]See Bayraktar & Egami (2008).

[136]The first study is Prabhu (1960), see also Asmussen (2003). An early example for its application within the context of fluid queue theory is Kendall (1957).

company has full discretion over the dividend payout, it can utilise internal funds to increase D. This is consistent with the case study of *Schweizer Rück*. The process relates to the Cramér-Lundberg model, as the latter can be tought of as the process generating $E(t)$. Any further theoretical considerations are not of relevance in the present context and are left for future research.

$Y(t)$ and y are assumed to be unobservable internal reserves whilst cashflows D - in the following generalised to be time-varying - and $E(t)$ are available from profit and loss statements. It is also assumed that companies adhere to the paradigms of Lintner (1956) and adjust dividend payout toward a firm-specific target payout as the company matures.[137] The target payout ratio $\theta_t^\star$ puts both cashflows into relation and is defined as the target internal DPR, or

$$\theta_t^\star = \frac{D_t^\star}{E_t}, \tag{4.3}$$

where $D_t^\star$ denotes the target dividend distribution.[138] This variable can only be inferred indirectly from the cashflow dynamics. In accordance with the fundamental business strategy of an insurance company it is assumed that the long-run target dividend payout maximises *profitability*

$$\mathbb{E}[\theta] = \max_D \frac{\mathbb{E}[D^\star]}{\mathbb{E}[E]} \tag{4.4}$$

under the first-order condition that *stability* - and thus the target dividend reserve $Y^\star$ - remains constant, or

$$\frac{\partial Y^\star(t)}{\partial D} = 0. \tag{4.5}$$

This also requires assumptions regarding the actuarially fair long-run expected net earnings performance of the company. Investor-related risk shifting is associated with the intentional decrease of *stability* by reducing the target dividend reserve $Y^\star(t)$. This can occur by directly releasing funds as dividend payout, which applies to the case of *Schweizer Rück*. Alternatively, companies can increase the target dividend payout ratio and re-allocate net earnings cashflows from building up reserves towards the target dividend reserve $Y^\star$. This is assumed to have taken place in Germany and shows that both historical case studies need to be associated to the same investor-focused risk shifting.

[137] See Powell (2009, p.367) for a detailed description of the model.

[138] The definition of the target is subject to the considerations of the company. *Schweizer Rück* for example used a dividend rate of 30% as target indicator.

4.4 Dividend signalling by insurance companies

4.4.1 The Lintner partial adjustment model in insurance literature

Two studies successfully apply the Lintner partial adjustment model to insurance-related questions. Lee & Forbes (1982) analyse the dividend payout ratio of 61 U.S. non-life insurance companies between 1950 and 1976. The study finds that dividend payout is correlated with previous year's dividends, current earnings and the ratio of equity relative to total assets, called capacity ratio. Harrington (1981) examines the effect of group affiliation on the dividend policy based on a sample of 68 U.S. life insurance companies, also between 1950 and 1976. The study finds that group subsidiaries paid more dividends in comparison to independent companies. This also confirms that insurance companies have a strong interest in providing a consistent dividend cashflow.

4.4.2 Model specification based on Arrelano-Bond GMM estimator

The model provides a method to derive the target dividend payout $D^\star$ from the intertemporal cashflow dynamics. The absolute dividend change ΔD_t in period t relative to period $t-1$ is formally defined as

$$\Delta D_t \quad = \quad \gamma \left(D_t^\star - D_{t-1} \right) + u_t, \tag{4.6}$$

where $\gamma \in [0,1]$ denotes the speed of adjustment to the target payout ratio $D^\star$. The error term u_t remains to be defined. The speed of adjustment factor captures the velocity with which a company seeks to adjust its payout to the target dividend $D_t^\star$ under the assumption that the company has not yet reached it. Its magnitude represents the interest of the company in achieving the pre-defined target. Substituting $D_t^\star$ with Equation (4.3) allows to represent the dividend payout D_t at time t as

$$D_t = \gamma \theta^\star E_t + (1-\gamma) D_{t-1} + u_t. \tag{4.7}$$

This is transformed into a linear regression model by specifying the coefficients as

$$\gamma \theta^\star \quad = \quad \beta_1^S \tag{4.8}$$

and

$$1-\gamma \quad = \quad \beta_2^S \tag{4.9}$$

in accordance with Lintner (1956, p.109). Together with the addition of the intercept β_0, this yields the econometric representation of the model for company $i \in N$ as

$$\begin{aligned} D_t &= \beta_0 + \beta_1^S E_{it} + \beta_2^S D_{i(t-1)} + u_{it} \\ u_{it} &= \sum_t (\beta_t YEAR_{it}) + \nu_i + \epsilon_{it}. \end{aligned} \tag{4.10}$$

This approach takes into account year controls $YEAR$ and a control for idiosyncratic fixed effects inherent to company i, ν_i. The state variable denoted by superscript $S \in [0;1]$ represents different realisations of a binary factor variable that maps observations to the Golden Twenties or the Great Depression period. This allows to compare results for the relevant realisations whilst ensuring the use of a single intercept β_0. The error term ϵ is assumed to be normally distributed with $\mathbb{E}[\epsilon] = 0$.

The specified model features an unbalanced panel dataset of 161 individual companies covering ten years of data. The properties of the panel as "large N small T"[139] might introduce "dynamic panel bias", given that the lagged variable $D_{i(t-1)}$ is potentially correlated with the fixed effects ν in u_{it}.[140]. In order to take this into account, the Arrelano-Bond two-stage generalised method of moments (GMM) estimator[141] is used. The following approach utilises a two-step system GMM to allow the use of Windmeijer-corrected standard errors, small-sample adjustments and orthogonal deviations, the latter to minimise data loss.[142] Net earnings E_t and time controls $YEAR$ are treated as predetermined variables to allow for potential correlation with past errors. Regarding E_t this takes into account sudden income shocks, which were absent during the Interwar period and that companies could also use internal funds to directly stabilise reported net earnings. Time controls are obligatory since the used state variable S is also time-dependent given that it sub-divides observations based on annual classification.[143] Finally, the inclusion of an intercept implies that companies are more willing to increase than decrease dividends.[144]

4.4.3 Classification of model results

The results of the econometric model serve to calculate implied values for the target dividend payout rate $\theta^\star$and speed of adjustment α based on Equation (4.9), respectively Equation (4.8). Due to the necessary assumptions inherent to the model approach, results are not interpreted in absolute but in relative terms. Relative differences between the estimates for the sub-periods of 1926 to 1929 and 1930

[139] See Roodman (2009, p.128).
[140] See Nickel (1981).
[141] See Arellano & Bond (1991).
[142] See Arellano & Bover (1995) and in general Roodman (2009).
[143] Interestingly, however, adding strictly exogenous variables, such as macro-economic performance data, does not lead to substantial changes in the results.
[144] Compare especially Fama & Babiak (1968) for different specifications.

Table 23: Summary statistics dynamic model

Variable	Unit	Obs	Mean	Med	Std Dev	Min	Max
Dividend	RM	1,219	124.062	40.00	286.885	0	2,580
Net operating profit	RM	1,220	283.54	88.00	673.880	-3,990	6,664
Nominal ROE	%	1,219	7.527	8.000	6.556	0	80
DPR	%	1,220	39.53	43.669	29.801	-58	126
Utilisation rate	%	1,220	5.21	3.839	8.192	-14	200

Note: Reported negative values for DPR and DPR per nominal ROE are associated with
Source: Dataset II "Company"

to 1935 serve to identify potential differences of relevance. Furthermore, model results are compared with benchmark results from studies on U.S. data, which are based on the same methodology. The results in Lintner (1956), Fama & Babiak (1968) and Fama & French (1988) are chosen as benchmarks. Since the studies feature overlapping coverage periods, differences in the individual results are assigned to the sub-periods that are exclusively covered by each study. The first study analyses dividend payout patterns of a sample of 28 U.S. companies from 1918 to 1941. Given that it exclusively covers the period 1918 to 1926 for the speed of adjustment, it is used as benchmark for the U.S. Interwar period. The second study considers 397 U.S. companies from 1950 to 1964. Due to its exclusive coverage of the period 1957 to 1964 it is considered as a benchmark for estimates associated with the economic stability of the U.S. 1960s. The third study provides only results for the speed of adjustment for the period from 1927 to 1956 based on the extensive CRSP dataset. Given its exclusive coverage of the years 1942 to 1949 it is used as benchmark for the immediate U.S. Postwar period.

4.5 Data

The sample consists of observations associated with dividend payments available from Dataset II "Company". Mutual companies are excluded due to the absence of dividend payout cashflows. A total of 161 companies were potential dividend payers. Table (23) provides the summary statistics. Potential different forms of shareholder compensation were considered where indicated in the records. These include the payment of dividends in company shares (*Amisia*, 1929), the reduction of shareholder liabilities (*Anker Transport*, 1930; *Berlinische Spiegelglas*, 1932) and share-specific payout cashflows (*Deutsche Glas*, 1932 - 1935). Negative values for DPR and the utilisation rate are attributed to *Norddeutsche Kraftfahrzeug*, a specialised motor insurer founded in Hamburg in 1928. In the same year the company reported a dividend rate of 4%, a dividend payout of 10,000 RM and a loss of RM 17,000. The maximum observation for DPR relates to the fire / transport insurance company *Iduna-Germania Versicherung* in 1932, when the company paid RM 340,000 in dividends whilst reporting earnings of RM 270,000. The maximum value reported for the utilisation rate is associated with the transport

Table 24: Results dynamic panel model

		Sub-periods		
	S	AB	OLS	FE
E_t	1	.342***	.321***	.164***
		(.070)	(.027)	(.032)
	2	.126**	.140***	.077***
		(.042)	(.009)	(.012)
D_{t-1}	1	.464*	.500***	-.004
		(.180)	(.058)	(.057)
	2	.610***	.585***	.075*
		(.098)	(.024)	(.034)
Intercept		-15.29*	12.97	86.27***
		(7.225)	(10.99)	(11.21)
(Pseudo-)R^2		.875	.876	.826
AB1 z		-1.60		
AB2 z		1.12		
Hansen J χ^2		136.22		
Instruments		108		108
Companies		161		161
Observations		1,028	1,028	1,028

Note: Standard errors in parentheses. Observations are reduced due to differentiation. Variable S maps the value "1" to observations from the period 1926 to 1929 and "2" to observations from 1930 to 1935. "AB" denotes results obtained from the Arrelano-Bond GMM estimator, "OLS" results from the ordinary least squares regression, and "FE" results from the fixed effects panel regression. Standard errors in parentheses.
* p< .05, ** p< .01, *** p< .001
Source: Dataset II "Company"

insurer *Wikinger Lloyd* in 1934. In this year, the company reported a very low dividend rate of 0.5% with a DPR of 100% .

4.6 Results partial adjustment model

Table (24) provides the results of the Lintner partial adjustment model. Overall, the GMM estimator provides results that are comparable to OLS regression estimates. The explanatory value of the (Pseudo-)R^2 statistic is limited by the inclusion of the lagged variable that causes large values, given that relative differences of current to previous-year dividends were limited. As a robustness check for GMM estimates, Roodman (2009) argues that results from the GMM estimator should be within or sufficiently close to the range of results obtained from OLS and fixed effects regression. Although the reported point estimates for E_t^1 and D_{t-1}^2exceed this range, both results are sufficiently close as the results of OLS regression lie within the standard deviation of both variables. The Arrelano-Bond test for serial correlation furthermore reports the necessary absence of serial correlation in second differences. Finally, the Hansen J-test confirms the exogeneity of the instrument set, thus suggesting that the model is well specified. Lastly, all parameter estimates are statistically significant at a p-value of 5%.

Based on the estimated results, Equation (4.9) allows the inference of the implied speed of adjustment

Table 25: Results GMM estimation, speed of adjustment and target payout ratio

Definition		Golden Twenties	Great Depression	U.S. Interwar	U.S. 1960s	U.S. Postwar
Period		1926 - 1929	1930 - 1935	1918 - 1941	1950 - 1964	1927 - 1956
Speed of adjustment	γ	.536	.390	.300	.400	.490
Target DPR	$\theta^{\star}$	.638	.323	.500	.380	-
Observations	N	161	161	28	397	*CRSP dataset*

Note: Own calculations. Reference data provided for comparative purposes on different periods and covering different datasets of U.S. companies.
Source: For Golden Twenties and Great Depression: Table (24); for U.S. Interwar: Lintner (1956); for U.S. Postwar: Fama & French (1988); for U.S. 1960s Fama & Babiak (1968)

γ and Equation (4.8) the calculation of the implied target payout ratio $\theta^{\star}$. Results are provided in Table (25).

The speed of adjustment γ is estimated at 0.536 during the Golden Twenties and 0.390 during the Great Depression period. The former period provides estimates that are closer to the results of 0.490 for the overall U.S. Postwar period from 1927 to 1956. The estimates for the later period fall between the benchmark values and are closer to the results for the U.S. 1960s. The point estimates for target dividend payout ratio $\theta^{\star}$ are 0.638 during the Golden Twenties and 0.323 during the Great Depression period. The arithmetic mean of both estimates, 0.481, is similar in magnitude to the benchmark of 0.500 for the U.S. Interwar period, thus supporting the robustness of results. The estimates imply first that insurance companies were targeting twice the dividend payout ratio during the first relative to Great Depression period. Second, the former estimate was also in excess of the U.S. Interwar benchmark. The estimate for the later period, however, is closer to the benchmark of 0.380 for the U.S. 1960s period.

Overall, the point estimates for the later period between 1930 and 1935 are comparable to the benchmark results for the U.S. 1960s period. This implies comparable dynamics in the underlying dividend reserve processes. A reason for this observation is that companies distributed funds that were not required for *stability* purposes during both, the U.S. 1960s period of economic stability and the Great Depression period in Germany. This helps to explain the increase in the aggregate utilisation rate in the later years of the Great Depression in Germany. It raises the additional question as to whether insurance earnings during the early 1930s were sufficient to enable companies the build-up of sufficient reserves. The hypothesis of German insurance companies engaging in risk shifting has to be rejected for the Great Depression period.

With respect to the earlier Golden Twenties from 1926 to 1929, the empirical evidence suggests that companies were actively shifting risk. The excess estimated target dividend payout rate are not comparable to the benchmark results. They are in addition consistent with the increased level of the aggregate utilisation as the relative cost of dividend compensation. Additionally, the relatively high

speed of adjustment is explained by the increased competition following the 1924 currency reform. As companies sought to return to pre-war business operations they also sought to return to pre-war payout levels. This is consistent with the benchmark of the U.S. Postwar period, which was also marked by a recovery from the U.S. war efforts. It confirms the hypothesis of German insurance companies actively shifting risk for the sub-period of the Golden Twenties.

4.7 Pro-cyclical dividend administration

This chapter showed that increased dividend payout of *Schweizer Rück* in 1932 as well as relatively increased relatively cost of dividend compensation in Germany during the Golden Twenties from 1926 to 1929 were both indicators for risk shifting activities. This finding was based on a newly defined dividend reserve process that contributed a new perspective to the discussion of optimal dividend payout strategies in actuarial ruin theory. Within this process, the Lintner partial adjustment model was used to analyse cashflow dynamics based on the Arrelano-Bond GMM estimator. Results indicated that increased relative cost of dividend compensation was associated with risk shifting during the Golden Twenties period. In contrast, likewise increased levels were found to be the consequence of sufficiently available reserve funds at the end of the Great Depression period and not with risk shifting.

The key contribution of this chapter to the identification of endogenous risk is the observation that the case studies of *Schweizer Rück* and the German market are based on similar dynamics. This relates similar patterns witnessed during the recent 2007/2008 Financial Crisis to the same underlying dynamics. During the recent crisis, banks and securities firms affected continued to pay dividends regardless of the adverse circumstances. Overall, 45% of TARP funds received by banks[145] and a total of USD 81.458 billion [146] were redistributed to shareholders. Acharya et al. (2011) explain this observation by the implied governmental guarantee for the institutions affected that were deemed "too big to fail". These companies were therefore able to maintain current *profitability* levels regardless of *stability*-related concerns. Acharya et al. (2013) analyse the motivation to maintain *profitability* level regardless of the business performance in a game theoretical setting. The study argues that, within an integrated financial market, dividend decisions of financial institutions are highly interconnected. Banks therefore do not unilaterally change dividend payout strategies, even although this would be consistent with the four paradigms expressed by Lintner (1956).[147] This shows similarity to the case study of *Schweizer Rück* that the company considered the financial statements of *Zurich* prior to its dividend decision. With respect to the 2007/2008 Financial Crisis, AIG also paid USD 1.6 billion in

[145] See Acharya et al. (2011, p.7).

[146] Own calculations based on data of quarterly dividend distributions by 13 U.S. banks in the period 2007 to 2009. See Acharya et al. (2011, Appendix, Table 4a).

[147] This relates in particular to the paradigm (iii) of Lintner (1956) that "[a] major unanticipated and non-transitory change in earnings would be an important reason to change dividends".

dividends over the three quarters of 2008 prior to the governmental bail-out that prohibited further payout in September 2008.[148] Interestingly, AIG even increased cash dividends from USD 0.20 per share to USD 0.22 in the third quarter of 2008 when the share price fell from USD 30.10 to USD 2.05.[149] By distributing funds from reserves as dividends, AIG as well as the other affected companies actively shifted risk from shareholders to policyholders. The antecedent of the Interwar period suggests that AIG engaged in similar activities prior to the 2007/2008 Financial Crisis, as is hypothesised in the introduction of this dissertation.

[148] See AIG 2008 10-K p.319.
[149] See AIG 2008 10-K p.34.

5 Reinsurance demand in Germany during the Interwar period

5.1 Reinsurance as financial derivative

Direct insurance companies - cedents - obtain reinsurance protection by passing on - or ceding - the liability for financial costs associated with the occurrence of an insurance claim. In turn, premiums originally earned on the accepted risk is passed on to the reinsuring party. This constitutes an important element of insurance risk management. At the same time, reinsurance as a derivative of insurance risk is actively traded on the secondary reinsurance market. During the Interwar period, Germany was home to the oldest specialised reinsurance company and the company that invented modern quota share reinsurance, *Kölnische Rück* und *Münchener Rück*, respectively. It featured a historically grown and well developed reinsurance market. Furthermore, the legal framework was historically unique given that neither reinsurance transactions nor specialised reinsurance companies were subject to governmental supervision. This suggests companies may have used reinsurance for purposes other than risk management. The following analysis analyses the determinants of reinsurance demand in Germany during the Golden Twenties and the Great Depression period between 1926 and 1935 in Germany.

The motivation to analyse reinsurance demand in the context of endogenous risk is motivated by the finding of Abdul Kader et al. (2010) that joint-stock companies active in the Swedish fire insurance market featured an increased demand for reinsurance demand during the 1920s. It is hypothesised that this was due to risk shifting by means of reinsurance. The extended risk exchange model by Borch (1986) is used to illustrate the theoretical interdependence between the reinsurance market and shareholders. It establishes that changes in the investment opportunity set of investors may cause risk shifting by means of reinsurance. The German reinsurance market of the Interwar period lends itself as a natural experiment due to its beneficial idiosyncratic characteristics. The model assumptions are tested empirically using a two-step panel model approach that advances the methodology introduced by Mayers & Smith (1990) and by Abdul Kader et al. (2010). It is found that insurance companies were shifting risk by reinsurance during the Golden Twenties and that residual insurance risk accumulated at specialised reinsurers. It is also shown that young specialised reinsurance companies accumulated residual risk.

The analysis contributes to the existing literature by introducing a new econometric two-step model that explicitly takes into account the statistical properties of the variable for reinsurance demand. In addition, a direct link between actuarial theory and empirical analysis is established that connects principal agent with actuarial ruin theory. The main limitation of the analysis is that underwriting portfolios of specialised reinsurance companies are not available for analysis due to a lack of reporting

standards. In addition, lagged variables are not considered due to the relatively short period under consideration.

The chapter is organised as follows: first, the characteristics of the "1901 Act on the Supervision of Insurance Undertakings" in general and the contemporary consideration of reinsurance in particular are provided. Second, the theoretical principles of reinsurance demand are discussed on the basis of extended risk exchange model. Third, the empirical approach is introduced on the basis of a detailed discussion of the statistical properties of the dependent variable. Fourth, the characteristics of the dataset at hand are pointed out. Fifth, the empirical results are provided and discussed. The empirical appendix provides additional robustness checks of the model assumptions.

5.2 Historical Background: reinsurance and the 1901 Act on the Supervision of Insurance Undertakings (VAG)

The codified insurance supervisory law for the German Reich, the "Act on the Supervision of Insurance Undertakings" (German: "Gesetz über die Beaufsichtigung der Versicherungsunternehmen" (VAG)) of 12 May 1901 remained valid throughout the Interwar period. Its main motivation at inception was to provide a "unified legal foundation for all territories of the [German] *Reich*."[150] Its core content remained applicable until the end of World War II. As primary source material, the legal documentation preceding the passing of the law together with the original May 1901 version of the law are available in the source collection "Motive VAG (1963)"[151]. Additional insight is provided from the contemporary commentary Moldenhauer (1903) and the concise analysis provided by Ruge (2001). A detailed discussion of the principle of insurance line separation is the doctoral dissertation Rhode-Liebenau (1973).

The following part first introduces the scope and purpose of German insurance regulation. Second, the treatment of reinsurance companies is discussed. Third, the code of conduct of reinsurance business operations is presented.

5.2.1 The scope and purpose of the 1901 VAG

The German insurance sector is historically divided into private and public insurance companies. The latter were subject to the legislation of the German federal states so that the 1901 VAG only applied to private joint-stock and mutual companies.[152]Regarding the general purpose of insurance regulation in general, the textbook Farny (2006, pp.108-125) lists four main purposes: first, micro-prudential

[150](German original, translated by the author:) "[...] einheitliche Rechtsgrundlage für alle Gebiete des Reiches." See Manes (1935, p.163).

[151]This source collection also contains all relevant amendments to the VAG until World War II. In the following the basic characteristics of the VAG are provided.

[152]"Public insurance companies, as incorporated under the directives of the federal states, are not subject to the provisions of the law." (German original, translated by the author:) "Die auf Grund landesgesetzlicher Vorschriften errichteten öffentlichen Versicherungsanstalten unterliegen den Vorschriften dieses Gesetzes nicht [...].) Art. 119 VAG, Motive VAG (1963, p.302)

consumer protection, second, guaranteeing the functionality of the insurance sector, third, preventing and eliminating potential market deficits and forth, the promotion of general economic growth. The need for the first purpose, consumer protection, arises from the information asymmetry between the counterparties of the insurance contract. Since policyholders have full information about the insured event, the reporting of false information is considered as fraud and is treated as a criminal offense. Insurance companies, however, have detailed expertise with respect to the legal framework of the insurance contract. This in turn puts policyholders with less legal expertise in a disadvantageous position. For example, it might remain unnoticed by the policyholder that certain types of risk might not be covered by the contract. This would cause a situation of unintentional lack of insurance protection. It therefore falls to the supervisor to ensure consumer protection, which includes to guarantee that insurance companies meet their liabilities towards policyholders.[153]

The 1901 VAG explicitly mentioned the purposes to protect consumers and to ensure the functionality of the sector as main mission statements of the German supervisory office in Art. 64:

> It is upon the German supervisory office to control the complete business operations of insurance companies, in particular the adherence to legal provisions and the adherence to the business plan in particular. It is authorised to make dispositions that are suitable for aligning business operations and the business plan with legal provisions or eliminating deficits that could either endanger the interests of the insured or put business operations in opposition to proper conduct. [...][154]

To ensure consumer protection, VAG Art. 64 defined the mission of the supervisory office as overseeing companies on a continual basis. It had the right to repeal the concession for companies that had violated particular principles, including their own individual business plan. This was the set of information required in order to obtain the concession for starting business operations. Art. 4 specified the particular set of information required for obtaining a concession:

> Insurance companies require the approval of the supervisory office for conducting business. The application for the approval of a concession has to include the business plan, which has to disclose the purpose and the establishment of the company, the geographical coverage of the intended operations as well as the conditions that are supposed to ensure the continuing fulfilment of the company's future liabilities.

[153] The general historical development of this solvency principle from an international perspective is provided in Sandström (2007).

[154] (German original, translated by the author:) "Der Aufsichtsbehörde liegt es ob, den ganzen Geschäftsbetrieb der Versicherungsunternehmungen, insbesondere die Verfolgung der gesetzlichen Vorschriften und die Einhaltung des Geschäftsplans, zu überwachen. Sie ist befugt, diejenigen Anordnungen zu treffen, welche geeignet sind, den Geschäftsbetrieb mit den gesetzlichen Vorschriften und dem Geschäftsplan im Einklange zu erhalten oder Missstände zu beseitigen, durch welche die Interessen der Versicherten gefährdet werden oder der Geschäftsbetrieb mit den mit den guten Sitten in Widerspruch gerät." Art. 64 VAG, Motive VAG (1963, p.296).

Elements of the business plan should be:

1. the commercial arrangement or the charter if the corporation is based on such;

2. the insurance-related general terms of agreement and the insurance-technical documentation if the nature of the intended insurance business requires such.[155]

Conditions for the repealing of a concession were provided in Art. 7 (VAG):

The concession to conduct business may only be denied, if

1. the business plan violates legal provisions;

2. based on the business plan, the interests of the insured are not adequately ensured or the continuing fulfilment of the company's liabilities is not sufficiently provided for;

3. facts exist that justify the assumption that business operations will not take place in compliance with legal provisions or proper conduct.

The concession can be made conditional on the provision of a suitable security deposit, for which the purpose and the terms for return are to be declared.[156] Both requirements indicate that the supervisory office could exert its authority with a great degree of discretion. The efficiency of the regulatory requirements thus substantially relied on the ability of the supervisory office to take objective and informed action. Anecdotal evidence suggests that the German insurance regulation was indeed efficient in providing consumer protection. Koch (2012, p.288) / Koch (2005, p.53) attest the German supervisory office a "high reputation amongst politics, companies and the insured, [and] the general public [...]".[157] The German supervisory office (German: Versicherungsaufsichtsbehörde) was the main regulatory body within the framework of the insurance supervisory law.

