Profitability and Growth in Motor Insurance Business – Empirical Evidence from Germany*

Liselotte Maichel-Guggemoos and Joël Wagner†

Abstract

Over the recent years, the German motor insurance business has faced significant changes, including a growing importance of direct insurance offerings. Motor insurance products are offered by a wide range of insurers, with companies differing in terms of legal status, size, product portfolio, distribution strategy and operational efficiency. Furthermore, one distinguishes between two main products, namely motor third party liability (MTPL) and motor own damage (OD). In our research, we analyze to what extend the characteristics of the companies can explain the premiums, the total claims costs and the operating expenses per contract in MTPL and OD. For our analysis, we use panel data of insurance companies, offering motor insurance products in Germany, for the years 2002 to 2014. The panel data provides almost full market coverage. In our study, we apply different statistical tests and multi-linear regression models. We show that mutuals relate to lower premiums, lower total claims costs as well as lower operating expenses per contract when compared to listed companies. In addition, direct insurance companies go along with lower premiums and lower operating expenses per contract compared to traditional companies selling via agents or brokers. Furthermore, we find major differences related to the range of the product portfolio, the size of the motor business, the dominance of the motor business within the non-life business and the calendar year. Our results are relevant to academics and practitioners alike and help to better understand the German motor insurance business.

Key words: motor insurance · German market · empirical analysis

1 Introduction

In recent years, the German motor insurance market has become the largest market in Europe. Between 2010 and 2014, it ranked before France, Italy and the UK in terms of premiums (Insurance Europe, 2014, 2016). The German market had been the largest market from 2002 to 2005 but then came second behind Italy for four consecutive years (Insurance Europe, 2010). In the period from 2002 to 2014 the total number of motor vehicles in Germany increased from 47 to 53 million (GDV, 2012, 2014b), showing the increasing need for motor insurance. In comparison to the other sizable European markets the concentration of the top 5 and top 10 groups of companies has been relatively low in Germany. Over the last years, it remained

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constantly below 50% (top 5) respectively 70% (top 10) with an average ratio of 47% (top 5) respectively 68% (top 10). The highest concentration can be found in Italy with an average ratio of 70% (top 5) respectively 89% (top 10), followed by France with 64% respectively 89% and the UK with 52% and 75%, whereby the average ratios include the years 2008 to 2013 (Insurance Europe, 2015).

Our paper aims to contribute to an improved understanding of the profitability and growth of the German motor insurance business. For this, we examine the relationship between the main characteristics of the insurance companies and three key performance indicators in the industry, namely the premiums, the total claims costs and the operating expenses per contract.

The existing literature on the German motor insurance business is interested in a variety of topics. One of the most-covered topics is insurance pricing. Hartmann et al. (2014) analyze tariffication strategies in Germany, Austria and Switzerland using a survey amongst insurance representatives in 2013. Their study focuses on the different components of pricing management in insurance firms. The study was conducted for the first time in 2006 (Erdönmez et al., 2007). Since then the insurance companies made significant progress regarding a systematic pricing process and the accessibility and usage of historical claims data. Laas et al. (2016) take the analysis of Hartmann et al. (2014) one step further. Based on the same dataset the authors extend the analysis beyond descriptive statistics and use several multivariate statistical methods to evaluate the survey results. They derive practical implications for insurance companies regarding actuarial pricing, non-traditional pricing components, the combination of pricing components and the pricing process itself. Schmeiser et al. (2014) provide an overview of the relevance of price differentiation criteria in five European countries for several products including motor insurance. They include the perspectives of the different stakeholders: insurers, regulators, ethicists and customers. The customers view results from an international customer survey, which examines the customers' acceptance of differentiation criteria, whereby the focus is on the gender criterion. Finally, the authors discuss possible implications of the ban of gender-specific premium differentiation in the European Union.