[155](German original, translated by the author:) "Versicherungsunternehmungen bedürfen zum Geschäftsbetriebe der Erlaubnis der Aufsichtsbehörde. Mit dem Antrag auf Erteilung der Erlaubnis ist der Geschäftsplan einzureichen, welcher den Zweck und die Einrichtung des Unternehmens, das räumliche Gebiet des beabsichtigten Geschäftsbetriebs sowie namentlich auch diejenigen Verhältnisse darzulegen hat, aus denen sich die dauernde Erfüllbarkeit der künftigen Verpflichtungen des Unternehmens ergeben soll.

Als Bestandteile des Geschäftsplans sind insbesondere einzureichen:

1. der Geschäftsvertrag oder die Satzung, sofern die Unternehmung auf solchem beruht;

2. die allgemeinen Versicherungsbedingungen und die technischen Geschäftsunterlagen, soweit solche nach der Art der zu betreibenden Versicherung erforderlich sind." Art.4 VAG, Motive VAG (1963, p.289).

[156]German: "Die Erlaubnis zum Geschäftsbetrieb darf nur versagt werden, wenn

1. der Geschäftsplan gesetzlichen Vorschriften zuwiderläuft;

2. nach dem Geschäftsplane die Interessen der Versicherten nicht hinreichend gewahrt sind oder die dauernde Erfüllbarkeit der aus den Versicherungen sich ergebenden Verpflichtungen nicht genügend dargethan ist;

3. Tatsachen vorliegen, welche die Annahme rechtfertigen, daß ein den Gesetzen oder den guten Sitten entsprechender Geschäftsbetrieb nicht stattfinden wird.

Die Erlaubnis kann von der Stellung einer angemessenen Sicherheit abhängig gemacht werden, wobei deren Zweck und die Bedingungen für die Rückgabe festzustellen sind." Art.7 VAG, Motive VAG (1963, p.289)

[157]Koch (2012, p.288) / Koch (2005, p.53) rests this conclusion partly on the description of the supervisory office in the novel *Kleiner Mann - was nun?* written by Hans Fallada in 1932. It describes the daily hardships of a sales clerk in a department store in Berlin during the late 1920s. Following the birth of the protagonist's son, the health insurance company harshly denied any liability. Upon writing a letter to the German supervisory office he received a first reply by postcard three days later, informing him that his case warranted a further investigation. The outstanding payment was received shortly after. Only four weeks after the protagonist's initial letter, the insurance supervisory office had informed the protagonist in a "concise and graceful" manner that, following the received payment, it considered the case as closed. Koch (2005, p.53) discusses the elements of this narrative and concludes that the prosaic descriptions are historically and legally accurate.

5.2.2 Limits of supervision

Not all private joint-stock companies were subject to supervision. Art. 116 VAG excluded joint-stock insurance companies that were exclusively active in transport insurance and reinsurance:

> Companies that conduct insurance against stock market losses or transport insurance or exclusively reinsurance, excluding mutual companies, do not require a concession.[158]

Transport insurance and reinsurance were of particular relevance for the German insurance market. Whilst the former was already featured in the first draft of the law, the latter was included in the first reading.[159] The German approach acknowledged that, unlike direct insurance, reinsurance was transacted on a business-to-business basis. The fact that both counterparties are represented by professional businessmen makes micro-prudential consumer protection redundant in reinsurance[160]. This absence of direct control led to the development of informal institutions in the form of a special code of conduct that ensured the functionality of the system. For example, the missing external protection against fraudulent reporting by the ceding party led to the formulation of the principle of "uberrima fides", or "utmost good faith" (German: "Treue und Glauben"), which mandated the full disclosure of all relevant information.[161] Contracts generally included terms that gave the reinsurer the right to conduct an audit of the covered insurance business.[162] During the period under consideration, reinsurers were nevertheless reluctant to make use of their right to audit the books, fearing that the ceding party would interpret this as general mistrust. This general dilemma was concisely outlined in an article in *The Review* of 24 November 1933:

> [...] [Primary insurance companies] state that they consider it an offence against their dignity to be asked to let the re-insurers check points of dispute at their head office, and again others think that the whole question should not arise at all, as re-insurers should not transact business with companies they cannot implicitly trust.[163]

A second important principle that provided protection for the direct insurance company was the concept of "pay-as-will-be paid" or German "Folgepflicht", see Gerathewohl (1976, p.525). It clarifies that all terms of the original insurance contracts covered by reinsurance also apply to the reinsurance company. This principle was also already established during the Interwar period, as is exemplified by the following court ruling in the United Kingdom:

[158] (German original, translated by the author:) "Unternehmungen, welche die Versicherung gegen Kursverluste oder die Transportversicherung oder ausschließlich die Rückversicherung zum Gegenstande haben, mit Ausnahme von Versicherungsvereinen auf Gegenseitigkeit, bedürfen keiner Zulassung." Art. 116 VAG, Motive VAG (1963, p.302).
[159] VAG, Motive VAG (1963, p.238)
[160] See Hermannsdorfer (1931, pp.28-43; p.29) and Wyrsch (1957, p.129).
[161] See Gerathewohl (1976, p.510).
[162] This was especially debated during the Interwar period when adverse economic conditions led reinsurance companies to fear potential fraud. See Kramer (1935) for the case of Germany.
[163] "The Checking of Treaty Accounts". The Review, November 24, 1933, pp.1134-1135.

> Norwich Union Fire Ins. Soc. v. Colonial Mutual Fire Ins. Co. [1922] 2 K.B. 461. N. having insured a ship, reinsured with C., the policy having the clause "subject to the same clauses and conditions as the original policy and to pay as may be paid thereon." The original insurance contract between N. and the shipowner was varied by reducing the value and the original policy endorsed accordingly. The variation was not communicated or known to C. The ship then became a total loss. Held, that as the head policy had been altered without the consent of the reinsurers the latter was not liable."[164]

Finally, the enforcement of the reinsurance code of conduct was ensured by arbitration courts. These were established in an ad-hoc basis and consisted of independent and neutral insurance experts. This self-regulation proved highly successful within the market.[165] It nevertheless remains to question as to whether the informal control mechanisms served to prohibit companies from using reinsurance for other means.

5.3 Risk shifting by means of reinsurance

The following part provides a theoretical identification of risk shifting in the context of the extended risk exchange model, which is introduced. It is followed by a derivation of risk shifting potential in the reinsurance market. In addition, the fundamental principles of reinsurance are covered in order to find potential means of abuse. Finally, the current state of the relevant literature is provided that suggests the hypothesis that joint-stock insurers engaged in risk shifting by means of reinsurance in the Golden Twenties.

5.3.1 The reinsurance market as risk exchange model

Reinsurance provides liability insurance against claims arising from insurance contract obligations. It allows companies to adjust the composition of underwriting portfolios in accordance with the company-specific risk appetite. Borch (1960) and Borch (1962) show that a pareto-optimal equilibrium solution does exist in a risk exchange market. This model of a reinsurance market assumes the exclusive use of quota-share reinsurance, risk-averse individual investor-entrepreneurs as participants with continuous utility functions, the absence of transaction costs including taxes and, more technically, only first and second moments of underwriting returns. It is consistent with the closely related Sharpe-Mossin-Lintner CAPM.[166]A simple market-consistent pricing method that arises from the risk exchange model is the well-known actuarial Esscher pricing principle due to Bühlmann (1980) and Bühlmann (1984).[167] It

[164]See Picard (1935, p.113).
[165]Gerathewohl (1976, p.584).
[166]The reinsurance model in fact predated the development of the CAPM, which was formulated independently in Sharpe (1964), Lintner (1965) and Mossin (1966). The latter study, also published in *Econometrica*, makes clear reference to Borch (1962). See also Lamm-Tennant & Garven (2002).
[167]See also Cummins (1990), Loubergè (1998) , Young (2006), Bernard (2013, p.621) and Bauer et al. (2013, pp.638-639).

mirrors the principles of both the Sharpe-Lintner-Mossin CAPM[168] as well as the Black-Scholes option pricing formula[169]. Nonnegative cashflows (losses incurred) arise from insured random events (insurance risk) $X_i \in \chi$, where χ denotes a set of nonnegative random variables given the probability space$(\Omega, \mathbb{P}, \mathbb{F})$. Every company $i \in N$ features individual risk aversion represented by the factor $\alpha_i \in \mathbb{R}_0^+$or the associated risk tolerance unit, defined as $1/\alpha$.[170] Furthermore, $Z = \sum_{i=1}^{N} X_i$ denotes the aggregate risk in the reinsurance market. The market-consistent price density (reinsurance premium) $\pi \in \mathbb{R}_0^+$ follows from the well-known Esscher transform, also known as exponential tilting, by

$$\pi_i = \frac{\mathbb{E}\left[X_i e^{\alpha_i Z}\right]}{\mathbb{E}\left[e^{\alpha_i Z}\right]}. \tag{5.1}$$

This pricing principle suggests that the market price for reinsurance is related to overall market supply of insurable risks together with the company-specific risk aversion. Increases (decreases) in risk aversion α, aggregate market risk Z as well as company-specific insurance risk X lead to a likewise increase (decrease) in the reinsurance premium π.

5.3.2 Risk shifting in the risk exchange model

The simplifying and highly theoretical assumptions of the model limit its applicability to actual reinsurance markets as noted by Garven & Lamm-Tennant (2002). The authors argue that the "[...] most apparent "de-ficiency" of [Borch's] model is that most insurers are not owned and operated by individual entrepreneurs; rather, they comprise a complex set of (implicit and explicit) contracts among various stakeholders, including policyholders, shareholders, managers, regulators, and tax authorities." [171] This relationship between the company and its shareholders is explicitly addressed by Borch (1985) and especially Borch (1986). The main argument is that the use of utility functions constitutes as an unrealistic modelling device. The risk aversion of an insurance company - represented by the risk aversion factor α - should be associated with the ability of the company to maximise shareholder value under the first-order condition of a constant level of default risk.

Let the probability set be defined by $(\Omega, \mathbb{P}, \mathbb{F})$. The nonnegative value of the company, denoted by $V(s) \in \mathbb{R}_0^+$for state of the world $s \in S$ that is adapted to the economic information set $\mathbb{F} = (\mathcal{F}_s)_{s \in S}$, is defined by the discounted net present value of expected dividend payout,

$$V(s) = \frac{1}{\nu(s, \alpha)} \mathbb{E}[D], \tag{5.2}$$

[168] Compare Müller (1987) .
[169] This is derived in Gerber & Shiu (1994).
[170] The risk version α can for example be represented by any continuous utility function of the hyperbolic absolute risk aversion (HARA) class, see Bühlmann (1984).
[171] See Garven & Lamm-Tennant (2002, p.165).

where $m = 1/\nu(s,\alpha) \in \mathbb{R}_0^+$ denotes the nonnegative state price density[172] that is a function of s as well as of α. The nonnegative dividend payout is denoted by $D \in \mathbb{R}_0^+$. The world can take two discrete states $S \in [1,2]$ that represent relatively better ($s = 1$) and worse ($s = 2$) investment opportunity sets leading to $\nu(1) > \nu(2)$. Let the discount rate be further defined by a stochastic company-specific discount factor

$$\nu(s) = \varphi(s) + g(\alpha), \tag{5.3}$$

where $\varphi(s)$ denotes a state-dependent and company-specific stochastic discount factor and $g(\alpha)$ the deterministic company-specific dividend growth rate. The latter is a function of α indicating that decreasing risk aversion leads to increased dividend growth or $\downarrow \alpha \rightarrow \uparrow g$.[173] Substituting ν in Equation (5.2) yields Equation (6.1) of Ch.4. It follows directly that the state transition represented by $\varphi(1) > \varphi(2)$ leads to $V(1) < V(2)$. The company can control this change by adjusting its dividend payout g, which implies a likewise adjustment of risk aversion α. More generally, the dynamics of the discount rate require minimising the rate of change in the value of the company with respect to changes in the investor opportunity set, or

$$\arg\min_{\alpha} \frac{\partial V}{\partial s}. \tag{5.4}$$

The business model of private non-life insurance, however, postulates that this maximisation of shareholder value requires a constant level of default risk. This leads to the first-order condition

$$\frac{\partial \alpha}{\partial s} = 0, \tag{5.5}$$

which shows that a company is violating this maximisation problem if it adjusts its value to changes in the investment opportunity set represented by s. Any increase caused in risk aversion α therefore has to be attributed to the company shifting risk from shareholders to policyholders.

In the context of reinsurance, risk shifting can occur due to three of four major sources for principal agent conflict; *claim dilution, asset substitution* and *underinvestment*.[174] *Claim dilution* arises from the fact that premium levels are customarily fixed for a longer period in direct insurance contracts than in reinsurance arrangements where conditions are renegotiated annually.[175] Companies can

[172] This indicates that the approach is consistent with the Arrow-Debreu model that also forms the foundation for the risk exchange model. See Borch (1962).

[173] This is the basic relationship within the dividend optimisation problem of the Cramér-Lundberg model. A detailed derivation is provided in Borch (1985) and especially Borch (1986) as well as Avanzi (2009, pp.218-219). Although Karl Borch makes no reference to the Esscher Pricing Principle, the risk aversion factor α is explicitly defined in the context of utility functions by Paragraph 3.6 of Borch (1986, p.106).

[174] See Smith & Warner (1979, pp.118-119).

[175] This is referred to as "renewal". Compare Gerathewohl (1976) and Gerathewohl (1982) in general and Cruciger (1926) regarding its contemporary application. See also Maguhn (2007), where a "market friction" model is designed that especially takes into account the duration mismatch between direct and reinsurance arrangements as a potential source of liquidity risk.

use reinsurance to increase their exposure to risk whilst still earning premiums based on the pre-reinsurance level of default probability. Closely related is *asset substitution.* It describes the possibility of companies to sell shares of low risk-return underwriting portfolios in order to finance buying parts of high risk-return underwriting portfolios via quota-share reinsurance. The circumstances of the August 1929 FAVAG default illustrate the relevance of the joint of effect of both sources. Modert (2004) states that the company "conducted business in transport reinsurance on a large scale as the company intended to increase reported total premium volume by earning the associated relatively high premium levels."[176] The third source, *underinvestment*, relates to the potential exposure to unexpected severe loss experiences. Market-consistent insurance pricing does not only have to consider the actuarial net present value of insurance risks but also present market conditions. Companies that consider, for example, low-probability high-cost events in the calculation of the insurance premium might quote prices that are too high in contrast to other competitors. Facultative or excess-of-loss reinsurance helps to manage catastrophe risk or unexpected fluctuations in claim levels.

5.3.3 Use and potential abuse of reinsurance

Intentional risk shifting by means of reinsurance implies that its original purpose of risk management is abused for other purposes. Harrison (2004, Ch.1.4-1.9) lists six principal functions of reinsurance. A seventh follows from Gerathewohl (1976).

1. Surplus relief

   One of two basic forms of reinsurance is proportional or treaty reinsurance. It involves direct insurance companies passing on a share of a pre-defined risk portfolio to a reinsurance company. The foundation of this business transaction is a single contract - or treaty - between both companies that forms the foundation of the business relationship. Its terms can be renegotiated on an annual basis.[177] This function allows companies to substitute internal capital of their own with external reinsurance protection. It is therefore relevant in the context of the *claim dilution / asset substitution* conflict.

2. Stabilise the loss experience

   An alternative to proportional quota is excess-of-loss reinsurance. By specifying a retention limit, insurance companies cede the excess of the limit to the reinsurance company. This helps to reduce the variance in insurance liabilities. It is therefore subject to the *underinvestment* principal agent

[176](German original, translated by the author:) "Die Favag tätigte im großen Umfang Geschäfte in der Transport-Rückversicherung, weil sie an den dort anfallenden hohen Prämien zur Steigerung der von der Statistik erfassten Werte der Gesamtprämieneinnahmen interessiert war." See Modert (2004, p.30).

[177]See Gerathewohl (1976) and Gerathewohl (1982) in general and Cruciger (1926) regarding the contemporary application.

conflict. A potential problem in the present context is that excess-of-loss reinsurance was not a common contract type during the Interwar period, see Gugerli (2013, pp.178-179).

3. Protection against low probability / high cost events

   Another form of stabilising the loss experience is facultative reinsurance, or the protection against the financial losses of low probability / high cost events such as natural and man-made catastrophes. Given the rare occurrence of especially expensive events, direct insurance companies might favour buying protection over forming specifically earmarked reserves. Facultative reinsurance is different to treaty insurance as every random low probability / high cost event is underwritten independently. The relevance of facultative reinsurance as a method to control risk exposure is underlined by Winter (1988), Gron (1994), Meier (2006) and Maguhn (2007) for the insurance sector in general and by Gerathewohl (1976) for the reinsurance sector in particular. Given the absence of low-probability / high-cost events during the Interwar period, this function, which is relevant in the context of the *underinvestment* problem, will not be considered.

4. Increase large line capacity

   An insurer's line, not to be confused with "line of insurance business", is the maximum financial loss associated with a single insured event. The ceding company can increase the capacity to underwrite more expensive random events due to quota share or excess-of-loss agreements. This relates directly to the principal agent conflict of *underinvestment*.

5. Provision of underwriting guidance

   Companies that exclusively provide reinsurance protection are called specialised reinsurance companies. The classical business model of reinsurance is to provide risk mitigation across lines of insurance business, across borders and through time. Specialised reinsurance companies engage with a number of direct insurance companies and thus access to detailed market information.

6. Withdrawal from market segment

   Reinsurance allows companies a simple and cost-efficient alternative to withdraw quickly from insurance lines of business. It is a special case of Function 1 " Surplus Relief", where the direct insurer decides to cede a complete segment-specific underwriting portfolio.

7. Liquidity provision

   The quality of the reinsurance arrangement crucially depends on the ability of the reinsurer to meet existing liabilities. Therefore, reinsurance companies customarily provide collateral to cedent direct insurers in order to limit counterparty risk. Such deposits are usually comprised of liquid

assets to ensure that direct insurance companies have immediate access to liquid reinsurance funds. Liquid reinsurance deposits allow the ceding companies to substitute cash reserves of their own with higher yielding long-term alternative investments. This reduces the availability of liquid funds of their own and leads to a principal agent conflict that is due to *underinvestment.*

This identifies Functions 1 "Surplus relief" to be of particular relevance in the present. The hypothesis of this chapter is that joint-stock companies featured relatively stronger demand for reinsurance during the Golden Twenties than during the Great Depression period. This is associated with the use of reinsurance for the purpose of shifting risk from shareholders to policyholders.

5.3.4 Literature review on reinsurance demand by joint-stock companies

The present hypothesis is associated with the structural differences in principal agent conflicts between forms of corporate organisation. A recent summary of the related literature is provided by Mayers & Smith (2013). The first study to focus on reinsurance demand in this context is Mayers & Smith (1990). It argues that investors have the opportunity to themselves hedge risk related to shares in individual companies by holding well-diversified portfolios. Based on a dataset of 1,276 U.S. non-life insurance companies in 1981, it is found that demand for reinsurance increases with less diversified ownership structure. Additional factors that reduce demand are size, credit standing, geographic location as well as per-line concentration, whilst group affiliation increases demand. The study also argues that reinsurance allows to control managerial discretion due to the indirect control exercised by reinsurance companies. Given the absence of shareholder control in mutual companies, this helps to take into account potential informational assymmetries between owner-shareholders as principal and corporate management as agents.[178] That mutual companies demand more reinsurance than joint-stock companies is confirmed by Adams (1996) based on the analysis of reinsurance demanded by life insurance companies in New Zealand. Analysing non-life data on (between 240 and 251) U.S. non-life insurance companies between 1980 and 1987, Lamm-Tennant & Starks (1993) find that, overall, joint-stock companies feature relatively larger exposure to risk than mutual companies, indicating a reduced demand for reinsurance.

Most importantly, Abdul Kader et al. (2010) conduct a panel data analysis of reinsurance demand in the Swedish fire insurance sector during the period 1919 to 1939. This study considers the full period as well as two sub-periods from 1919 to 1928 and from 1929 to 1939. With respect to the impact of organisational form, the study hypothesises that mutual insurance companies feature relatively higher reinsurance demand. It is however found that the parameter estimate for the 1920s is positive and significant, "because in the interwar years, stock insurers were writing more (and potentially more

[178] See also Abdul Kader et al. (2010, pp.273-274).

complex) fire risks nationally and, as such, they were more exposed to unexpectedly high losses (e.g., due to mis-priced underwriting risks) compared with more localised mutual fire insurers."[179] Estimates for the 1930s are found to be comparatively small and insignificant. This observation directly points towards the hypothesis of risk shifting by means of reinsurance during the Golden Twenties. This motivates the present analysis on the basis of the more established, unregulated[180] German reinsurance market that in addition featured a consistent tax regime and the absence of exogenous shocks on reinsurance prices.

5.4 Model specification: determinants for reinsurance demand

The contemporary German reinsurance market features optimal characteristics for the analysis of risk shifting by means of reinsurance. The investment opportunity set is represented by the business cycle decomposed into a set of two discrete states of the world. The period from 1926 to 1935 is divided into the sub-periods 1926 to 1929, representing the Golden Twenties as a state with sound investment opportunities, and 1930 to 1935, the Great Depression representing a state with limited investment opportunities. The absence of changes in regulatory and taxation standards as well as natural catastrophes avoids the introduction of exogenous bias. Company-specific investment performance as well as the life insurance sector are therefore excluded from the analysis. In the following, the statistical properties of the reinsurance ratio are discussed first. This motivates a two-step approach that separates the structural discrete decision to not engage in reinsurance from continuous reinsurance demand. The former is represented by a panel probit regression model as established second. Third, a mixed model is specified that captures the continuous component of the reinsurance ratio. Fourth, the set of predictor variables is introduced and discussed.

5.4.1 The reinsurance ratio as fractional variable

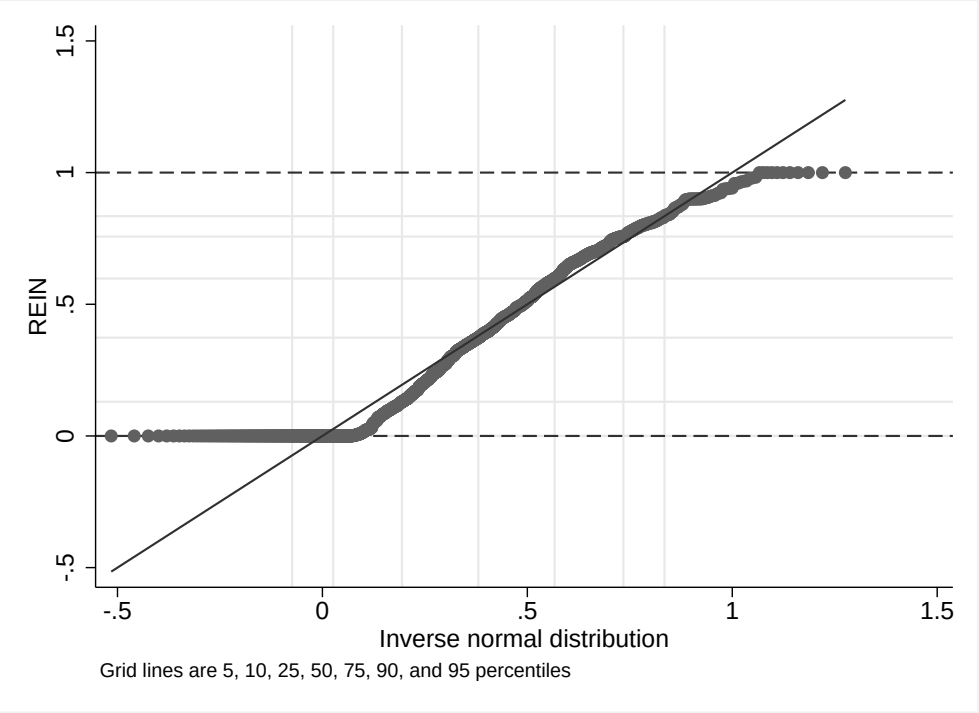
Neither the reinsurance premium π nor the supply of reinsurance are directly observable. The reinsurance demand as represented by the reinsurance ratio is the only observable measure. It is defined as

$$RIN_{it} \quad = \quad 1 - \frac{Net\,Premiums\,Earned_{it}}{Gross\,Premiums\,Earned_{it}}. \tag{5.6}$$

Changes in the reinsurance premium π reflect changes in the demand and supply of reinsurance. An increase (decrease) of π is, for example, associated with an increase (decrease) in the demand for reinsurance given constant supply. This in turn is associated with an increase (decrease) either in

[179] See Abdul Kader et al. (2010, p.279).
[180] Abdul Kader et al. (2010) do not provide information on the contemporary Swedish regulatory framework.

Figure 7: Distribution RIN



Source: Dataset II "Company"

exposure to insurance risk X or in the discount factor φ. These relationships directly follow from the relevant reinsurance functions.

Figure (7) shows that RIN follows a mixed distribution. It is continuous for values $0 < RIN < 1$ and features a discrete Bernoulli distribution if $RIN = 0$ and $RIN = 1$.[181] Cook et al. (2008) shows that treating the complete mixed distribution as coherent and continuous introduces bias. Two approaches are provided in the econometric literature that take this into consideration: the first follows Papke & Wooldridge (1996) in treating the limit values as infinitesimally small realisations of the continuous distribution. Given the sigmoid shape of the distribution as seen in Table (7), they apply a logit or probit link to transform the variable. A solution for balanced panel data is developed in Papke & Wooldridge (2008). The second approach assumes that the components of the mixed distribution originate from different data generating processes. Cook et al. (2008) develop a zero-inflated beta regression model for the specific application to financial ratios. This approach assumes the continuous component to follow a beta distribution as the precision parameter allows to specifically consider possible heteroscedasticity for values close to the boundaries. The boundary solutions are modelled in the form of a latent-variable model, usually a logistic regression.[182] By following the second approach, a zero-inflated beta model is approximated by a two-step approach: the discrete part of the distribution

[181] Fractional data is not censored given that values for $RIN > 1$ and $RIN < 0$ do not exist. This rules out the use of the Tobit model, which interprets excess values as unobserved. See Maddala (1991).
[182] See especially Ospina & Ferarri (2012) for a general discussion.

Table 26: Companies ceding full premium volume

Name	Years	Line	Organisational Form
Hansa Bremen	1926-1929	Transport	Joint Stock
Haftpflichtverband Zuckerfabriken	1929	Liability	Mutual
Roland Bremen	1926-1929	Transport	Joint Stock
Union Stettin	1927	Transport	Joint Stock

Source: Dataset II "Company"

as to whether a company did or did not demand reinsurance is considered in the context of a discrete choice model. The continuous part is represented by a mixed model. The latter approach parallels Mayers & Smith (1990) and Abdul Kader et al. (2010).

5.4.2 Discrete choice model

It is assumed that the decision to not engage in reinsurance is dependent on structural determinants and thus not dependent on sub-periods. A total of 221 observations is associated with $RIN = 0$. In contrast, eleven observations are associated with $RIN = 1$, which is a direct application of Function 6 "Withdrawal from market segment". Table (26) shows that this case is associated with ten observations. All observations occurred between 1926 and 1929 and nine were associated with transport insurance. This case is considered to be part of the continuous component of the mixed distribution. The discrete choice of the company to refrain from reinsurance - or to become a non-cedent in the following - is denoted by the indicator function $\mathbf{1}_{\neg RIN}$, so that

$$RIN_{it} = \begin{cases} = 0 & \Leftrightarrow \mathbf{1}_{\neg RIN}(i,t) = 1 \\ > 0 & \Leftrightarrow \mathbf{1}_{\neg RIN}(i,t) = 0 \end{cases}$$

and

$$\mathbf{1}_{\neg RIN}(i,t) = \begin{cases} 1 & if\ z_{it} \geq 0 \\ 0 & if\ z_{it} < 0 \end{cases},$$

where $z \in \mathbb{R}$ is a latent variable. The unbalanced dataset is analysed by a generalised linear model employing a probit link function ("probit regression") that controls for company-specific random effects. The model takes the form

$$
\begin{aligned}
\mathbb{P}\left(\mathbf{1}_{\neg RIN}\left(i,t\right)=1\right) &= \mathbb{P}^{\star}(z_{it}>0) \\
&= \Phi\left(u_i+\beta\mathbf{x_{it}}+\sum_{l}\left(\beta L_{ilt}\right)+\sum_{t}\left(\beta Y_{it}\right)\right) \qquad (5.7)\\
u_i &= \beta_0+\mu_i+\epsilon_{it}.
\end{aligned}
$$

The company-specific random variance is denoted by μ, assumed to be normally distributed with $\mathbb{E}\left[\mu\right]=0$ and uncorrelated with the equally normally distributed error term ϵ with $\mathbb{E}\left[\epsilon\right]=0$. The variables L and Y denote the variables that control for insurance line and business year.

5.4.3 Mixed model

The continuous element of the mixed distribution $0<RIN\leq 1$ is assumed to be normally distributed. The potential existence of heteroskedasticity close to the boundaries warrants the use of cluster-specific Huber-White sandwich standard errors. The model takes the form

$$
\begin{aligned}
RIN_{it}^{S} &= z_i^S+\gamma^S\mathbf{x_{it}^{S}}+\sum_{l}\left(\beta L_{ilt}\right)^S+\sum_{t}\left(\beta Y_{it}^S\right) \qquad (5.8)\\
z_i^S &= \gamma_{0i}^S+\eta_i^S+\xi_{it}^S,
\end{aligned}
$$

where the normally distributed random effects component denoted by η_i with $\mathbb{E}\left[\eta\right]=0$ captures company-specific variance. It is assumed to be uncorrelated (random-effects assumption) with the error term ξ. Further fixed effects are used to control for exposure to individual insurance lines as well as time effects. The Appendix provides alternative model specifications that confirm the robustness of model results to relaxing the random-effects assumption. Two different specifications are used: the first assumes a linear relationship and pools all years from 1926 to 1935 into one equation. The second considers the possibility of a structural break after the 1929 FAVAG default. It uses two sub-period clusters for the years 1926 to 1929 and 1930 to 1935. This is represented by the superscript $S\in\{1;2;0\}$, where

$$
S=\begin{cases}
1 & if\, YEAR\in\{1926,1927,1928,1929\}\\
2 & if\, YEAR\in\{1930,1931,1932,1933,1934,1935\}\\
0 & if\, P=0\cap P=1
\end{cases}
$$

and allows to analyse potential differences between both sub-periods conditional on equal company-specific random effects and the same reference year - 1930. Additional Wald tests are further used to test whether sub-period estimates can be pooled.

5.4.4 Variable definition

The selection of variables follows Mayers & Smith (1990) and Abdul Kader et al. (2010). Time-dependent variables are not considered to allow for a clear distinction between the sub-periods. The variable of interest is the indicator for organisational form.

Organisational form The organisational form is defined by the indicator function

$$\mathbf{1}_{ORF}(i) = \begin{cases} 1 & if\ Joint-Stock \\ 0 & if\ Mutual \end{cases}. \tag{5.9}$$

This variable is assumed to be time-invariant given that only one case of demutualisation occurred during the period under consideration. In 1929, the mutual life insurance company *Deutschnationale Handlungsgehilfen GG*, founded in Hamburg in 1913 , also operated as a fire insurance company under the same name. It was merged into *Deutscher Ring Sachversicherungs AG* in 1929.

The hypothesis follows with the findings of Abdul Kader et al. (2010) by assuming that reinsurance demand was positively related to reinsurance demand during the Golden Twenties and insignificant during the 1930s. This implies an overall negative effect in the discrete choice model given that joint-stock insurance companies were less willing to forfeit the ability to manage risk actively by means of reinsurance.

Underwriting risk Underwriting risk is associated with the characteristics of the insured random events. It represents the ability of the company to generate profits from its underwriting operations net of reinsurance effects. The ratio of aggregate losses incurred to net premiums earned is defined as

$$CPR_{it} \quad = \quad \frac{Losses\,Incurred_{it}}{Net\,Premiums\,Earned_{it}}.$$

A positive relationship indicates that reinsurance was purchased due to Function 1 “Surplus relief”. Potential differences in the magnitude of the coefficient between sub-periods are to be expected from the differing cost of capital, of which reinsurance is a substitute.[183] This translates into a negative relationship with respect to the decision to not reinsure.

Solvency risk Functions 2, 3 and 4 consider the ability of the company to grow without suffering from constraints induced by its capital situation. The company is in particular exposed to solvency risk

[183] Compare Ch.7. It is also noted that capital increases were a rare event during the period under consideration as shown in Ch.3.

caused by earnings volatility in the case of increased leverage. This is defined as the amount of net premiums earned relative to surplus so that

$$LEV_{it} \quad = \quad \frac{Net\,Premiums\,Earned_{it}}{Surplus_{it}}. \tag{5.10}$$

Abdul Kader et al. (2010) argue that companies use reinsurance to hedge against the agency problems of *underinvestment* and *asset substitution* and suggest a positive relationship.[184] In this context, reinsurance provides protection against an unexpected shock to assets that might trigger shareholders to exercise the limited-liability put option and discontinue the company. This, however, depends on other factors that might introduce bias in the explanatory power of the variable LEV.[185] It is nevertheless probable that the absence of low-probability high-cost events and the fact that excess-of-loss reinsurance was not yet practiced limits the relevance of this variable in the present context. It is therefore assumed that insurance companies rather used leverage to diversify (net) premium income so that reinsurance needs to be considered as a substitute. Therefore, a negative relationship is expected in the mixed and a positive relation in the discrete choice model.

Size In accordance with the findings of Mayers & Smith (1990) and Abdul Kader et al. (2010) it is assumed that size offers direct insurance companies the advantage of diversification effects. It therefore serves as a natural substitute for reinsurance demand due to Function 1 "Surplus relief". The time-dependent size is defined by the natural logarithm of the total asset value so that

$$TAV_{it} \quad = \quad ln(Total\,Asset\,Value_{it}). \tag{5.11}$$

This transformation is necessary given the non-normal distribution of total asset value as exemplified by the relatively large difference between the 95 % percentile of RM 29.6 million and the 99 % percentile of RM 201 million. The distribution of total asset value is provided in Table (27). The relationship is assumed to be negative in the mixed and positive in the discrete choice model specification.

Profitability Reinsurance companies charge a premium for taking over ceded risks, which is an operating expense for the cedent. The demand for reinsurance is therefore also dependent on the ability of the company to pay additional charges. In accordance, the return on assets is defined as

[184] See Abdul Kader et al. (2010, p.272 / Fn.10).
[185] Compare Ch.3 for an analysis of company defaults in the German insurance market during the Interwar period.

Table 27: Summary statistics total asset value

Total Asset Value (in RM 1,000)									
				Quantile					
Obs	Mean	Std Dev	Min	25	Median	75	95	99	Max
1,704	10.469	35,132	16	810	3,220	8,215	29,647	204,022	486,909

Source: Dataset III "Company"

$$PFT_{it} = \frac{Net\,Operating\,Profit_{it}}{Total\,Asset\,Value_{it}}. \tag{5.12}$$

This suggests a negative relationship in the mixed model, given that increasing (decreasing) reinsurance demand leads to increased (decreased) expenses and thus decreased (increased) earnings. More profitable companies are assumed to be less likely to not reinsurance. This implies a negative effect in the discrete choice model.

Liquidity Function 7 "Liquidity provision" suggests that reinsurance demand is motivated by the provision of liquid deposits. This suggests that overall company liquidity serves as a determinant for reinsurance demand. It is represented by the ratio of assets invested in cash (and cash equivalents) to total asset value that is

$$LIQ_{it} = \frac{Cash_{it}}{Total\,Asset\,Value_{it}}. \tag{5.13}$$

Function 7 implies that reinsurance serves as a substitute and that the relationship is therefore negative. It is noted, however, that Abdul Kader et al. (2010) find a positive relationship which they attribute to the interest of managers "to 'protect' accumulated cash resources for investing in future positive [net present value] projects in more uncertain economic times."[186] This implies a negative effect in the mixed and a positive effect in the discrete choice model.

Investment returns Insurance net operative profit consists of underwriting and investment income. Abdul Kader et al. (2010) define the relative return on investment as the ratio of interest earned on the total book value of assets, or

[186]See Abdul Kader et al. (2010, p.279).

$$ROI_{it} = \frac{Interest\,Earned_{it}}{Total\,Asset\,Value_{it}}. \tag{5.14}$$

An increasing return on investments can be used to compensate for additional reinsurance protection. This leads to assume a negative correlation to the reinsurance ratio in the mixed model. Increased investment returns also imply that companies are less likely to not reinsure, this causing a negative effect in the discrete choice model.[187]

Business concentration One of the purposes of reinsurance is to provide diversification to specialised direct insurance companies. Cummins & Nini (2002) and Klein et al. (2002) provide empirical evidence in favour of the hypothesis that operating in diverse lines decreases the insolvency risk. In accordance with Mayers & Smith (1990) the dependence of a company on one particular line is defined by the Herfindahl index in order to measure to what extent the net premium volume of a company was concentrated in one insurance line, so that

$$CNC_{it} = \sum_{l=1}^{L} \left(\frac{Net\,Premium\,Income_{ilt}}{Total\,Net\,Premium\,Income_{it}} \right)^2, \tag{5.15}$$

where $l \in L$ denotes the number of insurance lines under consideration. Given this definition, better diversified insurance companies are assumed to feature lower values of CNC. This implies a negative effect in the mixed model. However, companies with higher values are assumed to be less likely to not reinsure, thus implying a negative sign in the discrete choice model.

Group affiliation Powell & Sommer (2007) show that group affiliation of an insurance company is an important determinant for reinsurance demand. In accordance, companies that were member of a larger insurance group are identified by the use of an indicator function, or

$$\mathbf{1}_{GRP}(i,t) = \begin{cases} 1 & if\,affiliated\,with\,group \\ 0 & if\,independent \end{cases}, \tag{5.16}$$

where $\mathbf{1}_{GRP}(i,t) \in \{0,1\}$. Given that take-overs occurred frequently, this variable is assumed to be time-dependent. In accordance with Mayers & Smith (1990) and Powell & Sommer (2007) it is assumed that group membership is associated with a relatively lower cost for reinsurance due to internal arrangements. The relationship is assumed to be positive in the case of the mixed and negative in the

[187] Compare also Oppenheimer & Schlarbaum (1983).

case of the discrete choice model.

Franchise value The franchise value is defined as a proxy indicator variable that maps the value "1" to companies that were found prior to 1914 and "0" to later foundations, or

$$\mathbf{1}_{FRV}(i,t) = \begin{cases} 1 & if\, company\, i\, was\, founded\, before\, 1914 \\ 0 & if\, company\, i\, was\, founded\, after\, 1914 \end{cases}.$$

The franchise value represents the market perception of the company. This is in particular relevant in quota-share reinsurance, where companies form long-term relationships on the basis of a general treaty. A strong reputation in the market or long-standing business relationships are therefore associated with a positive relationship with reinsurance demand. A negative effect thus follows for the discrete choice model.

Line exposure It is necessary to control for the differences in characteristics across insurance lines of business. Given that CPR measures the aggregate loss ratio, it is necessary to control for the company-specific exposure to a particular insurance line. Following Mayers & Smith (1990) the ratio of net premiums earned per line relative to the total net premium volume represents the relative per-line exposure, so that

$$LINE_{ilt} = \frac{Net\, Premium\, Income_{ilt}}{\sum_{l=1}^{L}(Net\, Premium\, Income_{ilt})}, \tag{5.17}$$

where L denotes the set of all considered direct non-life and indirect insurance lines. This is an implicit factor variable in the cases of hail and reinsurance, given that only specialised companies operated in these lines.[188] No particular assumptions are formulated with respect to the associated model effects.

5.5 Data

5.5.1 Dependent variables

The dependent variable of the discrete choice model is the indicator function $\mathbf{1}_{\neg RIN}(i,t)$. Statistics summary on the number of companies not using reinsurance - referred to as non-cedents in the following - are provided in Table (28).

The ratio of non-cedents to cedents remained relatively constant at about 11% throughout the late 1920s. It increased to 15 % in 1931 and remained at the relatively higher level of about 16%. This

[188] Some companies such as *Allianz* reported hail insurance under the aggregate "miscellaneous lines". Furthermore, reinsurance provision by direct companies is unobserved

Table 28: Summary statistics non-cedent, 1926 to 1935

Year	Obs	Mean	Min	Max
1926	193	.067	0	1
1927	197	.112	0	1
1928	198	.111	0	1
1929	184	.114	0	1
1930	161	.112	0	1
1931	158	.151	0	1
1932	156	.167	0	1
1933	157	.166	0	1
1934	149	.168	0	1
1935	152	.158	0	1
26-35	1,705	.130	0	1

Note: Standard deviation omitted for binary variables.
Source: Dataset II "Companies"

Table 29: Summary statistics reinsurance ratio, 1926 to 1935

Year	Obs	Mean	Med	Std.	Min	Max
1926	193	.391	.392	.273	0	1.00
1927	196	.399	.390	.285	0	1.00
1928	198	.401	.392	.282	0	1.00
1929	181	.402	.396	.282	0	1.00
1930	161	.382	.360	.283	0	.94
1931	158	.360	.363	.277	0	.94
1932	156	.353	.345	.276	0	.97
1933	157	.355	.347	.277	0	.97
1934	149	.355	.342	.270	0	.98
1935	152	.355	.348	.267	0	.90

Note: Minimum and maximum values rounded to the nearest real number.
Source: Dataset II "Companies"

suggests that a reaction to the Great Depression was to stop demanding reinsurance. Whether this was due to a general improvement in profitability or due to a decreased risk aversion remains to be tested.

Year-specific summary statistics of the dependent variable are provided in Table (29). The mean reinsurance ratio remained at relatively equal levels between the years 1926 to 1929, with about 39 to 40%, and, between 1932 to 1935, with approximately 35%. It experienced a sharp decline between the years 1929 and 1930, when it fell by approximately 4%. Insurance companies thus became less risk averse before the onset of the Great Depression.

5.5.2 Independent variables

Additional explanatory variables are calculated using company-specific income data and business information taken from Dataset II "Companies". Line-specific information for the variable $LINE$ is taken from Dataset II "Line". Table (30) provides summary statistics. The negative minimum values of

Table 30: Summary statistics Dataset II "Company" and III "Line"

Variable	Obs	Mean	Med	Std Dev			Min	Max
				overall	between	within		
RIN	1,701	.377	.371	.278	.262	.100	0	1
CPR	1,690	.506	.463	.401	.347	.318	-.045	8.71
LEV	1,697	.768	.488	1.983	1.48	1.19	0	35.134
TAV	1,686	7.885	8.099	1.701	1.725	.345	2.772	13.096
ERN	1,684	.001	.023	.387	.209	.330	-11.167	1.136
LIQ	1,334	.205	.119	.478	.274	.405	0	1.137
ROI	1,333	.040	.036	.033	.025	.020	0	.491
$\mathbf{1}_{GRP}$	1,704	.417					0	1
CNC	1,704	.757	1	.322	.299	.105	0	1.
$\mathbf{1}_{ORF}$	1,704	.721					0	1
$\mathbf{1}_{FRV}$	1,704	.639					0	1
LIN								
Hail	1,704	.028		.078	.088	.017	0	.91
Motor	1,704	.030		.120	.132	.051	0	1
Glas	1,704	.023		.052	.056	.013	0	.5
Burglary	1,704	.016		.122	.114	.041	0	1
Fire	1,704	.239		.360	.338	.063	0	1
Glass	1,704	.029		.149	.154	.024	0	1
Accident	1,704	.099		.233	.205	.073	0	1
Transport	1,704	.172		.330	.308	.133	0	1
Liability	1,704	.093		.290	.269	.0	0	1
Reinsurance	1,704	.152		.359	.375	.0	0	1

Note: Standard deviation and median omitted for binary variables. Median omitted for binary variables.
Source: Dataset II "Lines", Dataset III "Companies"

RIN, CPR and ROI are due to refunds from reinsurance companies. The maximum value for LEV of 351.3 % is found for *Norddeutsche Hagel*, a mutual hail insurance company that experienced record losses of RM 10.49 million in 1928. This depleted the company's technical reserves, yet did not lead to default due to the recovering performance of hail insurance during the following years.

5.6 Model results

In the following, the results for the discrete choice model is provided first. It analyses the decision to not engage in reinsurance. Second, the mixed effects model provides estimates for determinants of reinsurance demand conditional on companies actively engaging in this practice.

5.6.1 Discrete choice model

Table (31) provides model diagnostics and coefficients for the panel probit model. A likelihood ratio test supports the choice of the random effects assumption over a pooled probit regression that ignores company-specific variation.[189] In order to interpret model results, average marginal effects are calculated that represent the relative increase in predicted probability due to a one-unit increase in the respective variable, or $d\mathbb{P}\left(1_{\neg RIN^{\star}}=1\right)/d\mathbf{x}$, where $\mathbf{x}$ is the set of regressors. This calculation further assumes that the random-effects component μ is zero.[190] The expected sign is inverted to the sign of the mixed effects model, given that in $\mathbb{P}\left(\mathbf{1}_{\neg RIN}=1\right)=\mathbb{P}\left(RIN=0\right)$.

Consistent with the prior assumption, organisation form $\mathbf{1}_{OF}$ is found to feature a negative sign. Whilst the coefficient is significant at the 5%, level the marginal effect is nevertheless not found to be significantly different from zero. Although estimates constitute weak evidence in favour of the assumption that joint-stock companies were less probable to not reinsure, this can not be concluded with certainty. With respect to time-varying variables, the marginal effect of the total asset value TAV is found to be significant at the 1% level with a negative sign. A one-unit increase thus leads to a decrease of 3.1 ($\pm$1.0)% in the predicted probability of being a non-cedent. Relatively larger companies were therefore more likely to reinsure. A potential explanation is that relatively larger companies were more concerned with overall exposure to unexpected loss events. In addition, estimates for underwriting risk CPR are found to feature a positive sign, thus indicating that companies were more probable of being a non-cedent with increased loss experience. The relatively large variance of the margin effect of 1.0 ($\pm$1.6)% nevertheless casts doubt on the significance of the result. The only time-invariant variable that features a statistically significant marginal effect is franchise value FRV. The fact that a company was founded before 1914 leads to a decrease in the predicted probability of 11.6 (5.2)%. A straightforward

[189] Alternative model specifications including interaction terms were rejected with respect to AIC / BIC statistics.
[190] The c-statistic is not available in panel probit models due to the random-effects component.

Table 31: Results discrete choice model

Variable	Expected Sign	Coefficient	Marginal effect
		$\mathbf{1}_{\neg RIN}$	
$\mathbf{1}_{OF}$	-	-3.345*	-.129
		(1.511)	(.068)
CPR	-	.270	.010
		(.401)	(.016)
LEV	+	.024	.001
		(.059)	(.002)
TAV	+	-.790**	-.031**
		(.263)	(.010)
PFT	-	-.431	-.017
		(.365)	(.014)
LIQ	+	.031	.001
		(.128)	(.005)
ROI	-	- 4.113	-.159
		(3.868)	(.150)
$\mathbf{1}_{GRP}$	-	-.886	-.034
		(.997)	(.040)
CNC	-	-.765	-.030
		(1.669)	(.066)
$\mathbf{1}_{FRV}$	-	-2.997**	-.116*
		(1.139)	(.052)
Intercept		5.397*	
		(2.550)	
Year controls		Yes	
Line controls		Yes	
Pseudo-R^2		.045	
LL $RE = 0$	$\bar{\chi}^2(1)$	418.26***	
AIC		546	
BIC		714	
Obs		1,669	

Note: Standard errors in parentheses. The expected sign is inverted.
Source: Dataset II "Lines", Dataset III "Companies"
* p< .05 ** p< .01 *** p< .001

Table 32: Discrete choice model, line controls

$1_{\neg RIN}$ Variable	Random Effects	Marginal effects
Accident	-182.3	-7.055
	(97.95)	(4.120)
Burglary	12.80*	.495
	(6.223)	(.253)
Credit	-7.026	-.272
	(6.858)	(.271)
Fire	-1.033	-.040
	(1.353)	(.053)
Glass	1.628	.0630
	(2.018)	(.081)
Hail	-.551	-.021
	(.682)	(.027)
Motor	.843	.033
	(2.302)	(.089)
Transport	.204	.008
	(1.757)	(.068)
Liability	3.170	.123
	(1.758)	(.082)
Reinsurance	4.733**	.183*
	(1.518)	(.072)

Note: Standard errors in parentheses. Marginal effects are the relative change in expected probability, assuming $\mu = 0$.
* p< .05 ** p< .01 *** p< .001
Source: Dataset II "Lines", Dataset III "Companies"

explanation is that relatively older companies featured established reinsurance arrangements whilst relatively younger companies faced relatively higher cost of reinsurance.

Results for the line-specific control variables are provided in Table (32). Exposure to reinsurance increased the marginal effect on the predicted probability by 18.3 ($\pm$7.2) % and is statistically significant at the 5% level. It suggests that reinsurance companies were the most likely to not retrocede gross premium volume. This means that residual risk accumulated at specialised reinsurance companies during the Interwar period, suggesting an increased supply within the contemporary reinsurance market.

5.6.2 Mixed effects model

Several tests confirm the validity of the model specification. A Hausman test favours the null hypothesis of random effects over a fixed effects model with $\chi^2(6) = 6.29$ and a p-value of 0.39. That the independent variables are uncorrelated with the random-effects component, or $Corr(\mathbf{x}, \nu) = 0$, is confirmed by a Sargan-Hansen test given $\chi^2(25) = 49.365^{***}$. A Breusch-Pagan Lagrange multiplier test also supports the use of the random-effects assumption with $\bar{\chi}^2(1) = 2.783^{***}$.

Table (33) provides results for the random effects model. Parameter estimates are directly comparable

Table 33: Results mixed model

$0 < RIN < 1$		Pooled	Unpooled		
Variable	Expected Sign	Interwar	Golden Twenties	Great Depression	Wald F-Test (1)
$\mathbf{1}_{OF}$	+	.121	.123*	-.085	.89
		(.063)	(.061)	(.063)	
CPR	+	.027**	.039***	-.001	8.25*
		(.008)	(.010)	(.009)	
LEV	-	-.007	-.010	-.011*	.19
		(.004)	(.005)	(.006)	
$LnTAV$	-	-.027	-.025	-.025	.00
		(.019)	(.016)	(.016)	
PFT	-	-.007	.030	-.041	.64
		(.009)	(.015)	(.095)	
LIQ	-	-.001	-.001	.026	.44
		(.005)	(.004)	(.042)	
INV	+	.137	.133	.376	.38
		(.230)	(.228)	(.339)	
$\mathbf{1}_{GRP}$	+	.074**	.072**	.101***	2.74
		(.024)	(.024)	(.027)	
CNC	-	.013	-.002	-.025	.20
		(.041)	(.046)	(.056)	
$\mathbf{1}_{FRV}$	-	-.050	-.054	.053	.00
		(.039)	(.039)	(.041)	
Intercept		.461***		0.477*	
		(.122)		(.230)	
Year controls		Yes		Yes	
Line controls		Yes		Yes	
R^2 (overall)		.125		.133	
Comps.		219		219	
Obs		1,458	(669)	(789)	

Note: Standard errors in parentheses. The Interwar period covers the full sample from 1926 to 1935. The Golden Twenties period covers the years 1926 to 1929 and the Great Depression the years 1930 to 1935.
* p< .05 ** p< .01 *** p< .001
Source: Dataset II "Lines", Dataset III "Companies"

between pooled und unpooled specifications due to the use of identical fixed as well as random effects together with the same intercept and reference year. Individual Wald tests also indicate that all parameters can be pooled between sub-periods with the exception of credit, glass, liability and transport insurance lines. This causes the overall $R^2$of the pooled specification to be relatively smaller. The F-tests for $LnTAV$, CNC and 1_{FRV} suggest that there are statistically negligible differences in the per-period parameter estimates.

All parameters meet the expected relationship with reinsurance demand. The results with respect to the organisation form 1_{OF} show a pro-cyclical pattern with a positive sign - statistically significant at the 5 % level - during the 1920s and a negative sign in the 1930s. This confirms the findings of Abdul Kader et al. (2010) and thus the hypothesis. The loss ratio CPR features a positive sign during the full period as well as the Golden Twenties, which is consistent with the assumption that reinsurance was used for the purpose of risk mitigation. This finding is weakened by the insignificant result of the Wald test, indicating that results could be pooled across both sub-periods. Leverage LEV is found to be negatively correlated with RIN, with estimates close to the 5% significance level.[191] This rejects the assumption that the demand for leverage was pro-cyclical.