One of the core areas of the pricing and marketing research is the price sensitivity of motor insurance clients. Yeo et al. (2001) aim at predicting retention rates after premium changes in motor insurance. Guelman and Guillén (2014) focus on the calculation of price-elasticity functions on an individual policyholder level. They develop an approach which uses a causal inference framework. Their approach allows to calculate individual price-elasticity functions based on characteristics of the customer and thus allows to maximize the overall profitability of the portfolio.

Over the last few years, following the technological developments, the topic of telematics has been introduced into the discussion of motor insurance pricing. Weidner and Weidner (2014) use telemetry data for pricing. The authors reduce the asymmetry of information between customer and insurer by using data on speed, acceleration and used road types for the tariff calculation. Surminski (2014) discusses the viability of motor insurance tariffs based on telematics in Germany. The author emphasizes two questions, focusing on the customer and on the insurance company. What must be offered to the customer in terms of financial benefits so that he agrees to take part in telematics based pricing? What amount of money has to be saved (in terms of reduced claims payments) to exceed the additional costs for the telematics based pricing for the insurance company? Paefgen et al. (2013) also analyze the potential of telematics based pricing and derive conditions for a successful business model. The paper gives concrete recommendations for a successful introduction of telematics with one of the main points being to offer additional telematics based services like stolen vehicle tracking or remote assis-

tance. Kremslehner and Muermann (2016) test if driving information usually not observed by insurance companies, like the number of car rides or the speed, influences the chosen insurance coverage and the level of risk. They use a telematic dataset and match it to the corresponding data on insurance coverage and claims information from the insurance company, whereby the insurance company had no access to the telematics data. According to the authors usually unobserved factors like speeding, the number of car rides and the driven distances at night and on weekends are relevant for the chosen insurance coverage and the risk level. The impact of new technologies can also be seen in the growing importance of direct insurance. Swiss Re Sigma (2014) highlights the effects direct insurance can have on customers buying and information behavior. The authors discuss the empowerment of the customer and possible implications on classic intermediaries. Hocking et al. (2014) point out the importance of adapting to technological changes all along the insurance value chain, including distribution. Based on a global customer survey the authors examine the trend towards less face-to-face distribution and name the aspects that are important to customers when using online offerings, for example easy to use websites and simple explanations about products.

Eling and Luhnen (2008) analyze if the periods 1996 to 1999 and 2005 to 2006 can be considered as periods of "price wars" in the German motor insurance market. The authors use a three-step approach: they compare the development of the motor insurance market to the developments of other non-life business lines, examine if the common definitions of price wars can be applied to the German motor market and compare the insurance market to non-insurance reference cases. The authors conclude that the periods can only be referred to as times of intense competition and not as price wars.

Much of the research focuses on the customers of motor insurance products and their characteristics. We contribute to the current state of research by focusing on the insurance companies and their characteristics. We use data from insurance companies, offering motor insurance in Germany, for the years 2002 to 2014 to allow for an analysis over more than 10 years. This is important because one of the major changes in the German motor insurance market, the rise of direct insurance, started with the beginning of the new millennium (see Table 3 in Section 2). We aim to find out, to what extend the characteristics of the motor insurance companies can explain the premiums, the total claims costs and the operating expenses per contract in motor insurance. Our main findings are that companies with the legal status of a mutual relate to lower premiums, to lower total claims costs as well as to lower operating expenses per contract when compared to listed companies. In addition, direct insurance companies go along with lower premiums and lower operating expenses per contract compared to traditional companies selling via agents or brokers. It is surprising that they also relate to lower claims per contract in own damage (OD), since direct companies are mainly used by younger people usually associated with higher claims risks in the motor business. We derive possible explanations in Section 4. Additionally, we present further results related to the range of the product portfolio, the size of the motor business, the dominance of the motor business within the non-life business and the calendar year.

The remainder of this paper is organized as follows: Section 2 further introduces the research topic by providing an overview of the German motor insurance market and its developments, including a paragraph dedicated to the rise of direct insurance companies. Section 3 consists of two parts: Section 3.1 presents our hypotheses and introduces the model framework and Section 3.2 describes the regression models. In Section 4 we present and discuss our results for MTPL (Section 4.1) and own damage (Section 4.2). Our main findings and possible areas of future research are summarized in Section 5. The Appendix reports further regression analysis

results and provides a list of companies included in our analysis.