The fixed effects for individual line exposure is provided in Table (34). Wald tests indicate whether estimates of the individual sub-periods can be pooled. Differences between the periods were most pronounced in credit, glass, liability and transport insurance. Changes in credit and transport insurance were directly related to the reduction in trade activity, causing an increase in the former and a reduction of losses in the latter. In the case of glass insurance this can be associated with the public disorder of the 1930s Great Depression. The increase in liability insurance suggests increased relative losses in this line. This is confirmed in Ch.7. Although not statistically significant, the negative sign of reinsurance suggests that specialised reinsurance companies were reducing retrocession during the Great Depression period. This is consistent with the findings of the discrete choice model. Overall, the differences in the significance of results between the sub-periods appear to be closely related to the effect of reinsurance demand due to underwriting risk CPR. Whilst the latter played an important role during the Golden Twenties, line-specific considerations became dominant during the Great Depression period.

5.7 Reinsurance as dynamic risk mitigation

This chapter concludes that joint-stock companies in particular demanded reinsurance during the Golden Twenties. This was based on the connection between the shareholder value maximisation problem and the risk exchange model by Borch (1962). It was shown analytically that changes in the opportunity set of investors have the potential to cause risk shifting of insurance companies by

[191] The reported p-value for the Golden Twenties is 0.059 and for the Great Depression 0.041.

Table 34: Mixed model, Line fixed effects

$0 < RIN < 1$ Variable	1926-1935	1926-1929	1930-1935	Wald F- Test (1)
Accident	.343	.225	.389*	2.90
	(.189)	(.124)	(.158)	
Burglary	.405	.312	.375	.19
	(.244)	(.240)	(.252)	
Credit	.063	-.051	.145**	8.09**
	(.041)	(.057)	(.044)	
Fire	.117	.092	.183*	2.98
	(.076)	(.073)	(.089)	
Glass	.030	-.078	.122	8.96**
	(.061)	(.055)	(.074)	
Liability	-.086	.002	.072	8.97**
	(.076)	(.090)	(.087)	
Motor	.007	-.095	.091	.76
	(.054)	(.058)	(.058)	
Transport	-.046	.006	-.057	4.51**
	(.058)	(.055)	(.071)	
Hail	.047	.016	.160*	.65
	(.032)	(.031)	(.067)	
Reinsurance	.021	-.003	-.098	2.30
	(.066)	(.066)	(.085)	

Note: Standard errors in parentheses.
* p< .05 ** p< .01 *** p< .001
Source: Dataset II "Lines", Dataset III "Companies"

means of reinsurance. This motivated the empirical analysis at hand of reinsurance demand in the German insurance sector, which featured optimal conditions during the Interwar period. Historical evidence from the German supervisory act illustrated that the contemporary reinsuance market is an example of an unregulated financial service sector. The further absence of changes in tax regulations, of unproportional (e.g. excess-of-loss) reinsurance as well as of exogenous effects that might have caused price movements (e.g. natural catastrophes) allowed to focus the analysis on the use of quota-share reinsurance as a way of shifting risk. From an econometric perspective, the model took into account that the variable representing reinsurance demand was biased by companies intentionally not using reinsurance. Separating the discrete from the continuous part of the mixed distribution allowed for analysing the structural interest in reinsurance as well as the time-dependent demand for reinsurance.

Whith respect to the analysis of the discrete choice to not use reinsurance it was found that size and franchise value mattered. Both variables were associated with an an increased interest in demanding reinsurance. Furthermore, specialised reinsurance companies were more likely to not use reinsurance, or in this case retrocession. This allowed to conclude that residual risk - insurance risk unclaimed by other companies - was accumulated in the reinsurance sector. This is consistent with the findings of Ch.3 that reinsurance companies featured a relatively larger default risk.

With respect to the continuous demand for reinsurance, model estimates were consistent with similar results by Abdul Kader et al. (2010). Joint-stock companies were found to feature a pro-cyclical demand for reinsurance. Parameter estimates were statistically significant and positive during the Golden Twenties, a period that was associated with increased opportunities. In contrast, the effect for the Great Depression period was found to be relatively small and insignificant. Although a Wald test could not conclude that effects were not due to two different data-generating processes, this confirmed the hypothesis. Further factors that were found to be significant were underwriting risk as well as group affiliation as consistent with Powell & Sommer (2007).

Table 35: Appendix: BLUP random effects model

Obs	Mean	Med	Std Dev	Min	Max
1,581	0	0	.232	-.407	.465

Note: The full-period specification is used.
Source: Dataset II "Company"

Appendix

Robustness check random effects model

The applied mixed model is based on the random-effects assumption, namely that the set of regressors $\mathbf{x}$ is uncorrelated with the random-effects component, or $Corr(\nu, \mathbf{x}) = 0$. The relatively large inter-company variance in the sample, together with the result of a Hausman test, support the validity of the assumption. The results of the discrete-choice panel model nevertheless suggest that exogenous time-invariant variables were found to have a significant effect on the decision to not engage in reinsurance. Following from this result it can be hypothesised that the same time-invariant regressors are correlated with company-specific random effects. This model is based on the weighted average of inter-company and intra-company variance, which requires zero correlation for estimates to be unbiased. A potential correlation is first checked by analysing whether structural variables help to explain the variance of the random effects component.

Analysing the random effects component

Although only the company-specific variance is observable, it is possible to approximate the point estimate as the mean of the probability density cloud. This yields best linear unbiased predictors (BLUPs) as provided in Table (35).

BLUPs are sample-specific approximations of the company-specific relative difference to the model intercept or $\alpha_0 + \eta$. A negative value indicates that unobserved company characteristics lead to relatively smaller constant demand for reinsurance and vice versa. An ordinary least-squares regression is specified that regresses the time-invariant variables $\mathbf{1}_{ORF}$ and $\mathbf{1}_{FRV}$ on ν, or

$$\eta_i = b_0 + b_1 \mathbf{1}_{ORF}(i) + b_2 \mathbf{1}_{FRV} + e,$$

where e is the uncorrelated and normally distributed error term with $\mathbb{E}[e] = 0$. Results are provided in Table (36).

Both time-invariant variables explain 6.5 % of variation in η. Furthermore, $\mathbf{1}_{ORF}$ is correlated at a significance level of 5%. The variable $\mathbf{1}_{FRV}$ is negatively correlated at the same level. This leads to the

Table 36: Appendix: OLS regression results

Results OLS regression

$\mathbf{1}_{ORF}$	.082*
	(.038)
$\mathbf{1}_{FRV}$	-.074*
	(.032)
Intercept	-.020
	(.429)
R^2	.065
N	220

Source: Dataset III "Line"

conclusion that joint-stock companies were on average assigned a relatively larger value of η, implying that the coefficient of $\mathbf{1}_{ORF}$ does capture the full effect. The opposite is true for companies founded before 1914. Furthermore, this casts doubt on the assumption $Corr(\nu, \mathbf{x}) = 0$, given that both time-invariant variables are elements of $\mathbf{x}$. The robustness of the full-period parameters to relaxing this assumption is checked against a fixed-effects model. The results based on the pooled specification are provided in Table (37).

The results indicate that the estimated correlation is negative. Sign, significance and magnitude of the parameters are not substantially different. Results for line controls are also confirmed and omitted. Intra-company variance is explained equally well by the fixed as well as the mixed model. This indicates that the used random-effects parameter estimates are robust to relaxing the underlying assumption.

The Hausman-Taylor estimator

A disadvantage of the fixed-effects model is that time-invariant variables are differenced out. This especially concerns the relevant parameter estimates for the structural variable $\mathbf{1}_{ORF}$ as well as $\mathbf{1}_{FRV}$. The Hausman-Taylor estimator, introduced by Hausman & Taylor (1981) and defined by Greene (2012, pp.434-435), instruments known endogenous time-invariant variables with the set of time-varying variables in $\mathbf{x}$. This approach avoids potential bias arising from the endogeneity of the structural variables that are correlated with the company-specific random effects. Following the results of the OLS regression, the structural variables $\mathbf{1}_{ORF}$ and $\mathbf{1}_{FRV}$ meet this criterion. Model results are available in Table (37). The Sargan-Hansen test of overidentification restrictions confirms the set of instruments. This model provides full-period parameter estimates that are very similar to the ones obtained from the random effects model. Differences in significance levels of variables are due to the fact that the

Table 37: Appendix: Results fixed effects / Hausman-Taylor

$0 < RIN < 1$ Variable	Random effects	Fixed effects	Hausman-Taylor
$\mathbf{1}_{ORF}$	.121 (.063)	- -	.010 (.095)
CPR	.027** (.008)	.025** (.008)	.026*** (.007)
LEV	-.007 (.004)	-.006 (.004)	-.007** (.002)
TAV	-.028 (.019)	-.033 (.027)	-.032*** (.008)
ROA	-.007 (.009)	-.007 (.009)	-.007 (.013)
LIQ	-.001 (.005)	.001 (.006)	.001 (.007)
INV	.137 (.230)	.084 (.234)	.103 (.130)
$\mathbf{1}_{GRP}$	.074** (.024)	.111*** (.028)	.088*** (.023)
CNC	.013 (.041)	.018 (.049)	.021 (.025)
$\mathbf{1}_{FRV}$	-.050 (.039)	- -	.105 (.075)
Intercept	.461*** (.122)	.551* (.228)	.476*** (.091)
Random effects	Yes	No	Yes
Year controls	Yes	Yes	Yes
Line controls	Yes	Yes	Yes
R^2(intra)	.091	.095	
R^2(overall)	.124	.024	.922
Sargan-Hansen χ^2			(23) .122
$Corr(\nu, \mathbf{x})$	0 (fixed)	-.202	
Companies	219	219	219
Obs	1,456	1,456	1,456

Note: Standard errors in parentheses. Standard errors in the random and fixed effects model specifications are Huber-White sandwich standard errors and conventional in Hausman-Taylor.
* p< .05, ** p< .01, *** p< .001
Source: Dataset II "Company", Dataset III "Line"

Hausman-Taylor estimator does not use intra-company Huber-White sandwich standard errors. This confirms that the assumption that regressors and random effects are uncorrelated does not bias results.

6 Insurance investor sentiment in Germany during the Golden Twenties, 1926 to 1931

6.1 The informational content of insurance dividend announcements

Insurance operations depend on highly sophisticated actuarial methods and complex mathematical assumptions. This leads to an information asymmetry between internal managers and external investors. Therefore the dividend payout is interpreted as a signal for the internal financial situation of the company. A major limitation of this type of indicator is the relatively low quarterly or - in the case of the Interwar period - annual reporting frequency. In the meantime, investors form expectations that are validated by the later dividend announcement. Under the assumption of the semi-strong efficient market hypothesis, this may lead to price reactions in the case that investors did not expect the newly disseminated information. This contributes new insights into the relationship between changes in the dividend growth level and associated changes in asset returns. The relationship described helps to explain the observation that insurance share prices outperformed during the Interwar period prior to the 1931 Financial Crisis. This contrasts with the finding of Voth (2003) that an intervention of *Reichsbank* in May 1927 to reduce margin lending caused an artificial depression of share prices. It is argued that insurance companies catered to an investor clientele that priced insurance shares on the basis of dividend payout information.

The chapter is organised as follows: first, the historical relevance of dividend payout for insurance investors is established. In addition, the insurance share price and dividend performance is introduced in general and contrasted to the Berlin stock index as well as the effect of the May 1927 *Reichsbank* intervention. Second, the theoretical implications of dividend catering on the formation of asset prices is discussed on the basis of the Gordon growth model. Third, event study methodology is established that allows to test contemporary market sentiment. Fourth, the newly compiled dataset at hand is introduced. Fifth, the results of the empirical analysis are provided. It is found that investors used dividend information in the formation of market prices on the basis of an optimistic sentiment.

This analysis contributes new insights with respect to equity valuation under the assumption of heterogenous investor preferences. This establishes a theoretical explanation for the general observation that dividend growth rates do not predict asset returns. In addition, the to the knowledge of the author first empirical analysis of disaggregated equity price data is presented for German companies during the Interwar period. This provides a new perspective on the effect of the May 1927 *Reichsbank* intervention.

There are two important limitations connected to this chapter that lend themselves for future research: the only benchmark stock market index available for this period, the Berlin stock exchange index, is based on monthly observations. The availability of weekly data would allow the construction

of a new index on a smaller time grid. In addition, both the focus on individual share classes rather than companies as well as the diversity of different insurance lines covered limits the ability to make cross-sectional inferences. This may motivate the extension of the dataset to include other sectors, such as banking or manufacturing.

6.2 Historical background: investor dividend perceptions and the May 1927 *Reichsbank* intervention

There is little historical evidence for the shareholder composition of German insurance companies. Based on extensive archival research, Froehlicher (2013) identifies the general characteristics of the shareholder base of the Swiss non-life joint-stock insurance company *Zürich* for the period from 1910 to 1940. Shareholders of the company were in particular identified as long-term investors to the point that the investment in a share was regarded as a form of pension plan[192]. This points towards a particular clientele of investors that was interested in purchasing insurance equity, which is in the following part inferred from relevant contemporary secondary literature. It derives that dividend payout by insurance companies served as an important signal for contemporary investors. Following on, the effect of the May 1927 *Reichsbank* Intervention is put into perspective with insurance stock performance and dividend announcements.

6.2.1 The perception of dividend payout by investors during the Interwar period

During the Interwar period, insurance dividend payout conveyed important information on the profitability of an insurance share to shareholders. This was due to the uniqueness of the insurance business model and its inherent complexities. Lengyel (1927)[193] provided the following passage as an introduction to insurance accounting:

> The nature of insurance business is idiosyncratic and different from other trade businesses. Insurance is not a monetary or credit business, but it is rather a socio-economic institution based on a mathematic-statistical foundation [...]. The reading and analysis of statements of accounts therefore requires additional specific knowledge in addition to basic business knowledge.[194]

It was also generally known to contemporaries that the nature of insurance liabilities introduced uncertainty into the accounts of companies:

[192] See Froehlicher (2013, p.76).
[193] Froehlicher (2013, p.25) remarks that this textbook was also in use at *Zürich*.
[194] (German original, translated by the author:) "Die Natur des Versicherungsgeschäfts ist eine eigentümliche und von der anderer Handelsgeschäfte verschieden. Die Versicherung ist auch kein Geld- oder Kreditgeschäft, sie ist vielmehr eine auf mathematisch-statistischer Grundlage aufgebaute sozial-ökonomische Institution [...]. Das Lesen und die Analyse ihrer Rechnungsabschlüsse bedingt somit außer allgemeinen kaufmännischen Kenntnissen noch besonderes weiteres Wissen." Lengyel (1927, p.1)

> Whilst liabilities are certain in all other types of business corporations and it is in particular the valuation of assets that causes difficulties, conditions are reversed in the case of insurance companies. The most important liabilities of insurance companies, the so-called technical reserves, can not be determined in a numerically exact way, but can only be estimated technically. Every bank, every thrift knows exactly the sum of entrusted saving deposits and the liabilities that are associated with it.[195]

Business analysists required specific insurance-related expertise to fully comprehend the content of insurance balance sheets and this was further complicated by the presentation of content - especially in Germany. After the collapse of FAVAG in 1929, the internationally renowned insurance newspaper "The Review" commented on the complexity of published German insurance accounts. It suggested that even external experts with an intimate knowledge of insurance operations found it hard to objectively interpret insurance accounts:

> Dealing as we do with the accounts of companies of all nations the verifying forms of accountancy in which they are presented often come under consideration. Generally one can very easily accommodate oneself to the national form. Recent events in Germany brought to attention a weakness there which had not been realised. German accounts, generally speaking, are very informative, indeed they are often subject to the comment that they are too formally detailed, so that one "cannot see the wood for the trees" – the general result is lost or obscured in a maze of detail, however, one naturally gave to the accounts for similarly precise and detailed verification, and that we find does not exist. They are in general merely office accounts, unverified by outside independent and expert authority. It is the old, old tale. Things may be most securely and formally arranged, but somewhere at the rear there is a screw loose, and the credit of the whole thing collapses. It is one of the most serious results of the Frankfurter General collapse that it has thrown doubt on German accountancy. And in insurance, which rests so greatly on the basis of trust and the utmost good faith – *uberrima fides* [sic!] is of the essence of insurance and of re-insurance in externals as well as internals – that is a very serious flaw. [...]"[196]

The complexity of published information was also noted by Lengyel (1927) who specifically noted that the access to internal information necessitated a different valuation of large share packages relative to individual shares:

[195](German original, translated by the author:) "Während bei allen anderen Arten von Wirtschaftsunternehmen die Passiven in der Regel feststehen und vor allem die Bewertung der Aktiven Schwierigkeiten bereitet, liegen die Verhältnisse bei den Versicherungsgesellschaften gerade umgekehrt. Die wichtigsten Verbindlichkeiten der Versicherungsgesellschaften, die sogenannten technischen Reserven, können ziffernmäßig exakt nicht ermittelt, sondern nur technisch abgeschätzt werden. Jede Bank, jede Sparkasse kennt genau die Summe der ihr anvertrauten Spareinlagen und ihre aus diesem Titel bestehenden Verbindlichkeiten." Lengyel (1927, pp.1)

[196]The Review, 08 November 1929, p.1093

> In general the effective profitability can only be derived from internal accounts, not rarely even on the basis of additional analyses. Generally, it is available from internal balances and therefore also known to the supervisory board or the exponents of the major shareholders. The profitability for a major shareholder, who is aware of these facts and who can accommodate to them, therefore is or can be different than to that of the small-scale shareholder, who is only in a loose relationship with the company and for whom the actual share return is constituted by the distributed cash dividend. In practical terms this difference leads to a different standard used for the valuation of large share packages (share majority or qualifying minority) in comparison to an individual share.[197]

Based on this evidence it is to be assumed that the profitability of an individual share was valued using the dividend payout performance over a longer period[198] , which suggests that insurance titles were of particular interest for long-term investors. This is further supported by the observation that the majority of insurance shares were partly paid-in name shares that required the registration of shareholders in company-specific share registers.[199] It is also compatible with the statement that insurance companies especially applied "conservative" dividend payout policies in order "to prevent insurance shares from becoming the focus of speculation."[200]

6.2.2 The effect of the May 1927 *Reichsbank* intervention on insurance share performance

The 1924 currency reform initiated the return to normality for the German economy. The speed of this process caused concerns about the potential build-up of a speculative bubble in asset prices. Hjalmar Schacht, President of the German central bank *Reichsbank*, decided to intervene in May 1927. This action was motivated by the fast increase in share prices, the concern that this rally could divert funds required in productive investment and the influx of foreign capital predominantly used for speculative activities. [201] German banks were required to reduce lending against securities as collateral.

[197] (German original, translated by the author:) "Die effektive Rentabilität kann in der Regel nur aus den internen Bilanzen, nicht selten sogar nur auf Grund besonderer Untersuchungen festgestellt werden. In der Regel wird sie aus den internen Bilanzen zu entnehmen, folglich auch dem Aufsichtsrat, d.h. den Exponenten der Großaktionäre bekannt sein. Die Rentabilität für den Großaktionär, der alle diese Tatsachen kennt, und sich darauf einrichten kann, ist oder kann demnach eine andere sein als die für den Kleinaktionär, der zum Unternehmen nur im losen Verhältnis steht und für den die ausgeschüttete Dividende die tatsächliche Rentabilität seiner Aktie darstellt. Praktisch wirkt sich diese Verschiedenheit darin aus, daß für die Bewertung eines großen Aktienpakets (Aktienmajorität oder qualifizierte Minderheit) ein anderer Maßstab angelegt wird, als für die einzelne Aktie." Lengyel (1927, pp. 219-220).

[198] See Lengyel (1927, pp.220).

[199] This nevertheless restricted the fungibility of insurance shares due to the lengthy registration process and motivated German stock exchanges to define special "house rules". For example, the Berlin stock exchange issued special regulations for the first time in 1925 in order to organise and speed up registration processes. For further information, see Berman (1930). This, however, substantially reduced the reliability of shareholder liabilities as a certain source of capital. Attempts by insurance companies, such as the requirement of collateral posting for shareholder liabilities, was objected by German courts. See Neumanns Zeitschrift für Versicherungswesen, 1 October 1930, p.1027.

[200] See Lengyel (1927, p.119) and compare Ch.4.2.1.

[201] See James (1985, p.39) as well as Voth (2003, p.68).

Noncompliant institutions were threatened with reduced or no access to rediscount facilities. On 12 May 1927 Berlin banks announced measures to reduce margin lending.[202]

Analysing the contemporary circumstances, Voth (2003) rejects the hypothesis of an asset bubble and calls the actions of *Reichsbank* "misguided"[203]. The perceived rapid increase in share prices especially in the year 1926 was attributed to the economic normalisation following the hyperinflationary period. Voth (2003) attributes the rally to an increase in aggregate dividend payout, which continued well after the May 1927 intervention. As a consequence, Germany would not have experienced the build-up of a speculative bubble such as in the United States.[204] Voth (2003) furthermore argues that the *Reichsbank* intervention limited company in raising capital at financial markets and thus contributed to an underinvestment and the onset of an economic recession in 1928.

With respect to insurance prices, the weekly published insurance magazine "Neumanns Zeitschrift für das gesamte Versicherungswesen" for instance reported similar adverse effects of the *Reichsbank* intervention but expectations in a future recovery of prices:

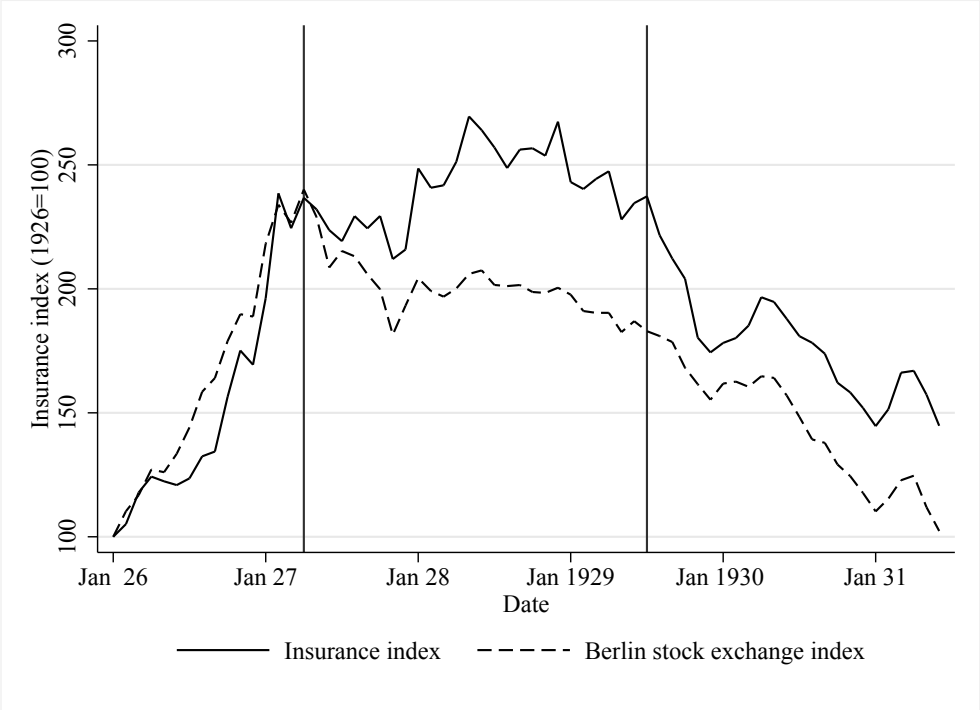
> Unfortunately, the price development did not show consistency. Even insurance shares were not spared by the "black days at the stock exchange" and by the associated volatility. The same picture was provided by the second half of the year, yet the general price level increased again. In December 1927, the share prices were the highest of the whole year [...].
> [205]

Insurance share prices indeed recovered from May 1927 onwards as shown in Figure (8). Prior to the intervention, insurance shares had participated in the general rally caused by the normalisation of business conditions. This is illustated by the likewise decrease of the interest rate on daily money as shown by Voth (2003, p.79, Fig.5). Overall dividend payout nevertheless increased from 1927 onwards as evidenced by Voth (2003, p.75, Fig.3). Following on from May 1927 the insurance index outperformed the Berlin index and peaked in mid-1929. The gap between both indices increased to about 50 points from January 1928 onwards and remained at this level until the August 1929 FAVAG default. This trend reversion also predated the October 1929 Wall Street Crash that also affected the trade activity at German stock exchanges.

With respect to the main reason for the post-intervention recovery of the insurance index, the article in "Neumanns Zeitschrift für das gesamte Versicherungswesen" suggested expectations in dividend increases for the year 1927, paid out in the year 1928:

[202] See Voth (2003, p.68).
[203] See Voth (2003, p.84).
[204] Compare DeLong & Shleifer (1991) and Rappoport & White (1993) .
[205] (German original, translated by the author:) "Die Kursbewegung zeigte leider keine Stetigkeit. Auch die Versicherungsaktien wurden von den "schwarzen Börsentagen" und den Zuckungen nicht verschont. Im zweiten Halbjahr ergab sich das gleiche Bild, doch hat sich das Kursniveau weiter gehoben und im Monat Dezember 1927 waren die Kurse [...] die höchsten des Jahres 1927." See "Neumanns Zeitschrift für das gesamte Versicherungswesen" February 1928, p.130.

Figure 8: Comparison insurance to Berlin stock exchange index, January 1926 to July 1931



Note: The insurance index is a weighted average of market prices taken from all actively market-traded insurance shares listed at every German stock market per 100 GM paid-in capital. The base month is January 1926. The Berlin stock exchange index is rescaled to January 1926 as base month as well.
Source: Dataset IV "Share Price", Reichsamt (1927 - 1932).

> In line with price increases in December, the [dividend] yield decreased likewise, which leads to the expectation of further dividend increases for the year 1927.[206]

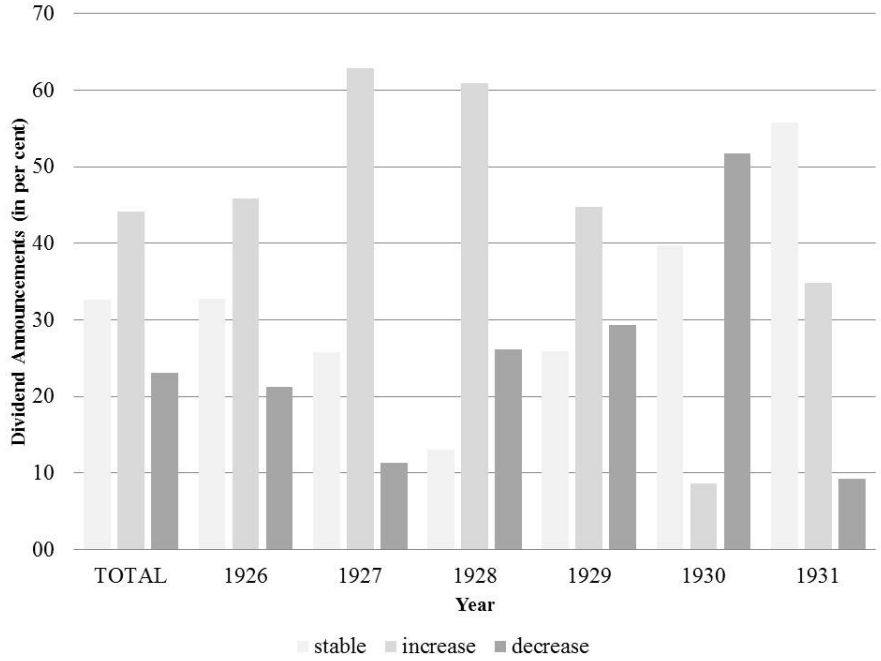
Figure (9) shows the percentage of discrete changes in dividend announcements per increase, decrease or no change between 1926 and 1931.

Dividend increases started to become more frequent from the reporting year 1927 (for the business year 1926) onwards. Its total share increased to 60.9% in 1928 (business year 1927), before it corrected to 44.8% in 1929 (for the business year 1928), the year the German economy went into recession. In this year the majority of announcements occurred prior to the August 1929 FAVAG default. This small consolidation preceded the decrease to 8.6 % in 1930 (business year 1929) was not immediately related with the onset of the Great Depression in Germany.

The close interplay between insurance stock prices and dividend is illustrated by the performance of the aggregate dividend yield as shown by Figure (10). It shows the decrease from 9.09% in January 1926 to 5.18% in January 1927 that was mentioned in the magazine article. From then onwards, the increases in share prices did not affect the insurance dividend yield, which remained relatively

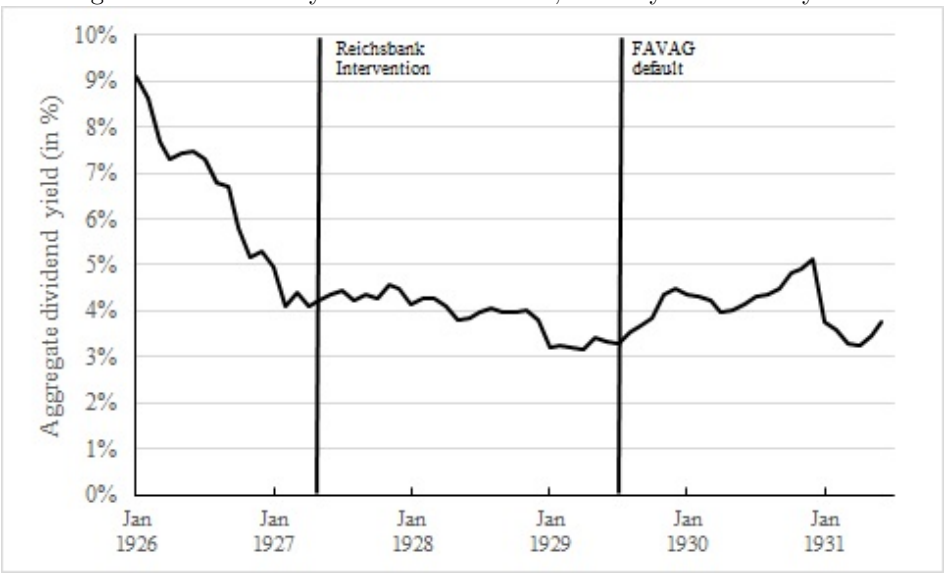
[206](German:) "Infolge der Kurssteigerung im Dezember hat sich die Rendite entsprechend gesenkt, wodurch sich die Aussicht auf eine weitere Steigerung der Dividende für das Jahr 1927 ergibt." See "Neumanns Zeitschrift für das gesamte Versicherungswesen" February 1928, p.130.

Figure 9: Percentage dividend changes per year, 1926 to 1931



Note: Relative dividend announcements are aggregate changes in the dividend level relative to all dividend announcements. Dividend increases are defined as an increase / decrease / no change in the dividend rate relative to a relatively smaller / larger / equal rate in the previous year. The given year is the year of the dividend announcement for the previous business year. Dividend announcements of 1926 relate to the business year 1925 and so forth.
Source: Dataset IV "Share Price", see Table (40).

Figure 10: Dividend yield insurance index, January 1926 to July 1931



Note: Aggregate dividend yield is the ratio of the mean dividend rate relative to the aggregate monthly insurance stock price per RM 100 paid-in capital.
Source: Dataset IV "Share Price"

constant at approximately 4% until January 1929. It reached its minimum in July 1929 at 3.30%, but recovered to 4.83% in January 1930 after a short rally starting after the August 1929 FAVAG default and continuing until the end of 1930. This relative stability in dividend yield suggests that the aggregate dividend rate was developing in close connection with the share price.

This shows that insurance stock prices were not affected by the May 1927 *Reichsbank* intervention and were based on market fundamentals. This contrasts with the finding of Voth (2003), for which a possible explanation is that the *Reichsbank* intervention explicitly targeted margin lending activities. Titles not bought on margin were less likely to be affected persistently by the intervention. Given that insurance especially targeted a generally optimistic non-speculative clientele of long-term investors, it is probable that insurance titles were less likely to be bought on margin. This asset class was hence less affected by the intervention. Other dividend-paying companies that attracted different investor clienteles would have nevertheless been affected by the intervention. This leads to the hypothesis that insurance investors indeed formed expectations on the basis of information provided by the dividend payout. In addition, it is hypothesised that aggregate clientele sentiment was unaffected by the May 1927 *Reichsbank* intervention and continued to be optimistic due to the improved macro-economic conditions.

6.3 The demand for dividend payout

The assumption that companies cater to specific investor clienteles is part of the catering theory of dividends, which is introduced as a first step. Second, a valuation approach on the basis of the Gordon growth model is provided. This includes providing a new interpretation on previous empirical findings with respect to dividend growth rates. Third, these results are put into the perspective of the dividend catering model. This suggests using event study methodology to test the hypothesis empirically on the foundation of the semi-strong efficient market hypothesis. Fourth, a review of relevant studies is provided that establish the compatibility of event study methodology with insurance business operations.

6.3.1 The catering theory of dividends

The classical Modigliani-Miller Theorem attests under certain assumptions, that the value of a company is independent of its capital structure. Paying out dividends directly leads to a decrease in the value of the company. The distribution of dividends therefore does not add immediate value to the shareholder. That companies nevertheless distribute cash payment was coined as the "dividend puzzle" by Black (1976*a*). Modigliani & Miller (1961, p.431), however, clarify that the Miller-Modigliani Theorem does not take into account certain preferences of investor clienteles:

> If, for example, the frequency distribution of corporate payout ratios happened to correspond

> exactly with the distribution of investor preferences for payout ratios, then the existence of these preferences would clearly lead ultimately to a situation whose implications were different in no fundamental respect from the perfect market case. Each corporation would tend to attract to itself a 'clientele' consisting of those preferring its particular payout ratio, but one clientele would be entirely as good as another in terms of the valuation it would imply for the firm.[207]

This observation motivated the definition of the catering theory for dividends by Baker & Wurgler (2004), see also de Rooij & Renneborg (2009). The theory formulates three relevant assumptions: it is first argued that investors have an uninformed and potentially time-varying demand for shares that pay dividends. This corroborates the finding that insurance investors were relying on dividends as a signal for insurance business operations. Information conveyed by dividends were more relevant as signals to investors than as predictors for future earnings performance.[208] The second assumption is that arbitrage does not prevent price differences between dividend paying and non-paying shares. This is the assumed explanation for the gap between the insurance index and the Berlin stock exchange index from 1927 onwards. Third, managers cater rationally to investors and pay dividends especially in periods of pronounced demand for dividend payments. This third assumption would suggest that the increased dividend payments were due to managers catering to investor expectations.[209] This serves as further motivation to analyse the actual status of contemporary investor sentiment.

The basic assumptions of Baker & Wurgler (2004) inspired a substantial number of empirical studies that tested the validity of the catering theory of dividends. An overview of results is provided by de Rooij & Renneborg (2009, pp.226-229). Most studies are based on large macro-economic datasets of Postwar observations. A main topic in recent literature is the declining propensity to pay dividends.

6.3.2 The valuation of insurance companies

The effect of dividend changes on asset prices is part of the more general analysis of excess return volatility.[210] This academic discussion was mainly based on the dividend discount model of Williams (1938) and Gordon & Shapiro (1956). The model interprets the value of a dividend-paying joint-stock company $V \in \mathbb{R}_0^+$ as the present value of expected dividend payout $\mathbb{E}[D] \in \mathbb{R}_0^+$ discounted by the a company-specific discount factor $\varphi \in \mathbb{R}_0^+$, which is not necessarily equal to the risk-free rate and the dividend growth rate $g \in \mathbb{R}_0^+$ assumed to be constant. The formal definition in the single period setting

[207] Modigliani & Miller (1961, p.431).
[208] This relates to dividend signalling hypothesis that is based on the observation of Lintner (1956) that "a major unanticipated and non-transitory change in earnings would be an important reason to change dividends.(Paradigm (iii))" See Baker & Wurgler (2004, p.1130, fn.7). This is consistent with the observation of Benartzi et al. (1997) that dividends are not a reliable signal for future earnings.
[209] See Baker & Wurgler (2004, pp.1125-1126).
[210] LeRoy (2006) provides an informative literature review.

is

$$V = \frac{1}{\varphi - g}\mathbb{E}\left[D\right]. \tag{6.1}$$

A necessary mathematical condition is $0 < g < \varphi$ in order for the model to be well defined. In the present context the discount rate is defined more generally on the basis of an alternative investment opportunity set instead of the more widely used risk-free rate. This takes into account that investor clienteles can have varying definitions of risk-free assets.

Generalising the single-period model into a multi-period setting underlines the relevance of the semi-strong efficient market hypothesis in the present context. It assumes that all prices are formed on the basis of publicly available information. This also suggests that the expected future dividend payout is conditional on the information available at present, or time $t \in T$. Given the probability space $(\Omega, \mathcal{F}, \mathbb{P}, \mathbb{F})$, the dividend payout expected by investors is conditional on the cádlág filtration set $\mathbb{F} = (\mathcal{F}_t)_{t\in T}$ so that the expectation becomes time dependent, $\mathbb{E}_t\left[D|\mathcal{F}_t\right]$. Under the semi-strong efficient market hypothesis assuming the absence of arbitrage further implies that the market price $P \in \mathbb{R}_0^+$ captures new information instantaneously. No arbitrage arguments lead to a conversion of the intrinsic value of the company and its market price so that $V \equiv P$. Under the assumption that all other variables are time dependent, Equation (6.1) then becomes

$$P_t = \frac{1}{\varphi_t - g_t}\mathbb{E}_t\left[D|\mathcal{F}_t\right]. \tag{6.2}$$

The non-linearity of this model motivated Campbell & Shiller (1988) to develop a dynamic version based on a Taylor approximation. Research especially focused on the dynamics of the dividend yield defined as expected dividend payout per market value of the company, or

$$\frac{\mathbb{E}_t\left[D|\mathcal{F}_t\right]}{P_t} = \varphi_t - g_t,$$

as for example Equation (2) in Fama & French (1988, p.5)[211]. Changes in the dividend yield are caused by changes in the discount factor or in the dividend growth rate.[212] Fama & French (1988) and Fama & French (1989)[213] find that, in the long run, changes in the dividend yield predict changes in returns, defined as $R = ln\left(P_t/P_{t-1}\right)$. Changes in the dividend growth rate g are not found to predict changes in the dividend yield.

[211] There, observations of the previous period $t-1$ are used to predict current estimates at t without taking expectations.
[212] Compare LeRoy (2006) for the contemporary academic discussion that took place during the 1980s but did not take into account discount factor variability.
[213] See also Cochrane (2011).

6.3.3 The endogeneity of dividend growth rate and discount factor

Investors bought or sold shares following changes in the expected dividend payout $\mathbb{E}[D|\mathcal{F}_t]$ due to the arrival of new information $\mathcal{F}_{t+1}$. This new information could either be introduced by changes in the discount factor φ or in the dividend growth rate g. The results of Fama & French (1988) and Fama & French (1989) suggest the former as primary source given the absence of any predictive power of the latter. However, these findings are based on aggregated continuous dividend information. This introduces bias, given that the dividend payout D for the business year t is of discrete nature and usually announced at the annual general meeting that takes place some time later - in the present context during the following business year $t+1$. Therefore, there is no instantaneous reaction of the dividend growth rate to g i.e. to observable earnings shocks. For example, directly observed unanticipated exogenous discount rate shocks φ_t in business year t, such as for example caused by a natural catastrophe, may lead to instantaneous changes in the market price P_t. This is caused by investors anticipating the associated future reduction in dividend payout. Maintaining the previous dividend growth g for period t as reported in business year $t+1$ would signal to investors that the company was able to absorb the exogenous shock. This could have for example been due to the release of dedicated internal reserve funds, reinsurance arrangements that were unknown to external investors or the fact that the company had not been exposed to the shock. In this case, investors would re-adjust expectations that cause positive returns R_{t+1}. The reported change in the dividend growth rate g in this example would nevertheless be nil. This explains that changes in g are of relevance in contrast to the results by Fama & French (1988) and Fama & French (1989).

6.3.4 Literature review: dividend signalling in insurance operations

An insurance company is able to intentionally signal relevant information to investors by means of dividend payout. Previous findings in the context of insurance include Lee & Forbes (1980), who analyse the relationship between non-life insurance share prices and dividend payout from 1955 to 1975 based on a sample of 34 companies. They focus on the dividend yield as a measure for the realised return on investment for the stock of an insurance company. They find a statistically significant correlation for the sub-period from 1955 to 1968. This relationship nevertheless disappears between 1969 to 1975. Akhigbe et al. (1993) analyse the informational content of 253 dividend increase announcements in the U.S. non-life sector between 1969 and 1991. They confirm positive abnormal returns in the stock price of a company following the announcement of increased dividend payout. Motivated by methodological issues in Akhigbe et al. (1993), Zhong (1999) improves their approach by taking into consideration the lines of insurance business a company was active in. Based on a sample of 161 U.S. insurance companies between 1976 and 1994, the study confirms the occurrence of abnormal returns in the case of increased

dividends. A survey of relevant empirical studies is provided in Baker (2009, p.473 / Table 26.1, p.466). The only study based on non-U.S. data is Reddemann et al. (2010), who utilise aggregated data from insurance sector indices, information on earnings-per-index-share and dividends-per-index-share taken from *Bloomberg Data Services* from 1999 Q1 to 2008 Q4. It is the only study to apply time series methodology. By exclusively focusing on dividend decreases, they conclude that cutting dividends during periods of economic turmoil, in this case the 2007/2008 Financial Crisis, does not have negative effects.

With the exception of Reddemann et al. (2010), results on the relationship between dividends and the share price of an insurance company are empirically associated with periods of relative economic stability. This contrasts with the pronounced cyclicality of the Interwar period. Following previous utilisation in comparable studies, event study methodology[214] is employed to examine the causal relationship between dividends and stock price performance.

6.4 Testing informational content and clientele sentiment

It is hypothesised that investors were using dividend announcements as signals to validate expectations in future dividend payout. In addition, the catering theory of dividends suggests that companies were adjusting dividend payout to the interests of its investor clientele. This would require a positive sentiment towards future dividend increases. In the following, an empirical model is specified first that captures changes in the discount factor as well as in the dividend growth rate. Second, the characteristics of dividend announcements are illustrated. Third, abnormal and cumulative abnormal share price returns are defined as a measure for investor reactions. Fourth, potential results are categorised into different states of clientele sentiment.

6.4.1 Share price and return definition

Following from Equation (6.2) it is assumed that insurance companies can provide new information to financial markets by changing the dividend growth rate g.

Let the monthly cum-ex price of a insurance share $P \in \mathbb{R}_0^+$ of a class $j \in J$ at the counted month $t = m \in T$ with $T = \mathbb{R}^+$ be defined as the discounted present value of future dividends per per-share capital, or

$$P_{j,m} = \frac{1}{\varphi_m} \sum_{m=1}^{T-m} \frac{\mathbb{E}\left[\varphi_{j,m} D_{j,m}\right]}{u_{jm}}, \tag{6.3}$$

where $D_{j,m} \in \mathbb{R}_0^+$ denotes the monetary value of distributed cash dividends, $\varphi_{j,m}$ is the time-dependent

[214] Regarding the use of monthly data, see Brown & Warner (1980) in particular and Henderson (1990) and MacKinlay (1997) in general.

and class-specific discount factor and $u \in \mathbb{R}^+$ the monetary value of paid-in share capital scaled to RM 100. Given that one company can have issued different share classes simultaneously, the identifier variable is the individual share class. The relative change in the share price between months m and $m+1$ defines return $R \in \mathbb{R}$, or

$$R_{j,m} = \ln\left(\frac{P_{j,m+1}}{P_{j,m}}\right), \tag{6.4}$$

, which is assumed to be log-normally distributed.[215] Expected returns are calculated by the so-called market model in accordance with MacKinlay (1997). It is defined as

$$\mathbb{E}\left[R_{j,m}\right] = \beta_0 + \beta_1(R_{A,m}) + \epsilon_{jm}, \tag{6.5}$$

where $R_{A,m} = \ln\left(P_{A,m+1}/P_{A,m}\right)$ is the log-normally distributed market return based on the index return R_A, which is represented by the Berlin stock exchange. For the uncorrelated error termϵ a normal distribution, with $\mathbb{E}\left[\epsilon\right]$, is assumed. The market model does not explicitly consider a risk-free rate. This is appropriate in the present context given that it is not possible to define an risk-free asset that was regarded as an alternative investment opportunity by the investor clientele under consideration.

6.4.2 Dividend announcement definition

A dividend announcement of share class j at time t is denoted by the indicator function $\mathbf{1}_E(D_{j,t})$. It represents the change in the dividend growth rate associated with share class j in month m relative to the previous month $m-1$. The only time a change can occur is the month of the annual general meeting. Three possible types of dividend announcements are defined, i.e. "increase" denoted by $+$, "decrease" denoted by $-$, and no change denoted by 0, so that $E \in [+,-,0]$. Increases occur if the dividend of the current reporting period - where individual months m are associated with the respective reporting periods - is larger relative to the dividend of the previous reporting period, decreases if smaller and no change if equal. The formal definitions are

$$\mathbf{1}_+(D_{j,t}) = \begin{cases} 1 & if\, D_{j,m} > D_{j,m-1} \\ 0 & if\, D_{j,m} \not> D_{j,m-1} \end{cases}$$

$$\mathbf{1}_-(D_{j,t}) = \begin{cases} 1 & if\, D_{j,m} < D_{j,m-1} \\ 0 & if\, D_{j,m} \not< D_{j,m-1} \end{cases}. \tag{6.6}$$

[215] This follows Merton (1973) and Cochrane (2005) and allows to interpret R_h as a percentage change of $P_{j;(m+1)}$ relative to P_{jm}.

$$\mathbf{1}_0(D_{j,t}) = \begin{cases} 1 & if\, D_{j,m} = D_{j,m-1} \\ 0 & if\, D_{j,m} = D_{j,m-1} \end{cases}$$

6.4.3 Classification of normal and abnormal returns

The reaction of investors is measured in terms of abnormal returns $AR_{j,m}$, defined as the percentage difference between the observed return $\hat{R_{jm}}$ in month m and the expected return $\mathbb{E}[R_{jm}]$if no dividend announcement hat been taken place, so that

$$AR_{j,m} = \hat{R_{j,m}} - \mathbb{E}[R_{j,m}|\mathbf{1}_E(\neg D)]. \tag{6.7}$$

$\mathbb{E}[R_{jm}]$ is approximated by integrating over a period without new information, or $\mathbf{1}_E(\neg D) = \mathbf{1}_E(D) = 0$, and is called estimation window. Bootstrap procedures are applied in order to take into consideration the limited number of observations. This is possible due to the basic assumption that returns are log-normally distributed and that no exogenous shocks occur. A minimum of six observations from a nine month period is used to allow for gaps between observations. This means that July 1926 is the earliest announcement date for which it is possible to calculate normal returns. Observations are taken from the period from twelve to three months prior to the announcement, or $m_{est} = \{-12, \ldots, -3\}$. 1,000 bootstrap samples are drawn with replacement from this sample to calculate error bands. The observed return $\hat{R_{jm}}$ is measured within a pre-specified event window, or the period in which new information arrives that is chosen to be $m_{event} \in \{-1, 0, 1\}$. The relatively long interval is chosen to take into account possible early information dissemination prior to the announcement as well as potentially delayed trade activity.[216]It is assumed that abnormal returns occur in the month of the dividend announcement, represented by the annual general meeting. Additionally, the months prior and after are also included since announcements could have be disseminated earlier than the actual annual general meeting - especially if it had been scheduled at the beginning of a month. Averaging over all assets J yields the average abnormal return AAR per event E and month m, or

$$AAR_{E,m} = \frac{1}{J}\left(\sum_{j=1}^{J} AR_{j,m}\right), \tag{6.8}$$

which allows for interpreting the general effect of dividend announcements on share price performance.

In order to test whether abnormal returns are persistent across the whole event window q, cumulative

[216]Throughout the period under consideration, insurance companies especially relied on partly paid-up name shares that required the purchaser to be listed in the company-specific register. This act was necessary to track shareholder liabilities. At the same time, it limited the fungibility of shares, given that a new entry was required for every transaction. German stock exchanges published special "house rules" to ensure fluent trading. The most important German market place in Berlin issued such special regulations for the first time in 1925 in order to regulate, for instance, the liabilities of shareholders who had failed to register appropriately and to speed up the process of registration. See Berman (1930) for a contemporary discussion of this issue and a description of the house rules provided by the Berlin stock exchange.

Table 38: Definition clientele sentiment

Clientele sentiment state		Optimistic	Normal	Pessimistic
Announcement	Variable	Abnormal returns		
Increase	$\mathbf{1}_+(D_{j,t})$	0	+	+
No change	$\mathbf{1}_0(D_{j,t})$	-	0	+
Decrease	$\mathbf{1}_-(D_{j,t})$	-	-	0

Note: Abnormal returns are classified in increases, denoted by "+", decreases, denoted by "-" and no changes, denoted by "0".
Source: See text

average abnormal returns per event E are considered, which are defined as

$$CAAR_E = \sum_q \frac{1}{J} \left(\sum_{j=1}^{J} AR_{j,m} \right). \tag{6.9}$$

The metric allows that abnormal changes can cancel each other out across the full event window.

Two test statistics are used to assess the statistical significance of the measured abnormal returns: first, a parametric test statistic is used as proposed in Boehmer et al. (1991) that uses a standardised definition of variance to control for potential event-induced volatility. Second, the non-parametric Wilcoxon W-test[217] is used to take into account that the calculated average abnormal returns are not necessarily normally distributed, which rules out the use of the standard t-statistic. This Wilcoxon test takes into account the calculated magnitude by ranking observations as well as using the median value as well as the sign of the parameter estimates.

6.4.4 Categorisation of clientele sentiment

Investors are assumed to expect that companies follow long-term dividend strategies as detailed in Ch.4. Only the arrival of previously unexpected information leads to an abnormal price reaction as investors adjust expectations. Under the hypothesis of semi-efficient markets abnormal returns indicate that markets incorporate all publicly available information into the formation of market prices. The characteristics of this change categorise the set of clientele sentiment states $s \in S \in \{1; 2; 0\}$ with $s = 1$ denoting "optimistic", $s = 2$ "pessimistic" and $s = 0$ "normal", which is schematically summarised in Table (38).

The clientele sentiment state "normal" is confirmed by the mentioned studies that analyse data from periods of relative economic stability. It is assumed that investors do not anticipate any changes to dividends. Dividend increases (decreases) are followed by a positive (negative) aggregate price reaction as investors interpret them as an indication for a persistent positive (negative) earnings shock. The clientele sentiment state "optimistic" is based on the assumption that investors expect dividend

[217] The null hypothesis is $H_0 : AAR_{jm} = 0$.

increases. This suggests that the announcement of no change or dividend decrease leads to a negative aggregate price reaction. The clientele sentiment state "pessimistic" is accordingly based on investors anticipating dividend decreases. In this state, the aggregate price reaction is positive in case of both, no change and dividend increase.

6.5 Data

Dataset IV "Share Price" consists of monthly insurance stock market prices as well as the market index of the Berlin stock exchange. The dataset was collected for all relevant German stock exchanges from "Neumanns Zeitschrift für das Versicherungswesen": Berlin, Breslau, Frankfurt, Cologne, Leipzig, Magdeburg, Mannheim, Munich and Stuttgart. For share classes that were traded at different stock exchanges the arithmetic mean was calculated. Price quotations for a total of 64 different shares classes was collected during the chosen period from January 1926 until June 1931. Table (39) provides a general overview over the included exchange markets, companies and associated share classes. The arithmetic mean of the quotation was used in case that the same share class was traded at different exchanges. The starting date was chosen in order to avoid introducing bias from the hyperinflation period up until 1924. Given that the dividend announcements for the year 1925 occurred in 1926, the relative change in dividend payout announced depended not on the year 1924 either. The ending date was attributed to the fact that trading was discontinued at German stock exchanges between 12 July and 2 September as well as between 19 September and 31 December 1931 due to the financial crisis in Germany. The frequency was chosen to be monthly and follows Voth (2003) and Gielen (1994). For the period under consideration both studies use data taken from Reichsamt (1927 - 1932), which is only available monthly.[218] The date of ordinary annual general meetings are interpreted as the date of the dividend announcement. Dates were collected from the announcement section of "Neumanns Zeitschrift für Versicherungswesen" for the period under consideration. 6.02% (24 out of 399) of all possible dates were missing in the source.