2 The German motor insurance market from 2002 to 2014

In this section, we describe the developments of the German motor insurance market. We consider its premium development, contract development, development of total claims costs, development of operating expenses, the competitive landscape, the usage of distribution channels and the technological trends. All values are gross (before reinsurance). Note that the total claims costs consist of the claims payments, the change in the gross provision for outstanding claims and the associated claims settlement costs, as stated in § 41(1)-(2) RechVersV (German Federal Ministry of Justice, 2015b). The operating expenses include all costs for setting up a contract, see § 43(2) RechVersV and managing the contract, see § 43(3) RechVersV (German Federal Ministry of Justice, 2015b). The premiums are defined as gross earned premiums.

In our analysis, we focus on insurance companies mainly doing business in the private motor insurance sector. That is, we exclude pure commercial insurance companies. Available data is based on information from the annual reports of insurance companies for the years 2002 to 2014 as provided by the Hoppenstedt insurance database. It is enriched with further information on the legal or the direct insurer status. A complete list of the companies used in our analysis is included in Table 11 of the Appendix.

Market development An overview of the key figures is given in Table 1. The table is divided into three parts, a part on the total motor insurance business, followed by a part on the MTPL business and a part on the OD business. A separate analysis of the two products is important, since their characteristics differ widely with MTPL being compulsory and OD being voluntary (German Federal Ministry of Justice, 2015a), and both having developed differently over time.

The first section named *motor total* provides an overview from 2002 to 2014 on the number of insurance companies included in our analysis. All companies in our data offer MTPL and OD. Changes in their number can have different reasons. A decrease can result from a takeover of the motor insurance business by another company, for example the takeover of Ontos Versicherung by Direct Line Versicherung AG in 2008. It can also result from the integration of the business into another subsidiary of the mother company, for example the integration of the motor business of Deutsche Internet Versicherung into Europa Versicherung AG in 2014. An increase can result from new motor insurance offerings. Either the launch of a business from a German insurance company, for example the launch of Hannoversche Direkt AG by VHV in 2007, or the market entry of a foreign insurance company into the German market, for example the launch of Admiral Direkt by the British Admiral Group plc..[1] Our data shows a decrease in the number of active companies from 86 in 2002 to 76 in 2014. This consolidation can also be observed from the increasing average premium volume per company, which rose from 221€ mn in 2002 to 293€ mn in 2014. The market shares of the different legal forms of insurance companies remain constant over time with listed companies earning on average 74% of the premiums, leaving 14% for mutuals and 12% for public companies.

The next two sections *MTPL* and *OD* show that the contract volume is larger in the MTPL business than in the OD business. This can be explained with MTPL being a compulsory insurance and OD being voluntary. It is notable that the total claims volume in absolute terms as well as per contract fluctuates stronger in OD, leading also to stronger fluctuating loss ratios.

[1] Details and source references of these deals can be found in Table 3 in the section on direct insurance.