The distribution of monthly dividend announcements is provided by Table (40) and illustrated in Figure (9).

6.6 Empirical results

The empirical analysis of model estimates requires an initial examination as to whether results are biased by potential changes in the discount factor. The following part starts by analysing potential market-wide effects on the formation of market prices. This is followed by the discussion of the estimated

[218] This official annual publication also disclosed disaggregated prices but started to include insurance as late as in 1931 and limited itself to the Berlin stock exchange.

Table 39: Stock exchanges, companies and share classes covered by Dataset IV "Share Price"

Name	Share class	*Traded at the stock exchange?*								
		Berlin	Breslau	Frankfurt	Cologne	Leipzig	Magdeburg	Mannheim	Munich	Stuttgart
Aachener - Münchener		Yes			Yes				Yes	
Aachener Rück		Yes			Yes					
Agrippina					Yes					
Albingia	Lit.A	Yes								
Albingia	Lit.B	Yes								
Allianz		Yes		Yes	Yes				Yes	Yes
Allianz Leben		Yes		Yes	Yes				Yes	Yes
Assekuranz-Union	alte	Yes								
Assekuranz-Union	neue	Yes								
Badische Assek.								Yes		
Berliner Hagel	Lit. A	Yes								
Berliner Hagel	Lit. B	Yes								
Berlinische Feuer	alte	Yes								
Berlinische Feuer	neue	Yes								
Colonia Feuer	groß	Yes			Yes					
Colonia Feuer	klein	Yes			Yes					
Colonia Rück	10				Yes					
Continentale								Yes		
Dresdner Allgemein	alte	Yes								
Dresdner Allgemein	junge	Yes								
Frankfurter Allgemeine	alte	Yes		Yes				Yes		
Frankfurter Allgemeine	junge	Yes		Yes				Yes		
Frankfurter Rück	alte			Yes						
Frankfurter Rück	junge			Yes						
Frankona Rück	Lit. A	Yes		Yes				Yes		
Frankona Rück	Lit. D			Yes				Yes		
Gladbacher Feuer		Yes			Yes					
Hermes Kredit	100pc	Yes							Yes	
Hermes Kredit	25pc									
Kölner Lloyd					Yes					
Kölnische Hagel		Yes			Yes					
Kölnische Rück	alte	Yes			Yes					
Kölnische Rück	neue	Yes			Yes					
Leipziger Feuer	I, alte	Yes				Yes				
Leipziger Feuer	I, junge	Yes				Yes				
Leipziger Feuer	II, alte	Yes				Yes				
Leipziger Feuer	II, junge	Yes				Yes				
Leipziger Feuer	III, alte	Yes				Yes				
Leipziger Feuer	III, junge	Yes				Yes				
Magdeburger Feuer	große									
Magdeburger Hagel	alt	Yes					Yes			
Magdeburger Hagel	neu						Yes			
Magdeburger Leben		Yes					Yes			
Magdeburger Rück	alt	Yes					Yes			
Magdeburger Rück	neu	Yes					Yes			
Mannheimer		Yes		Yes				Yes	Yes	
Münchener Rück	alte								Yes	
Münchener Rück	junge								Yes	
National Allgemeine		Yes								
Nordstern Allgemeine		Yes								
Nordstern Leben		Yes								
Rheinisch-Westf. Lloyd		Yes			Yes					
Sächsische VAG	alte	Yes								
Sächsische VAG	neue									
Schlesische Feuer	alte									
Schlesische Feuer	neue	Yes	Yes							
Süddeutsche Rück									Yes	
Thuringia	junge	Yes								
Transaltantische Güter		Yes								
Vaterländische und Rhenania		Yes			Yes					
Victoria Allg.		Yes								
Victoria Feuer		Yes								
Württemberg. Feuer									Yes	Yes
Württemberg. Transport								Yes		Yes

Note: "Neumanns Zeitschrift für Versicherungswesen" provided monthly data until 1927. From this year onwards the source changed its data reporting practice and published weekly data.
Source: Dataset IV "Share Price"

Table 40: Summary statistics dividend announcements 1926 - Jun 1931

Period	Jan 1926 - Jun 1931			Jan1926 - Dec 1926			Jan 1927 - Dec 1927		
	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev
$\mathbf{1}_0(D)$	251	.327	.470	61	.328	.473	62	.258	.441
$\mathbf{1}_+(D)$	251	.442	.497	61	.459	.502	62	.629	.487
$\mathbf{1}_-(D)$	251	.231	.422	61	.213	.413	62	.113	.319
Period	Jan 1928 - Dec 1928			Jan 1929 - Dec 1929			Jan 1930 - Dec 1930		
	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev
$\mathbf{1}_0(D)$	69	.130	.339	58	.259	.442	58	.397	.493
$\mathbf{1}_+(D)$	69	.609	.492	58	.448	.502	58	.086	.283
$\mathbf{1}_-(D)$	69	.261	.442	58	.293	.459	58	.517	.504
Period	Jan 1931 - Jun 1931			Jun 1927 - Jul 1929			Not Jun 1927 - Jul 1929		
	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev
$\mathbf{1}_0(D)$	43	.558	.502	139	.187	.391	212	.382	.487
$\mathbf{1}_+(D)$	43	.349	.482	139	.561	.498	212	.363	.482
$\mathbf{1}_-(D)$	43	.093	.294	139	.252	.436	212	.255	.437

Source: Dataset IV "Share Price"

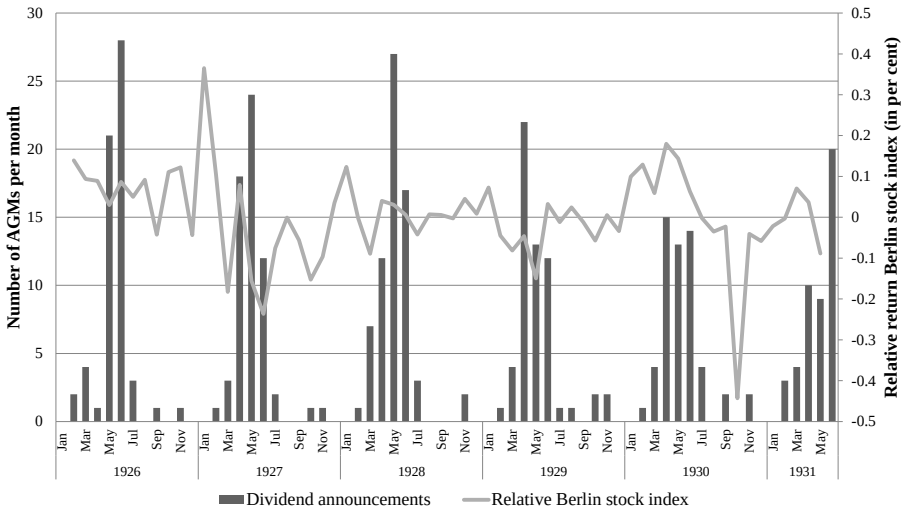
average abnormal returns AAR as well as the cumulative abnormal returns $CAAR$.

6.6.1 Potential bias from discount rate shocks

It is assumed that abnormal returns are independent from potential discount rate shocks. This also integrates over the dynamics of a risk-free rate that is not considered in the present context. There are nevertheless two potential sources for bias: on the one hand, exogenous shocks to the benchmark Berlin stock exchange index could have occurred during overlapping estimation windows. On the other hand, the general decrease in insurance share prices caused by the August 1929 FAVAG crisis could have also affected returns during estimation windows. Figure (11) plots the returns of the index against the histogram of dividend announcements.

It illustrates that the relative Berlin stock index return experienced pronounced variation during the run-up of the May 1927 *Reichsbank* intervention and immediately after. This might introduce bias that the majority of event windows falls in the immediate period surrounding the intervention. Since dividend increases constituted the relative majority of 69% in this year, this might lead to a downward bias in parameter estimates associated with this type of event. The index dropped also substantially during the stock market crash in October 1930. In contrast, only four dividend announcements in October and November 1929 coincided generally with the Wall Stress Crash and the FAVAG crisis. This leads to conclude that dividend increases might experience downward bias.

Figure 11: Frequency of dividend announcements per month and Berlin stock index



Note: Dividend announcements are associated with annual general meetings and provided as per-month count data. The relative return Berlin stock index is the standardised return of the Berlin stock index relative to the previous month.
Source: Dataset IV "Share price"

6.6.2 Results average abnormal returns model

Summary statistics for average abnormal returns are provided in Table (41). The robustness of the model is validated in accordance with Brown & Warner (1980) by analysing potential false-positive results. This refers to occurrences of abnormal returns outside of the event window $q = -1, 0, 1$. False-positive results are defined as months that feature statistically significant results for both, the Z and the W statistic. The only potential false-positive estimate is reported for dividend increases in $m = -2$. This does not bias the overall model, given that the observation is not within the estimation window. It suggests that dividend increases might have been communicated earlier than other announcements. Statistically significant negative abnormal returns are reported for one month after the dividend announcement across all types of announcements. Negative changes after dividend increases can be interpreted as market corrections following purchases in earlier months.

The statistical significance of results first supports the hypothesis that investors used dividends as am indicator. This is shown in all three types of announcements. The results for dividend increases, however, might be biased downward by potential bias from changes in the discount factor. The negative average abnormal returns for no changes and dividend decreases provide evidence for an optimistic clientele sentiment. Negative price reactions imply that investors were adjusting expectations in future dividend payout downwards. The positive abnormal returns in $m = -1$, however, appear to cancel each other out with the negative results in $m = 1$. This motivates the analysis of cumulative average abnormal returns.

Table 41: Average abnormal returns per type of announcement

	Increase				Stable				Decrease			
q	AAR	Z	W	N	AAR	Z	W	N	AAR	Z	W	N
-5	-.003 (.015)	-0.54	1.653	98	.009 (.006)	0.71	1.657	59	-.031 (.015)	-2.44**	-1.828	40
-4	.019 (.015)	0.89	.725	98	.017 (.008)	1.55	2.389**	59	.036 (.026)	1.20	1.048	40
-3	-.011 (.012)	-1.40	-.725	98	.016 (.009)	1.13	1.544	59	-.007 (.010)	-1.21	-.215	40
-2	.026 (.008)	2.61*	2.706**	98	.009 (.012)	0.36	1.612	59	.008 (.017)	0.13	.524	40
-1	.030 (.011)	2.21*	2.826**	98	.007 (.010)	0.24	.525	59	-.049 (.031)	-1.76	-1.465	40
0	.011 (.013)	0.42	1.132	98	-.014 (.009)	-1.97	-1.936	59	-.009 (.013)	-1.06	-1.116	40
1	-.013 (.008)	-2.21*	-2.032*	98	-.029 (.009)	-3.57***	-2.759**	59	-.053 (.016)	-3.69***	-2.930**	40
2	.006 (.008)	.13	.683	96	.001 (.010)	-0.39	-.151	55	.012 (.039)	0.17	-.819	38
3	.006 (.009)	.05	.810	92	-.006 (.012)	-0.88	.187	51	-.080 (.053)	-1.60	-2.309**	36
4	.006 (.013)	.03	-.319	92	-.003 (.009)	-0.92	-.568	43	.002 (.023)	-0.15	.707	36
5	-.003 (.015)	-.54	-.108	89	.007 (.013)	0.13	.229	43	-.001 (.023)	-0.25	.524	35

Note: Standard errors in parentheses.
* p< .05 ** p< .01 *** p< .001
Source: Dataset IV "Share Price"

Table 42: Cumulative average abnormal returns

Event Type	Increase	Stable	Decrease
$CAAR$	.028	-.035	-.110
	(.017)	(.016)	(.043)
Wilcoxon - W	1.805	-2.163**	-2.997**
BMP - Z	19.89***	-10.99***	-9.04***
N	98	59	40

Note: Standard errors in parentheses
* p< .05 ** p< .01 *** p< .001
Source: Dataset IV "Share Price"

6.6.3 Results Cumulative average abnormal returns

The summary statistics of the random variable $CAAR$ are provided in Table (42). It is confirmed that the signs of decreased and stable dividend announcements are significant at a minimum level of 1%. This supports the previous finding that dividends were used as a signal. For dividend increases it is confirmed that positive and negative abnormal returns cancelled each other out. The final $CAAR$ of 2.8($\pm$1.7)% is not statistically significant considering the W-test but significant at the 0.1% level based on the Z-test. This suggests that estimates are due to event-induced variance, which might be caused by the reported bias due to the share price reactions on the May 1927 *Reichsbank* intervention.

The announcement of a constant dividend rate led to an aggregate return of about -3.5($\pm$1.6)% that is statistically significant. Finally, dividend decreases caused a statistically significant pronounced

$CAAR$ of -11.0(±4.3)% as expected. Both findings confirm that clientele sentiment was optimistic during the period under consideration. This supports the assumption that insurance companies were not affected by the May 17 *Reichsbank* intervention, since the target investor clientele continued to react optimistically to company-specific dividend signals.

6.7 Optimistic clientele sentiment during the Golden Twenties

The chapter analysed the observation that German insurance share prices increased after the May 1927 *Reichsbank* intervention to limit speculation during the period from 1926 until summer 1931. This development contrasted with the general decrease in the Berlin stock index and differed from the findings of Voth (2003). Contemporary source material suggested that this spread was due to the fact that a specific wealthy long-term investor clientele was especially active in the trade with insurance shares, which was in line with the catering theory of dividends. On the basis of the Gordon growth model, it was argued that dividend announcement information conveyed relevant information for this particular clientele. In addition, it was questioned as to whether reactions to dividend announcement allowed to make inferences on the clientele sentiment during the Golden Twenties. The chapter applied event study methodology to analyse the reaction of German insurance share price returns on associated dividend announcement information. This was based on a novel dataset hand-collected share price information. It proved the hypothesis that investors interpreted dividend announcements as a relevant signal for valuation purposes. The results was interpreted as an indicator for optimistic clientele sentiment. This confirms the hypothesis that insurance shares were not affected by the May 1927 *Reichsbank* intervention due to its lack of impact on its investor clientele.

The findings of this analysis also relate to the third assumption of the catering theory of dividends that companies were catering to investor expectations especially in periods of increased demand. Discount rate shocks could also occur from endogenous sources, for example due to overall positive market conditions. In the present case, the rally in share prices that occurring in 1926 was driven by a general return to normalisation. The quoted statement in "Neumanns Versicherungszeitschrift" of February 1928 suggested that the observed decrease in the dividend yield led to expectations in future dividend increases. Following on, dividend increases outweighed other forms of announcements until the second discount rate shock, the August 1929 FAVAG default. From this period onwards, the share of dividend increases became smaller. The evidence confirms the observation of Ch.4 that insurance companies were actively catering to dividend expectations during the Golden Twenties.

7 Cost of capital and the German underwriting cycle during the Interwar Period

7.1 The correlation between underwriting and business cycle

A non-life insurance company can be regarded as the sum of different interconnected internal portfolios. Profit and loss cashflows associated with the provision of insurance protection against financial losses arising from the materialisation of uncertain events are collected within underwriting portfolios. A standard common denominator to classify different underwriting portfolios is the type of risk covered. Composite non-life insurance companies conduct business in different lines of insurance business in order to diversify the exposure to individual risk types. In addition, premiums are earned up-front and invested in asset portfolios until being reclaimed. The fluctuations of cashflows in asset portfolio are governed by other market forces than insurance-technical portfolios. Periods of relatively low market prices for insurance risk are colloquially termed "soft markets" and associated with decreased profitability and a higher rate of insolvencies and mergers. In contrast, periods of relatively high market prices are known as "hard markets" and feature sound conditions for profitability and solvency. The stage transition dynamics form the underwriting cycle, which is characterised by an idiosyncratic occurrence that remains an open field of research. Evidence from the Interwar period, for instance, suggests a pronounced effect of the business cycle on insurance-technical cost performance. This was explicitly stated in the 1930/1931 annual report of the then-second largest global reinsurance company *Münchener Rück*.

> The year 1930 was marked by the steadily increasing economic crisis that has experienced its propagation across almost all countries and its catastrophic intensification in the year 1931. In contrast, insurance business development was not unsatisfactory. Insurance has its own cyclicality. General economic conditions certainly do play a role in the production of premiums; revenue and commodity prices influence property insurance, levels of income, the development of life insurance as well as the appetite for insurance in all sectors. However, the fluctuations in business acquisitions are not too substantial in relation to the existing insurance portfolio, especially given that increases in premium income do not immediately represent additional profit due to the associated costs and required reserve depositions. The claims development is much more crucial and it is - exclusively in hail insurance and to a certain degree in transport but also fire insurance - dependent on elements and a number causes, the impact of which is yet unknown. It is nevertheless a fact that the German fire insurance featured a better development in the crisis years 1930 and 1931 than in the more

> beneficial year 1929. In a number of other lines, such as casualty, liability and life insurance - if not considering suicide and fraud - it is not possible at all to find indubitable connections between the claims development and the business cycle. Credit insurance, however, is completely dependent. [219]

One year later the company concluded in its annual report that the negative economic circumstances had indeed led to a positive claims development:

> The beneficial claims development continued in the year 1932 as well; it has to be feared that it will experience a turn-around as soon the economy has been successfully put back on track to a greater degree.[220]

This observation suggests that insurance lines were correlated differently with overall market conditions. This interdependence between underwriting and business cycle was examined by the contemporary dissertation Kurtz (1937). The availability of disaggregated data allows to test the results of this study within a line-specific cost-of-capital framework. This approach allows to aggregate results to analyse the dependence of the market aggregate per-company internal cost of capital on the business cycle.

This chapter contributes to the existing literature a new perspective on the properties of the standard model to calculate cost of capital, the Sharpe-Lintner-Mossin CAPM. It additionally provides the first empirical analysis of an underwriting cycle during a major economic crisis. The current approach is limited in scope by the relatively short period under consideration. The comparative calculation of beta coefficients within the CAPM is not conducted due to the sensitivity of results to the choice of a risk-free interest rate and a market portfolio. There is no generally accepted definition, especially of the former, whilst the latter is potentially biased by the effect of the 1931 Financial Crisis on market prices. In addition, this chapter does not inquire into the causes of underwriting cyclicality, given that the associated econometric examination would require data that are beyond the scope of this dissertation.

[219] (German original, translated by the author:) "Das Jahr 1930 stand unter dem Druck einer ständig zunehmenden Wirtschaftskrise, die im Jahr 1931 ihre Ausbreitung über nahezu sämtliche Länder und ihre katastrophale Verschärfung erfahren hat. Demgegenüber ist das Versicherungsgeschäft nicht unbefriedigend verlaufen. Die Versicherung hat ihre eigene Konjunktur. Wohl spielt in der Prämienproduktion die allgemeine Wirtschaftslage eine Rolle; Umsatz und Warenpreise beeinflussen die Sachversicherung, die Einkommensverhältnisse, die Entwicklung der Lebensversicherung sowie die Versicherungslust in allen Branchen. Indessen sind die Schwankungen des Geschäfts-zuwachses im Verhältnis zum bestehenden Versicherungsstock nicht allzu erheblich, zumal eine Prämienmehrung wegen der mit ihr verbundenen Kosten und Reservestellungen nicht ohne weiteres einen Mehrgewinn bedeutet. Entscheidend ist vielmehr der Schadenverlauf, und dieser ist in der Hagelversicherung ausschließlich, in der Transportversicherung und auch in der Feuerversicherung zu enem wesentlichen Teile von den Elementen und von einer Reihe nach dem Grade ihrer Wirkung noch unerforschter Ursachen bedingt. Tatsache ist jedenfalls, daß die deutsche Feuerversicherung in den Krisenjahren 1930 und 1931 einen wesentlich besseren Verlauf aufweist als in dem wirtschaftlich günstigeren Jahre 1929. In einer Reihe anderer Branchen, wie der Unfall-, Haftpflicht- und Lebensversicherung aber sind, wenn man von Selbstmord und Versicherungsbetrug absieht, unzweifelhafte Zusammenhänge des Schadenverlaufs mit der Konjunktur überhaupt nicht zu finden. Völlig abhängig ist allerdings die Kreditversicherung." See Annual Report 1931 *Münchener Rück*, p.4; see also Gerathewohl (1982, p.798).

[220] (German:) Dieser günstige Schadensverlauf hat auch im Jahr 1932 angehalten; es muss befürchtet werden, daß er in das Gegenteil umschlagen wird, sobald es gelungen sein wird, die Wirtschaft wieder in stärkerem Maße in Gang zu bringen." *Münchener Rück* annual report 1932, p.4. See also Bähr & Kopper (2015, p.139).

The chapter first discusses the contemporary analysis of the underwriting cycle during the Interwar period. Second, the CAPM is introduced and the differences between insurance-technical and financial cost of capital are highlighted. The factor-structure of underwriting returns is shown to provide a relative indicator for the cost-of-capital level. Third, the combined ratio as key performance indicator is aggregated from its components. The new compiled datasets at hand are introduced fourth. Fifth, the results of the empirical analysis are provided, which includes the descriptive discussion of plotted results as well as of calculated correlation coefficients.

7.2 Historical background: the German underwriting cycle during the Interwar period

The experiences made during the Great Depression period motivated contemporary research into the relationship between underwriting performance and economic conditions. In the following, the findings with respect to the U.S. insurance sector are presented. Furthermore, the results of Kurtz (1937), a contemporary doctoral dissertation that analysed the German insurance sector during the Interwar period, is provided.

7.2.1 Quantitative evidence from the U.S. insurance market

This unprecedented effect of the Great Depression on insurance operations was also a topic of particular interest in the United States. The first issue of the *Journal for Risk and Insurance,* for example, published in 1932[221] and titled "The Record of Insurance during the Depression" was dedicated to this issue. It collected the proceedings of a "round table on insurance", jointly held by the *American Economic Association* and the *American Statistical Association.* Presented papers considered investment and underwriting returns of life as well as fire and casualty insurance companies. The basic conclusions are summarised in Table (43).

It was found that companies had aligned their investment strategies to the crisis and focused on low-risk public debt as well as high-quality equity. Kulp (1932) noted that only 5.3% of emergency funds provided by the *Reconstruction Finance Association* had been successfully requested by life insurance companies. This line of insurance was especially successful in providing investment alternatives to savers during the banking crises of the 1930s. Non-life companies, in contrast, were able to offset investment losses with a generally beneficial development in underwriting results. In general, insurance companies experienced a substantial decrease in premium volume together with an increased number of surrenders in the case of life insurance. This was nevertheless partially offset by decreased mortality as well as a

[221] The *American Risk and Insurance Association* was also founded in 1932 under the designation *American Association of University Teachers of Insurance.* See Weiss & Qiu (2008).

Table 43: Key findings in *The Journal of Risk and Insurance* Vol.1 (1932)

	Investment	Underwriting
Life	Substantial shift towards government securities in investment portfolio; life insurers benefited from the relative weakness of banks; only 5.3 % of Reconstruction Finance Association loans provided to insurance companies of all kinds in 1931. (Kulp (1932))	Decreased mortality, but also decreased premium volume; substantial increases experienced in surrenders and lapses. (McCahan (1932))
Non-life	Higher quality of equity held by insurers lead to above-average investment returns, yet realised substantial investment losses due to depressed market values of assets; fire and marine insurers were able to offset investment losses by underwriting profit. (Bowers (1932))	Substantial decrease in premium income, both in fire and casualty lines, which outperformed the decrease in cost and losses. This especially led to only modest (aggregated) underwriting losses for casualty insurance companies. (Michelbacher (1932))

Note: The collective term "non-life insurance" is associated with fire and property / liability insurance companies in the United States.
Source: see table

general reduction in costs on losses in the case of non-life insurance.

7.2.2 Quantitative evidence from the German insurance market

The doctoral dissertation Kurtz (1937) provided a detailed contemporary assessment of German insurance companies in the immediate aftermath of the Great Depression. So far, it has not found consideration in the relevant literature. The conclusions regarding business volume are summarised in Table (44). The study separated lines into three categories indicating the differences in exposure and assumed lines that directly relied on commercial activities to experience a strong correlation to the business cycle. In addition, only credit and hail insurance were considered as negatively correlated, the former due to increased risk aversion of creditors and the latter due an increased risk appetite of farmers. Interestingly, the study argued for a less diverse development in claims incurred, which is provided in Table (45). All lines apart from hail insurance were reported to feature a negative correlation. The analysis by Kurtz (1937) thus confirmed the statements of *Münchener Rück* in 1931 that - with the noted exceptions - the Great Depression period did not immediately cause adverse conditions for insurance companies. The results of the contemporary study motivate to validate the results the underwriting cycle during the Interwar period on the basis of an econometric analysis. In line with Kurtz (1937) it is hypothesised that the Great Depression period did not have an aggregate

Table 44: Effect of business cycle on premium income, Kurtz (1937, p.54)

Proportionality of reaction relative to business cycle	Insurance line	Correlation to business cycle
Strong	Transport (incl. Marine)	Positive
	Credit	Negative
Medium	Hail	Negative
	Liability	Positive
	Motor	Positive
Weak	Fire	Positive
	Accident	Positive
	Burglary	Positive
	Glass	Positive

Note: Health and life insurance are not included.
Source: Kurtz (1937, p.57)

Table 45: Effect of business cycle on claims development

Proportionality of reaction relative business cycle	Insurance line of business	Correlation to business cycle
Significant, yet not necessarily strong	Fire	Negative
	Credit	Negative
	Liability	Negative
	Accident	Negative
Weak	Motor	Negative
	Burglary	Negative
	Glass	Negative
	Transport (incl. Marine)	Negative
None	Hail	None (potential mediate effects such as increased costs incurred due to changes in price level)

Note: Health and life insurance are not included.
Source: Kurtz (1937, p.57)

adverse effect on the underwriting performance.

7.3 The internal cost of capital of non-life insurance operations

This chapter identifies the correlation between the underwriting and the business cycle as an important determinant of insurance cost of capital. It first provides a review of relevant literature and establishes that previous methodological approaches are not an option in the present context. Second, internal insurance cost of capital calculation on the basis of the Sharpe-Lintner-Mossing CAPM is contrasted with the market-consistent valuation of insurance liabilities. This provides important insights into the aggregate performance of insurance companies.

7.3.1 Literature with respect to underwriting and business cycles

Literature reviews focusing on the research of underwriting cycles are provided by Harrington & Niehaus (2001) and Weiss (2007). Whilst there is no single explanation for the occurrence of this phenomenon, one explanation of immediate relevance is the potential effect of general business conditions that is usually approximated by the Gross National Product (GNP). Webb (1992) argues that underwriting cycles do not necessarily have to be perfectly correlated with business cycles and indeed appear to be more regular than the latter. In their analysis of underwriting cycles in 12 developed countries for the period from 1965-1987, Lamm-Tennant & Weiss (1997) find that general economic conditions are a relevant determinant for insurance cycles. In accordance, Grace & Hotchkiss (1995) prove a long-run correlation in the United States for the period 1974-1990, but reject this for shorter periods. Based on data from the period 1970-1995, Chen et al. (1999) confirm that economic growth is the main explanatory variable for the insurance cycles in Japan, Malaysia, Singapore, South Korea and Taiwan. Eling & Luhnen (2009) consider the German non-life insurance market and find a statistically significant effect of GDP on the underwriting cycle for the period 1957 to 2006. The above mentioned studies apply time series methodology to long-run periods and are concerned about the significance of explanatory variables as well as the duration of underwriting cycles. The mentioned studies are based on aggregated data from prolonged periods following World War II. Hence, these studies do not include years of pronounced recessions or even depressions. The relatively short period from 1926 to 1935 rules out the use of advanced time-series methodology in the present context. The availability of disaggregated company data, however, motivates to consider the relevance of the correlation between the underwriting and the business cycle in a corporate financial setting.

7.3.2 The insurance CAPM and insurance-technical returns

The Sharpe-Mossin-Lintner CAPM A standard model for representing the (internal) cost of capital of a company is the Sharpe-Mossin-Lintner Capital Asset Pricing Model (CAPM)[222]. It defines the expectation of insurance returns $\varphi \in \mathbb{R}_0^+$ as

$$\mathbb{E}[\varphi] = r + \beta (r_m + r), \tag{7.1}$$

where $r \in \mathbb{R}_0^+$ is the risk-free return on an alternative investment opportunity, $r_m \in \mathbb{R}_0^+$ the return on a market portfolio and $\beta \in [-1;1] = Cov[\varphi r_m,]/\sigma_m^2$ the beta factor representing systematic risk. In order to take into account the fact that insurance companies consist of different underwriting portfolios (alternatively: different exposures to insurance lines), Cummins & Phillips (2005) use per-line full-information industry data so that

$$\beta = \sum_j^J \beta_j \omega_j + \nu,$$

where associated portfolio weights are denoted by $w_l \in \mathbb{R}_0^+$ for lines $l \in L$ and ν is an error term.

An alternative representation of the Sharpe-Mossin-Lintner CAPM considers the Sharpe ratio or expected market price of risk, $\mathbb{E}[\lambda_\varphi] = (\mathbb{E}[\varphi] - r)/\sigma_\varphi$, which measures the return relative to a unit of standard deviation and represents the market price of risk. The model is rearranged to

$$\mathbb{E}[\lambda_\varphi] = \varrho_{\varphi m} \lambda_m, \tag{7.2}$$

where $\varrho_{\varphi m}$ denotes the correlation between the insurance company and the financial market. Any moments higher than the second are not considered in this model.[223] The returns of the market portfolio are usually constructed from a financial benchmark, such as a stock market index. This definition does not take into account that an insurance company is an aggregated collection of different financial and insurance-technical operations. The expected cost of capital therefore needs to consider both the investment and underwriting portfolios of the company. Whilst volatility of the former can be put into relation with financial benchmark returns, it is questionable whether this is appropriate for the latter.

A straightforward problem that features the same issue is the market-consistent valuation of insurance liabilities, see Wüthrich et al. (2010) and Wüthrich & Merz (2013). Given that insurance protection is not traded at secondary financial markets - disregarding the reinsurance market - there are

[222] Cummins (1990) and Bauer et al. (2013) provide overviews over different financial pricing methods in an insurance-related setting.

[223] This is problematic in the context of insurance cashflows, which are not necessarily log-normal. The so-called Wang transform by Wang (2002) takes this into account.

no directly observable market price quotations. If, for example, an insurance company is to be taken over, the calculation of its fair value also has to take into account the individual future cashflows arising from investment as well as insurance-technical operations. There is nevertheless a close relationship, given that investment returns are also generated from insurance-technical reserve funds.

Decomposing insurance cost of capital Let the probability space be defined as $(\Omega, \mathcal{F}, \mathbb{P}, \mathbb{F})$. The expectation of the cost of capital φ is redefined accordingly into a product structure, or

$$\mathbb{E}_t \left[\varphi | \mathcal{F}_t\right] = \mathbb{E}_t \left[\varphi^A | \mathcal{A}_t\right] \times \mathbb{E}_t \left[\varphi^T | \mathcal{T}_t\right], \tag{7.3}$$

where the cost of capital φ is defined by a financial discount factor $\varphi^A \in \mathbb{R}_0^+$ that explains the price formation at financial markets.[224] The insurance-technical density process $\varphi^T \in \mathbb{R}_0^+$ with $\varphi^T \equiv 1$ denotes a probability distortion that represents loadings for non-hedgeable insurance-technical risks. Both components are adapted to two specific information sets, or sigma fields, that capture insurance-technical as well as financial information. Let the former be denoted by the filtration set $\mathbb{T} = (\mathcal{T}_t)_{t \in T}$, which contains all relevant insurance-technical information and is based on the real-world probability measure. The latter is represented by the filtration set $\mathbb{A} = (\mathcal{A}_t)_{t \in T}$, which contains all relevant financial information. It is based on the risk-neutral probability measure.[225] Following Wüthrich & Merz (2013, p.163), it is assumed that both filtrations are absorbed by the set of all relevant economic information$\mathbb{F} = (\mathcal{F}_t)_{t \in T}$, so that

$$\mathcal{F}_t \subset \mathcal{A}_{s+1}$$

and

$$\mathcal{F}_s \subset \mathcal{T}_{s+1}.$$

This indicates that $\mathcal{A}_t$ and $\mathcal{T}_t$ are independent but conditionally given by $\mathcal{F}_{t-1}$ for all $t \in T$. This is Assumption 6.8 in Wüthrich & Merz (2013, Formula (6.13), p.164):

$$\begin{array}{ccccccc} & \nearrow & \mathcal{A}_t & & \nearrow & \mathcal{A}_{t+1} & & \nearrow & \dots \\ \mathcal{F}_{t-1} & & & \mathcal{F}_t & & & \mathcal{F}_{t+1} & & \\ & \searrow & \mathcal{T}_t & & \searrow & \mathcal{T}_{t+1} & & \searrow & \dots \end{array}.$$

[224] See Wüthrich & Merz (2013, p.165, Eq.(6.14)).
[225] Compare the discussion of probability measures in the context of insurance in Mildenhall (2000).

In other words, the ex-post reported cost of capital of a non-life insurance company can be separated in costs associated with financial investments and those associated with insurance operations. Future realisations nevertheless depend on the full set of information that takes into account both financial as well as insurance-technical information. The components can only be analysed from an ex-post perspective. Wüthrich & Merz (2013, p.164) give as an example the impact of an insurance-technical event, such as a catastrophe, on financial prices. This can nevertheless also work in the opposite direction. A substantial increase in financial prices might as well affect insurance-technical performance. Insurance companies can for example engage in so-called "cashflow underwriting" during financial boom periods. This involves the maximising the volume of premiums earned for investment purposes with the intention to refinance associated insurance-technical losses with generated asset returns. This underlines the relevance of the business cycle especially during the Golden Twenties and the Great Depression period.

Analysing the correlation of underwriting and business cycle Non-life insurance companies can be active in more than one line of insurance business. This means that the aggregate probability distortion is itself the average of individual per-line distortions with associated portfolio weights w_l and line-specific filtrations, or

$$\varphi^T = \frac{1}{L}\sum_{l=1}^{L} w_l \mathbb{E}\left[\varphi_l^T | \mathcal{T}_{lt}\right].$$

There is no generally accepted definition of the insurance-technical probability distortion $\varphi^T \in \mathbb{R}_0^+$ and the associated filtration set $\mathbb{T} = (\mathcal{T}_t)_{t\in T}$. In the present context the former is chosen to be the so-called combined ratio, which is an indicator of the costs associated with insurance operations. In accordance, $\mathbb{T}$ is chosen to contain all data relevant for the definition of the φ^T.[226] This motivates the use of the general economic performance as a benchmark for the economic information set $\mathbb{F}$. It is assumed that financial information are correlated with the general economy, which allows to focus on the insurance-technical performance and its correlation with the business cycle given that

$$\mathbb{E}_t\left[\lambda_\varphi^T | \mathcal{T}_t\right] = \varrho^T \mathbb{E}_t\left[\mathbb{E}_t\left[\lambda_m | \mathcal{A}_t\right] \mathcal{F}_t\right] \tag{7.4}$$

due to the law of iterated expectations. The insurance-technical correlation coefficient ϱ^T is therefore in itself an immediate indicator for relative required loadings. It is assumed that increased (decreased) relative correlation indicates increased (decreased) internal insurance-technical cost of capital. This motivates the following empirical analysis of market conditions in the German insurance sector. Different

[226]The definition deviates from the one of Wüthrich & Merz (2013, p.160), where it is interpreted as "more detailed information on the level that it provides a regulatory solvency model which contains all insurance technical information available to the supervisor." The present choice can be regarded as a sub-set of this more general definition.

per-market and per-line indicators for insurance-technical performance are used that allow comparisons with the results provided by Kurtz (1937).

7.4 The interdependence of business and underwriting cycle

The following econometric analysis considers aggregate market information on the basis of the market median value, is necessary to avoid potential bias introduced by outliers. This implies that the correlation is defined in the following on the basis of a deterministic trend model of the underwriting cycle. The company-specific correlation coefficient is thus defined as

$$\hat{\varrho_{it}^{T}} = \mathbb{E}\left[\phi_M | \mathcal{F}_t\right] + \eta_i,$$

where $\phi \in [-1, 1]$ denotes the deterministic median trend adapted to the economic information set F and η_i a company specific error term with $\mathbb{E}\left[\eta_i\right] = 0$. The following analysis addresses the deterministic trend component.

The basic key performance indicator for insurance operations is the so-called combined ratio, calculated per company and per year. Disaggregating the combined ratio allows to measure different market-wide insurance performances on different levels of aggregation. This approach is followed in the empirical analysis of the correlation between the business cycle and individual insurance measures, which sum up to the combined ratio as main indicator. Market-wide aggregates are formed by using the median value in order to avoid bias from outliers. Cashflows from net premium income as well as from losses incurred are observable from annual profit and loss statements on a per-company as well as a per-line of insurance business level. Given that the combined ratio was not used by contemporary practitioners, potential bias from managers smoothing associated information can be assumed as absent.[227] Company-specific market aggregates are defined as simple sums across all companies, or

$$Net\,Premium\,Income_N = \sum_{i=1}^{N} Net\,Premium\,Income_i \tag{7.5}$$

and respectively

$$Losses\,Incurred_N = \sum_{i=1}^{N} Losses\,Incurred_N. \tag{7.6}$$

Line-specific aggregate information is constructed in accordance. Putting both cashflows into relation forms the ratio of losses incurred after reinsurance per unit of net premum income. It represents the

[227] See Harrington & Niehaus (2001, p.652) and, more generally, Cummins & Outreville (1987).

cost associated with insurance claims. The company-specific loss ratio is therefore defined as

$$Loss\,Ratio_i = \frac{\sum_{l=1}^{L} Losses\,Incurred_{il}}{\sum_{l=1}^{L} Net\,Premiums\,Earned_{il}}. \tag{7.7}$$

Given that regulated companies were required to disaggregate premium and claims information per line of insurance business, it is possible to form line-specific market aggregates. Line-specific aggregate loss ratios are formed by summing over disaggregate line-specific information, so that

$$Loss\,Ratio_l = MEDIAN\left[\frac{\sum_{i=1}^{N} Losses\,Incurred_{il}}{\sum_{i=1}^{N} Net\,Premiums\,Earned_{il}}\right]. \tag{7.8}$$

This is used as a proxy to measure the correlation of individual insurance lines with the business cycle. The aggregate company-specific alternative follows as

$$Loss\,Ratio_N = MEDIAN\left[\frac{\sum_{i=1}^{N} Losses\,Incurred_{i}}{\sum_{i=1}^{N} Net\,Premiums\,Earned_{i}}\right]. \tag{7.9}$$

Operational expenses are usually reported on the firm-level instead of the portfolio level. This also includes commissions to insurance brokers or reinsurance companies. The ratio of operational expenses incurred per unit of total net premium income is represented by the cost ratio. Its market-wide aggregate is defined as

$$Expense\,Ratio_N = MEDIAN\left[\sum_{i=1}^{N} \frac{Operational\,Expenses_i}{\sum_{l=1}^{L} Net\,Premiums\,Earned_{il}}\right]. \tag{7.10}$$

The combined ratio is a key performance indicator that measures the amount of losses and cost incurred per unit of net premium income on a per-company level. It is the sum of the aggregate company-specific Expense Ratio and the aggregate company-specific Loss Ratio and is defined as

$$Combined\,Ratio_i \quad = \quad Expense\,Ratio_i + Loss\,Ratio_i, \tag{7.11}$$

where $i \in N$ is the company indicator and $l \in L$ the indicator for the individual line of insurance business. The market aggregate is

$$Combined\,Ratio_N \quad = \quad MEDIAN\left[\sum_{i=1}^{N} \frac{Cost_i + \sum_{l=1}^{L} Losses\,Incurred_{il}}{\sum_{l=1}^{L} Net\,Premiums\,Earned_{il}}\right].$$

Table 46: Summary statistics Dataset II "Company"

Variable	Unit	Obs	Mean	Med	Std Dev	Min	Max
Foundation	year	1,700	1887	1895	34.9	1781	1935
Organisational form	*binary*	1,705	.72	1.00	.45	0	1
Income							
Gross premiums earned	1,000 RM	1,705	7,857	2,076	21,746	0	248,549
Net premiums earned	1,000 RM	1,704	4,657	1,251	15,780	0	205,829
Interest earned	1,000 RM	1,704	322	73	1,175	0	16,734
Expenses							
Losses incurred	1,000 RM	1,705	2,060	534	6,144	-102	80,560
Cost	1,000 RM	1,704	1,778	434	6,002	-59	80,347
Dividends	1,000 RM	1,670	91	11	251	0	2,580
Assets							
Equity	1,000 RM	1,671	2,384	1,000	5,292	0	60,000
Paid-in Equity	1,000 RM	1,675	1,915	600	4,186	0	42,648
Surplus	1,000 RM	1,339	9,350		29,301	0	326,081
Total Asset Value	1,000 RM	1,704	10,470		35,133	0	486,909
Cash and Cash Equivalents	1,000 RM	1,704	884		1,897	0	41,110

Note: RM = Reichsmark. Standard deviation omitted for binary variables. Negative expenses imply reinsurance transfer refunds. Losses paid are net of losses reserved of the previous year.
Source: Dataset II "Company"

7.5 Data

Datasets II "Company" and III "Line" provide the foundation of contemporary data for this analysis. In addition, quantitative information with respect to the overall German business cycle is used in the following empirical analysis.

7.5.1 Dataset II "Company"

Dataset II "Company" provides company-specific information taken from P&L statements as well as balance sheet information. It covers an unbalanced panel data of a total of 242 German private non-life insurance companies for the period between 1926 to 1935. Summary statistics are provided in Table (46).

Table 47: Summary statistics, Dataset III "Line"

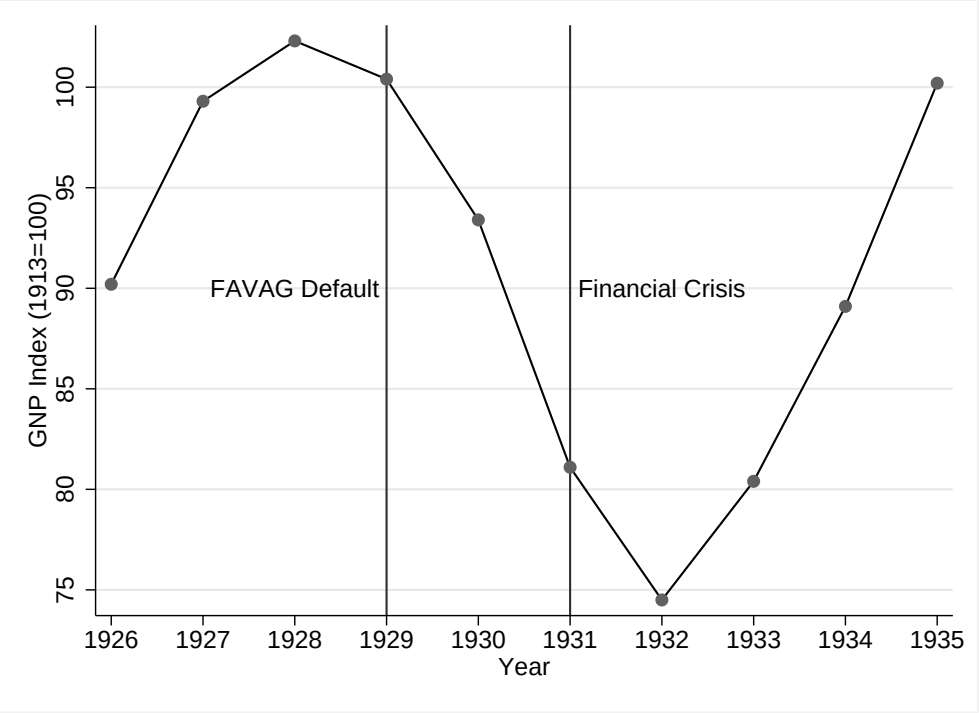
Variable		Unit	Obs	Mean	Med	Std Dev	Min	Max
Accident	Net Premium Income	RM	482	799	270	2,050	0	16,366
	Claims paid	RM	482	643	161	1,634	0	15,245
	Relative share	%	1,704	.028	0	.779	0	.91
Burglary	Net Premium Income	RM	553	329	153	624	0	5,335
	Claims paid	RM	553	2,248	43	210	-80	2,248
	Relative share	%	1,704	.023	0	.052	0	.50
Credit	Net Premium Income	RM	90	799	75	1,305	0	4,645
	Claims paid	RM	90	1,008	53	1,994	-50	9,745
	Relative share	%	1,704	.015	0	.122	0	1
Fire	Net Premium Income	RM	639	2,269	1,269	3,353	0	25,327
	Claims paid	RM	639	971	464	1,473	-8	11,880
	Relative share	%	1,704	.240	0	.360	0	1.27
Glass	Net Premium Income	RM	282	384	195	580	0	2,958
	Claims paid	RM	282	164	72	253	0	1,125
	Relative share	%	1,704	.028	0	.149	0	1
Liability	Net Premium Income	RM	517	1,330	482	3,656	0	30,782
	Claims paid	RM	517	1,278	488	2,749	0	23,262
	Relative share	%	1,704	.099	0	.233	0	1
Motor*	Net Premium Income	RM	405	471	169	954	-1	6.504
	Claims paid	RM	361	264	73	576	0	2,248
	Relative share	%	1,359	.314	0	.123	0	2.074
Transport	Net Premium Income	RM	621	1,171	409	1,982	0	1
	Claims paid	RM	621	1,072	322	2,281	-22	23,154
	Relative share	%	1,704	.172	0	.330	0	1
Hail	Net Premium Income	RM	158	2,185	1,110	4,223	0	29,970
	Claims paid	RM	158	1,586	504	3,686	0	27,102
	Relative share	%			*See comments*			

Note: Summary statistics of Reichsmark-denominated variables are conditional on the fact that a company was active in the respective line. Values in RM rounded to the next full digit. * indicates that values are omitted for the years 1926 and 1935 due to methodological reasons.
Source: Dataset III "Line"

7.5.2 Dataset III "Line"

The second dataset, Dataset III "Line", provides information for the following company-specific line of business activities: accident, burglary, credit, fire, glass, hail, liability, motor and transport insurance. Summary statistics are provided in Table (47). Reinsurance is omitted due to the changes in reporting standards in 1931. Livestock, life and health insurance as well as smaller specialist lines are not considered. Within the source, 1926 information for motor insurance was aggregated with reinsurance and is thus not comparable to later years. For the year 1935, net premiums earned and claims paid in motor insurance are aggregated with liability and accident insurance. Motor insurance is thus omitted for the years 1926 and 1935. Information on hail insurance was not published in disaggregated form but taken from aggregate information of companies registered as operating in hail insurance. The

Figure 12: GNP index Germany



Source: Ritschl & Spoerer (1997, Table A.1, pp.53/54)

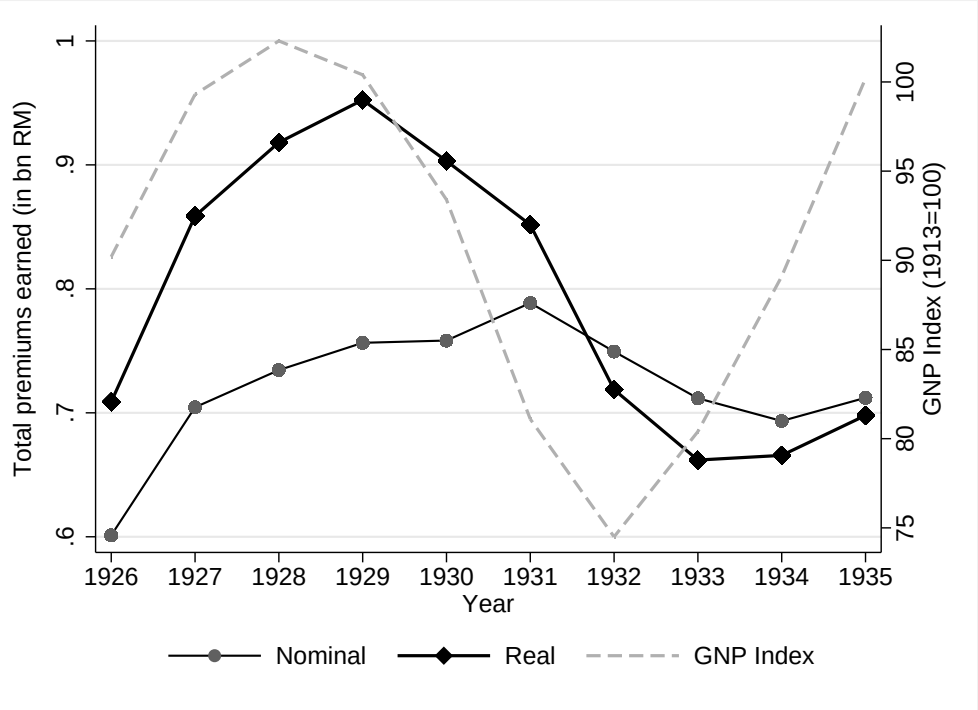
maximum motor insurance share of 2.074 is an outlier. The respective company, *Kraft,* was a specialised motor, accident and liability insurer that was a full subsidiary of *Allianz*. This company seems to have undergone a substantial restructuring process between the years 1934 and 1935, which might have included changes in the declaration of results. The maximum fire share of 1.266 is associated with a mutual fire insurance company, *Schwerdtfeger Brandgilde*, which reported RM 138,000 net premium income in fire insurance in 1927, but only a total net premium income of RM 109,000 for reasons unknown.

7.5.3 Business cycle information

In order to consider the effect of deflation on absolute Reichsmark values, 1913 prices are used as provided in Bundesbank (1976, Tab. A.1.02). The indexed real gross national product (GNP) of Germany is used to represent the business cycle. Data is taken from Ritschl & Spoerer (1997, Table A.1, pp.53/54) and presented in Figure (12). The period under consideration features a pronounced business cycle. Two events of particular relevance to the insurance sector were the FAVAG default in 1929 and the financial crisis of 1931. The years from 1931 to 1933 are defined as the period of the Great Depression in Germany and the subsequent years 1934 and 1935 as recovery period.[228]

[228] Compare Ritschl (2002).

Figure 13: Total net premium volume



Source: Dataset III "Line", Ritschl & Spoerer (1997, Table A.1, pp.53/54)

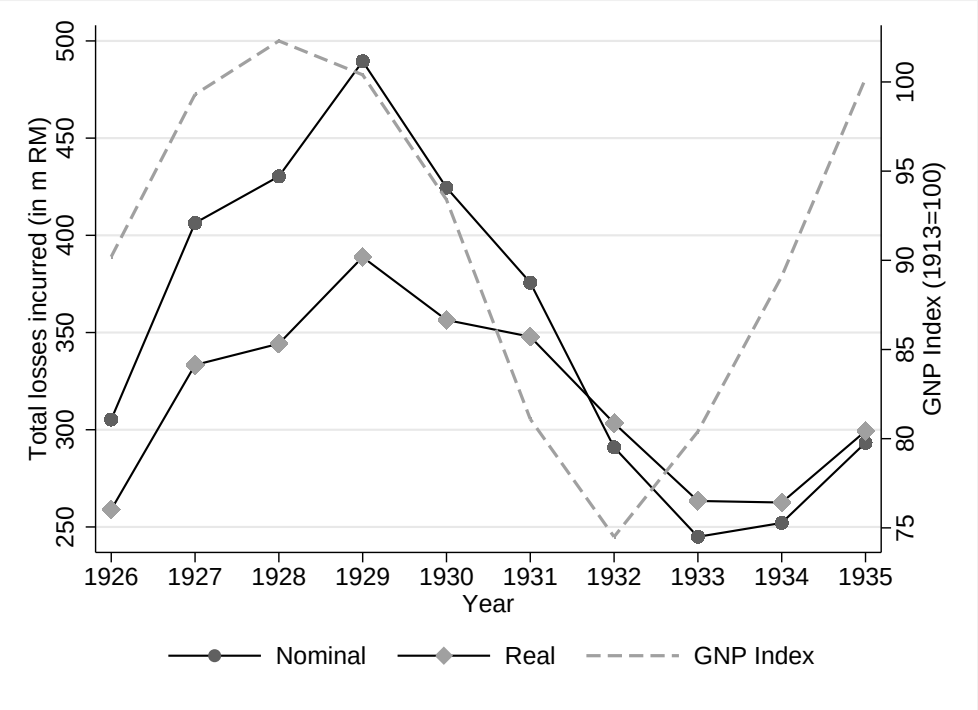
7.6 Empirical analysis of underwriting and business cycle correlation

The following empirical analysis first provides a description of the individual market-wide indicators. Second, correlation estimates are provided and compared against results obtained from Kurtz (1937).