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Motor total														
Market premium volume	€bn	19.0	19.4	19.6	19.3	19.3	18.9	18.5	18.3	18.3	19.0	20.0	21.2	22.3
Number of companies		86	84	81	80	79	78	80	79	78	78	78	77	76
Average premiums per company	€mn	221.3	231.4	241.4	241.6	244.9	242.6	231.8	231.0	235.1	243.1	256.3	275.6	293.1
Market share (measured in premiums):														
– of listed companies	%	73.1	73.1	73.1	73.4	74.9	75.0	75.2	75.2	75.1	74.9	74.8	74.5	74.2
– of mutuals	%	14.6	14.6	14.6	14.6	13.6	13.3	13.1	13.1	13.2	13.5	13.7	14.0	14.1
– of public companies	%	12.3	12.3	12.3	12.0	11.6	11.8	11.7	11.8	11.7	11.6	11.5	11.5	11.7
Motor Third Party Liability														
Market premium volume	€bn	11.9	12.1	12.2	12.0	12.0	11.7	11.4	11.1	11.0	11.4	12.0	12.7	13.3
Market claims volume	€bn	10.2	9.9	10.0	9.9	9.5	9.4	9.0	9.1	9.7	9.9	10.1	10.3	10.9
Market expense volume	€bn	1.8	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.2	2.2
Number of contracts	mn	50.4	49.8	50.2	50.5	51.0	51.4	52.0	52.5	53.5	54.3	55.2	55.9	56.8
Market loss ratio	%	85.7	81.8	82.1	82.6	79.2	80.4	79.2	82.6	87.9	87.2	84.5	80.7	81.4
Market expense ratio	%	14.8	14.9	14.8	15.3	16.1	16.5	16.9	18.1	18.0	17.7	17.5	17.1	16.9
Market combined ratio	%	100.5	96.6	97.0	97.9	95.4	97.0	96.1	100.7	105.8	104.9	102.0	97.8	98.3
Avg. premiums per company	€mn	138.6	144.2	150.1	149.8	151.4	149.5	142.3	140.1	141.5	145.9	153.9	165.1	175.4
Avg. contracts per company	th	586.2	592.8	619.3	631.4	646.0	659.2	650.3	665.1	685.9	696.8	707.8	725.3	747.2
Avg. claims volume per company	€mn	118.8	117.9	123.3	123.8	120.0	120.2	112.6	115.7	124.3	127.2	130.0	133.3	142.9
Avg. expense volume per company	€mn	20.5	21.4	22.2	22.9	24.5	24.7	24.0	25.3	25.4	25.8	27.0	28.3	29.6
Avg. premiums per contract	€	236.4	243.2	242.4	237.3	234.4	226.7	218.8	210.6	206.3	209.4	217.5	227.7	234.8
Avg. claims per contract	€	202.6	198.8	199.1	196.0	185.7	182.4	173.2	174.0	181.3	182.6	183.7	183.7	191.2
Avg. expenses per contract	€	35.0	36.1	35.9	36.3	37.8	37.5	37.0	38.1	37.0	37.1	38.2	39.0	39.6
Own Damage														
Market premium volume	€bn	7.1	7.3	7.4	7.3	7.4	7.3	7.2	7.2	7.3	7.6	8.0	8.5	8.9
Market claims volume	€bn	5.9	5.5	5.3	5.3	5.6	5.8	6.5	6.3	6.6	7.1	6.8	8.2	6.8
Market expense volume	€bn	1.5	1.5	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.5	1.6	1.6
Number of contracts	mn	38.0	37.3	37.4	37.5	38.0	38.3	39.0	39.8	40.6	41.3	42.0	42.4	43.1
Market loss ratio	%	83.1	75.6	71.5	72.0	75.5	80.0	90.9	88.2	90.9	93.5	84.7	96.2	75.6
Market expense ratio	%	20.9	19.9	19.3	19.7	20.2	19.6	19.7	20.1	19.3	19.1	19.0	18.4	18.1
Market combined ratio	%	104.0	95.5	90.9	91.7	95.7	99.6	110.6	108.4	110.2	112.6	103.7	114.6	93.7
Avg. premiums per company	€mn	82.8	87.2	91.3	91.8	93.5	93.2	89.5	91.0	93.7	97.2	102.4	110.5	117.7
Avg. contracts per company	th	442.4	444.2	461.3	469.0	481.3	491.1	487.3	503.8	520.7	529.6	537.8	550.5	566.5
Avg. claims volume per company	€mn	68.8	65.9	65.3	66.1	70.6	74.5	81.3	80.3	85.1	90.9	86.7	106.3	89.0
Avg. expense volume per company	€mn	17.3	17.4	17.6	18.1	18.9	18.3	17.7	18.3	18.1	18.5	19.4	20.3	21.3
Avg. premiums per contract	€	187.1	196.4	197.9	195.8	194.3	189.7	183.7	180.6	179.9	183.5	190.4	200.7	207.7
Avg. claims per contract	€	155.5	148.4	141.6	140.9	146.6	151.8	166.9	159.3	163.5	171.7	161.3	193.0	157.0
Avg. expenses per contract	€	39.1	39.2	38.3	38.5	39.3	37.2	36.2	36.3	34.7	35.0	36.1	36.9	37.7