7.6.1 Descriptive results

Net premiums earned Aggregate nominal net premiums experienced a pronounced cyclicality between the years 1926 and 1935, which is shown in Figure (13). Having peaked at approximately RM 950 million, total net premiums earned decreased to about RM 662 million before recovery started following 1933. It is interesting to note that the rapid decrease in net premium volume did not start between 1928 and 1929, but after 1929 - the year FAVAG defaulted - and accelerated until 1933. Comparing nominal and real net premium volume expressed in Goldmark with the purchasing power of 1913 shows that the latter was far less volatile. This is explained by the fact that financial conditions expressed in insurance contracts are usually quoted in nominal terms. The currency deflation starting in 1931 had the effect that its effect on the premium income during the Great Depression period served as a natural hedge against the economic turmoil of the 1930s. Nominal net premium income furthermore featured a stronger correlation with (real) GNP.

Figure 14: Aggregate losses incurred

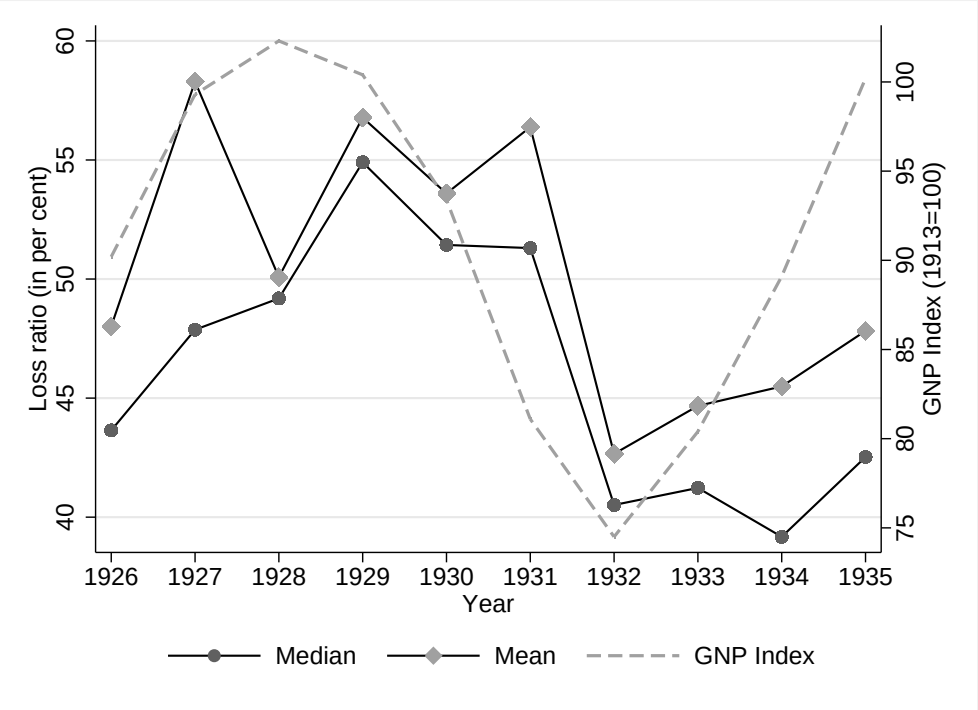


Source: Dataset II "Company", Ritschl & Spoerer (1997, Table A.1, pp.53/54)

Net losses incurred Whilst the volume of premium income depends on the business strategy an insurance company follows, it has no direct influence on the amount of claims net of reinsurance that arise from its liability to existing insurance contracts. Figure (14) indicates that total losses incurred net of reinsurance experienced a strong increase until 1929, followed by a decline during the crisis period 1931-1933. The local minimum was reached in 1933 followed by a recovery for the years 1934 and 1935. Contrasting nominal with real values illustrates the effect of the deflation on insurance companies. The real value became relatively more expensive in 1932 when the overall net premium volume was the lowest of the period. This suggests that the devaluation of the currency did not lead to substantial problems due to the beneficial claims development of the crisis years. The change in trend, however, happened in both cases after 1929, the year of the FAVAG default.

Line-specific loss ratio Aggregate and line-specific loss ratios illustrate the overall effect of the business cycle on the underwriting performance of German insurance companies. Figure (15) shows the effect of outliers on the mean aggregate loss ratio. This supports the decision to use the median instead of the mean. In addition, the aggregated loss ratio reached its maximum of 56% in 1929, the year of the FAVAG default. It decreased substantially between 1931 and 1932 and dropped below 40% in 1934, but recovered subsequently. This suggests a correlation with the business cycle.

Figure 15: Aggregate loss ratio



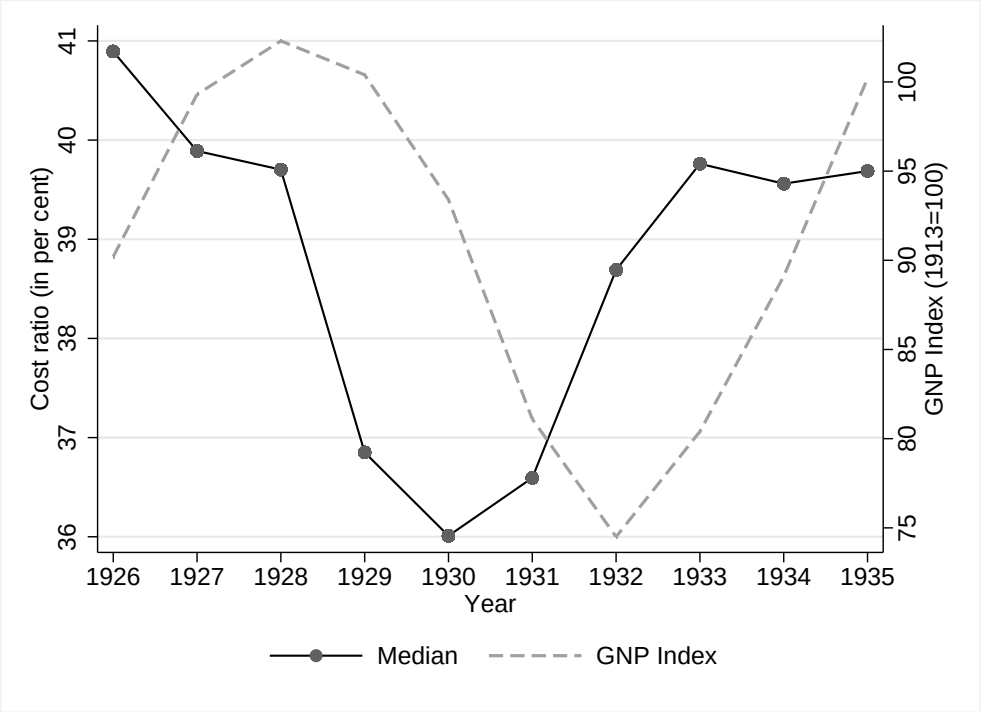
Source: Dataset III "Line", Ritschl & Spoerer (1997, Table A.1, pp.53/54)

Company-specific expense ratio Figure (16) indicates a persistent expense ratio of approximately 39% before 1929 and after 1932. The abrupt decrease to less than 37% from 1928 to 1929 was followed by a slow but gradual increase until 1935. This indicates that insurance operations became relatively cheaper during the crisis years. Unfortunately, it is not possible to directly measure the share of provisions in total operating expenses. One possible explanation for this particular development might have been changes in the reinsurance price. Assuming that reinsurance prices were low during the 1920s, companies decided to buy more reinsurance protection. Increasing prices in the 1930s were matched by a proportional decrease in demand.[229]

Combined ratio The per-year median development of the aggregate combined ratio is shown in Figure (17). It indicates that German non-life insurance operations remained relatively expensive until 1931. The initial 1928 recession as well as the FAVAG crisis had little impact on the combined ratio due to the development of the expense ratio. The trend reversed sharply in 1931 and started to slowly increase back to 89% until 1935. This suggests that, overall, underwriting returns were low for the economic boom of Golden Twenties and high for economic crisis of the Great Depression.

[229]This hypothesis will not be followed up since reinsurance prices are unobserved.

Figure 16: Median Expense Ratio



Source: Dataset II "Company", Ritschl & Spoerer (1997, Table A.1, pp.53/54)

Figure 17: Median combined ratio

Source: Dataset II "Company", Ritschl & Spoerer (1997, Table A.1, pp.53/54)

Table 48: Line-specific correlation

Correlation with (stylised) business cycle	Net Premium income	Losses incurred	Loss Ratio
Accident	.468	-.020	-.180
Burglary	.236	-.325	-.623
Credit	**.663**	**.177**	-.556
Fire	.552	**.414**	.139
Glass	.322	**.350**	.157
Liability	.147	.270	-.213
Motor	.040	**.158**	.274
Transport	.703	**.601**	-.204
Hail	**.412**	**.526**	.490
Aggregate	.619	.637	.458

Note: Differences to Kurtz (1937) are indicated in bold.
Source: Dataset III "Line"

7.6.2 Empirical results

Table (48) provides correlation coefficients for market data on net premium income, losses incurred and line-specific loss ratios. The results for the net premium income are generally consistent with the findings of Kurtz (1937). The only differences are found for credit and hail insurance. The pro-cyclicality of the former is consistent with the assumption that credit insurance depended on general trade activities. Information on the latter, however, is problematic, given that the occurrence of insured events was not related to the general economy. The correlation coefficients need to be interpreted as spurious and are not supported by theory. In general, however, premium income was positively correlated with the business cycle. With respect to losses incurred, results were generally not negatively correlated as suggested by Kurtz (1937). With the exception of transport and hail insurance - the former being also dependent on trade activity and the latter subject to exogenous weather conditions - the magnitude was overall relatively small.

Correlation of the underwriting cycle with the line-specific loss ratio needs to be interpreted as a pro-cyclical development of cots. The estimates find negative correlations for accident, burglary, credit, liability and transport insurance. Positive correlations are found for fire, glass and motor insurance.

Table (49) provides results for aggregate indicators on the per-company level; there are no benchmark results from Kurtz (1937). It shows that the cost ratio displayed only little correlation with the business cycle. Aggregate insurance cost of capital was more strongly correlated with the business cycle. This indicates that the insurance-technical loading was largest in relative terms during the Golden Twenties and decreased with deteriorating business conditions. The reported correlation coefficient is relatively large in comparison to line-specific results. This is due to relatively large portfolio weights for the

Table 49: Correlation of key performance measures

Ratio	Correlation with GNP	
Cost Ratio	None	.087
Combined Ratio	Positive	.766

Source: Dataset II "Company"

pro-cyclical fire and transport insurance lines. This overall finding of pro-cyclical insurance costs is consistent with the observations expressed in the 1931/1932 annual report of *Münchener Rück*.

7.7 Underwriting profitability and the business cycle

The present chapter has provided an estimate for the internal cost of capital rate of German non-life insurance companies during the Interwar period. It was argued that the market price for insurance risk depends on both financial as and insurance-technical aspects, which are not directly separable. The latter directly affect the aggregate cost level and thus qualify as indicators for the internal cost performance. This allowed to interpret the correlation between the underwriting and the business cycle as an indicator for an insurance-technical relative cost loading per line as well as for the aggregated insurance market. The results were compared against contemporary results provided by the dissertation Kurtz (1937).

It was shown that total net premium income generally decreased with deteriorating macroeconomic conditions as suggested by Kurtz (1937). The results for aggregate claim payments showed differences in their perceived relationship with the business cycle. Line-specific aggregate loss ratios indicated pronounced differences, with lines depending on economic activities generally indicating pro-cyclical patterns of profitability. An important exception was the largest German insurance line, fire insurance. This helped to explain why the aggregate company-specific insurance-technical loading showed a clear correlation of costs with the business cycle. Generally, German insurance companies were least profitable during the economic boom period of the 1920s and most profitable during the crisis years of the Great Depression.

8 Conclusion: endogenous risk in non-life insurance

Endogenous risk in the German insurance sector during the Interwar period

It follows from the individual findings of this dissertation that insurance companies shifted discontinuation risk from shareholders to policyholders by catering dividend payout to meet investor clientele expectations. Ch.2 identified concerns with respect to the reputation of a company as a potential motivation. Ch.3 indicated that companies with a better reputation - represented by the franchise value associated with being founded prior to 1914 - were less likely to be discontinued by shareholders. This highlighted the close relationship between franchise value as the perception of and the expectations in a company by the market. This chapter established the relevance of voluntary discontinuation as a real risk for companies.

Ch.4 analysed the relationship between the company earnings performance and the dividend payout strategies of non-life insurance companies. It identified the Golden Twenties period as in particular characterised by companies targeting increased dividend payout ratios. This was understood as an indicator for active risk shifting by distributing internal funds to shareholders. That the sub-period coinceded with an increased level of company discontinuations provides further support.

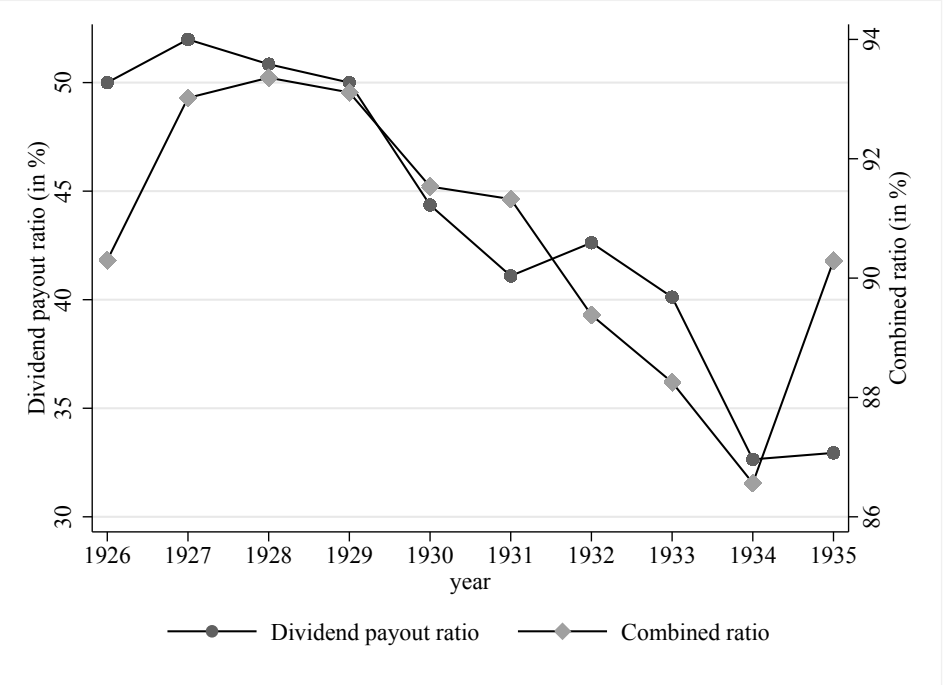
Also during the Golden Twenties period, Ch.5 found that private joint-stock companies were featuring increased demand for reinsurance relative to mutual insurers as well as own demand during the Great Depression period. This also pointed towards the use of reinsurance as leverage in order to increase the distributable income. It was also suggested that specialised reinsurance companies were demanding overall less reinsurance or retrocession during the Interwar period. This was consistent with the finding of Ch.3 that these unregulated companies faced the highest default risk.

From the perspective of investors, the years prior to the 1931 Financial Crisis were identified as a period of optimistic market expectations by Ch.6. It was shown that a specific clientele of wealthy long-term investors were on aggregate selling company shares if the company had failed to announce dividend increases. This was consistent with the observation of increased company discontinuations during the Interwar period, which can also be regarded as the interest of shareholders investments.

Ch.7 demonstrated that investor expectations were not in line with the actual insurance-technical profitability of companies. Figure (18) shows that the dividend payout ratio was relatively high (low) when the combined ratio was also high (low). This comovement was solely based on the fact that insurance companies catered to relatively higher investor expectations during the Golden Twenties. Following a decrease in the latter after the 1929 FAVAG default due to endogenous causes, the dividend payout ratio decreased in accordance.

This leads to the final conclusion that the increased dividend payments had to be provided for by

Figure 18: Comparison dividend payout ratio and combined ratio, 1926 to 1935



Note: The dividend payout ratio is the amount of dividends paid per unit of net earnings income and the combined ratio is the sum of costs associated with claims and expenses per unit of net premium income.
Source: Dataset II "Company", Dataset III "Line"

shifting risk, given that the internal earnings performance did not provide sufficient funds to refinance the associated cash expenses. The case study of *Kölnische Rück* provides a historical example of how the market pressures during the 1920s finally culminated in the 1930s without being rooted in the simultaneous Great Depression.

A generalised representation of endogenous risk

Apart providing empirical evidence the presence of endogenous risk in the German insurance sector during the Interwar period, the theoretical considerations of the individual chapters offer the framework to derive endogenous risk from established models of finance and actuarial science.

Endogenous risk is created by shocks or changes within the financial markets. This is represented by transitions in the states of the world denoted by $s \in S \in \{1, 2, (0)\}$. During the Interwar period the states $s = 1$ represented the prosperous conditions during the Golden Twenties and $s = 2$ the crisis conditions associated with the Great Depression. Ch.5 provided a mapping of these on the stochastic returns of alternative investment opportunities. With respect to the valuation of individual insurance companies, Ch.6 showed that the Gordon growth model provided a suitable foundation that reflected how investors valued insurance shares. Its time-dependent definition by Equation (6.2) is identical to the state-dependent definition by Equation (5.2) via Equation (3.8), where the latter is given as

$$V(s) = \frac{1}{\nu(s,\alpha)}\mathbb{E}[D].$$

under the assumption of the probability space $(\Omega, \mathbb{P}, \mathbb{F})$. The state price density $\nu(s,\alpha)$ was assumed to depend on the state of the world s as well as the risk aversion of the company denoted by α as per Equation (5.3) or

$$\nu(s,\alpha) = \varphi(s) - g(\alpha),$$

where $\varphi(s)$ denotes the state-dependent company-specific discount factor and $g(\alpha)$ the deterministic dividend growth rate. This equation provided the necessary interdependences for the transmission of changes in states s as found in Ch.6 into the risk aversion of companies α as per Ch.7. The alternative investment return process defining $\varphi(s)$ was represented by Equation (3.7), which is generalised into the objective measure in order to incorporate the company-soecific cost of capital by including the company-specific market price of risk due to Equation (7.2) so that

$$d\varphi_t = [\kappa\mathbb{E}[\varphi] - (\kappa + \lambda\sigma_\varphi)\varphi_t]\,dt + \sigma_\varphi W^P(t), \varphi(0) = \varphi_0$$

as per Brigo & Mercurio (2006, p.60 Eq.3.11). A continuous-time discrete-state representation as used in Ch.5 allows to map the dynamics of the state system on the level of φ_t. Following Equation (3.8) it is defined that

$$s = \begin{cases} 0 & if\ r_t \equiv \mathbb{E}[\varphi] \\ 1 & if\ r_t \gg \mathbb{E}[\varphi]. \\ 2 & if\ r_t \ll \mathbb{E}[\varphi] \end{cases}$$

The market price of risk λ combined financial as well as insurance-technical information as was discussed in Ch. 7 and took the form

$$\lambda_\varphi = \varrho\lambda_m = \frac{\mathbb{E}[\varphi] - \varphi}{\sigma_\varphi},$$

where the expectation was modelled on the basis of the single-period Sharpe-Lintner-Mossin CAPM

$$\mathbb{E}[\varphi] = r + \beta_{\varphi m}(r_m - r_f).$$

The argument of Ch.7 was that the dynamics of φ could not be as clearly separated as assumed in the single-period CAPM. This motivated the definition of factor-components for financial market information φ^A, and for the insurance-technical cost of capital level φ^A, to yield Equation (7.3)

$$\mathbb{E}[\varphi|\mathcal{F}] = \mathbb{E}\left[\varphi^A|\mathcal{A}\right] \times \mathbb{E}\left[\varphi^T|\mathcal{T}\right].$$

With respect to the former, Ch. 6 showed that the Golden Twenties were associated with a more optimistic investor sentiment represented by $\varphi^A(1) > \varphi^A(2)$. Ch. 7 in turn confirmed that $\varphi^T(1) > \varphi^T(2)$, or that insurance operations were relatively more risky during the Golden Twenties than during the Great Depression period. This allowed to infer that - all else equal - the value of an insurance company was relatively lower during the late 1920s than during the early 1930s in comparison to investment opportunity assets that were for example only responding to innovations in φ^A.

Endogenous risk was realised if the insurance company decided to act against this relative decrease in its assumed value. In other words, the risk of being discontinued was shifted by the company to its policyholders. This dissertation investigated different methods of risk shifting that are available to the management of an insurance company. The dividend reserve process defined by Ch.4 provided a first theoretical model that allowed to represent how managers administered dividend payout from internal reserves as represented by Equation (4.1), or

$$Y(\alpha, t) = y - Dt + E(t),$$

where the subscript α is added to exemplify that the amount of internally available funds Y is a direct function representation of risk aversion - the more internal funds a company keeps, the smaller is its default risk. Ch. 5 provided a direct model representation of the underwriting decision of insurance companies based on their demand for reinsurance. On the basis of the Esscher pricing principle it was shown that decreases (increases) in reinsurance demand could be directly associated with decreased risk aversion given Equation (5.1),

$$\pi_i = \frac{\mathbb{E}\left[X_i e^{\alpha_i Z}\right]}{\mathbb{E}\left[e^{\alpha_i Z}\right]},$$

where increased reinsurance demand was associated with an increase in the reinsurance premium π. Furthermore, Ch.7 argued that in order to bring down cost of capital, the company could directly control the individual exposure to different types of cashflows represented by the relative weights of internal portfolios.

Overall, insurance companies faced an endogenous maximisation problem as it depended on the states of the world. Ch.5 exemplified that this provided the insurance company with a dilemma: maximising time-varying shareholder value did on the one hand minimise state-dependent changes in the value of the company and thus discontinuation risk. It on the other hand necessitated the absorption of discontinuation risk by other means, represented by a decrease in risk aversion. This was formalised in Equation (5.4)

$$\arg\min_{\alpha} \frac{\partial V}{\partial s} \tag{8.1}$$

as the control problem to reduce the variation in the value V introduced by state transitions by means of risk aversion α. For the latter, however, the general insurance business model implied that

$$\frac{\partial \alpha}{\partial s} = 0,$$

or that the default risk of a company is supposed to be held constant.

This trade-off represents the principal-agent conflict that is inherent to the general concept of endogenous risk. It showed that the overarching theme could not only be identified based on the empirical analysis of the German insurance sector during the Interwar period, but also followed from a combination of established models and concepts from finance and actuarial science.

Concluding remark: endogenous risk and risk shifting at AIG

The hypothesis that endogenous risk is present in insurance operations was motivated by the finding that AIG conducted the business operations that ultimately required the intervention of the U.S. government in 2008, during a period in which the company was relatively underperforming against a self-defined peer group. As shown in Table (1), the corporate management of the company itself was admitting that the alternative investment opportunities for its shareholders were becoming more appealing. The model of endogenous risk suggests that this motivated the company to shift risk from shareholders to policyholders in order to improve its shareholder compensation. That the company was in general engaging in risk shifting was evidenced by Ch.4, given that the company increased its dividend payout even immediately before receiving governmental support in late 2008. This allows to believe that the company also actively administrated its dividend during the period before 2008. With respect to the preferences of its investor clientele, anecdotal evidence suggests similarities to the ones identified in the German insurance market during the Interwar period: "AIG, after the so-called Decade of Greed in the 1980s merged away dozens of blue-chip stocks, had thus become a 'widows and orphans' stock, a core holding for those interested in long-term safety of their investments."[230]

The London-based subsidiary AIGFP played an important role in the events leading to the company's distress in 2007/2008. It was this company's business operations that caused substantial write-downs and margin calls. Anecdotal evidence suggests that the fundamental motivation of AIG to establish its subsidiary AIGFP in 1987 was to provide for diversification in earnings performance.[231] Then-CEO Maurice R. Greenberg was said to be particularly concerned with this topic during the mid-1980s, a period of booming financial markets. His alleged motivation was to find "something that could be a sustainable business, where capital could be responsibly deployed to generate solid returns and yet was

[230] See Boyd (2011, pp.44-45), a non-fictional description of the historical engagement of AIG with financial markets.
[231] Compare Boyd (2011, pp.22-44).

Table 50: Combined ratio of AIG, 2000 to 2006

Year	2000	2001	2002	2003	2004	2005	2006
Overall	102.93%	103.60%	104.93%	92.68%	100.30%	104.69%	89.06%
Excluding catastrophes	102.66%	98.95%	104.67%	92.41%	97.56%	97.63%	89.06%

Source: AIG Restated financial supplement 2005 for years 2000 to 2005,p.11. AIG Annual Report 2006 for year 2006.

totally unconnected to insurance cycles. The capital markets were the natural answer [...]."[232] Based on this motivationg, AIG incorporated AIGFP in 1987.

Fully consistent with the findings of Ch.7, the structural purpose of AIGFP was to provide pro-cyclical diversification, yet ultimately exposed AIG to systemic risk in doing so. This became especially evident during the period from 2000 until the financial crisis in 2008, which was marked by increased insurance-technical costs especially caused by catastrophes, such as 9/11 or Hurricane Katrina. This was reflected in the combined ratio of AIG, presented in Table 3, which shows that the company made losses on its non-life business for all years except 2003 and 2006. Apart from the well-known activities of its subsidiary, even AIG itself substantially expanded its business in securities lending operations with assets outstanding increasing from USD 30 billion in 2003 to USD 88.4 billion in the third quarter of 2007. AIG lent on average more than 15% of its life insurance assets and even 19% in 2007, whilst competitors such as MetLife never lent more than 10%.[233] AIG used the freed-up liquidity to make long-term investment in the booming U.S. real estate market, which led to a substantial exposure to an asset-liability mismatch in the run-up to the 2007/2008 Financial Crisis.[234]

This course of events suggests that endogenous risk played a relevant part in the case study of AIG, which can be concluded from the findings concerning the German insurance market during the Interwar period. This can serve as a motivation for both further studies of endogenous risk in the context of principal-agent theory and future research on historical insurance markets.

[232] See Boyd (2011, p.34).
[233] See McDonald & Paulson (2015, pp.9-10).
[234] Ibid.

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