Table 1: Overview of the German motor insurance market. Key figures are reported for the years from 2002 to 2014.

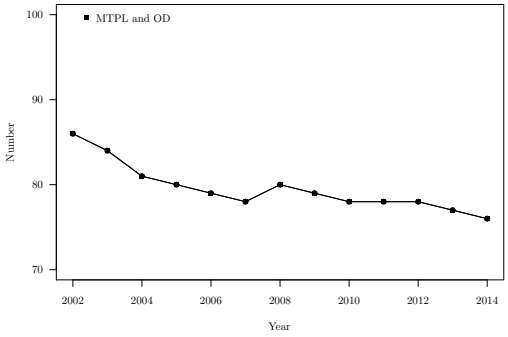
The reason for this is the influence of natural phenomena such as windstorms and hailstorms. In 2013 for example natural phenomena led to an exceptional high value in total claims in OD (GDV, 2014a). The loss ratio for our dataset increased from 2012 to 2013 by more than 10% from 84.7% to 96.2%, falling back to 75.6% in 2014. Regarding the operating expenses, we observe an increase over time in MTPL and a decrease over time in OD.

A selection of data from Table 1 is shown in Figures 1 and 2 to illustrate the development of MTPL and OD. Figure 1(a) shows the number of companies selling motor insurance in the German market, whereby all companies in our dataset offer both products, MTPL and OD. It illustrates the consolidation of motor insurance companies from 2002 to 2014. Figure 1(b) and Figure 1(c) show the development of premiums and number of contracts in MTPL and OD over the same period. In terms of premiums the values for OD never fell below the base year (index 100 in 2002), whereas the values for MTPL fell below the base year for a period of 5 years from 2007 to 2011. After a decrease below the base year at the beginning of the observed period, the number of contracts in MTPL and in OD grew up until 2014. Until 2008 the number of MTPL contracts was growing stronger than the one of OD contracts. Since then, the OD contracts outgrew the MTPL contracts. Figures 1(d) to (f) set the number of contracts in relation to the number of companies. The average number of contracts per company reported in Figure 1(d) shows that the companies have constantly more MTPL than OD contracts in their books. It also shows the consolidation process in the German motor insurance market with a growing number of contracts per company. When looking at the developments in MTPL and OD more closely one can observe that between 2002 and 2014 the companies of the 90%-quantile (i.e. the 10% largest companies) were gaining more contracts per company in OD (Figure 1(f)) than in MTPL (Figure 1(e)).

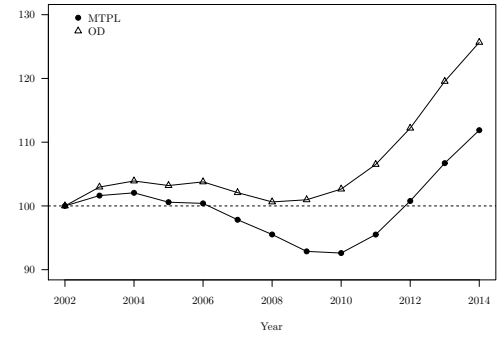
Figure 2 shows the development of the gross earned premiums, the gross total claims costs and the gross operating expenses per contract in MTPL and OD. In Figure 2(a) the time cycles for the premiums per contract become visible and become even clearer when indexing the data for the base year 2010 (Figure 2(b)). Figure 2(c) shows the higher fluctuation of the claims per contract over time in OD compared to MTPL. The operating expenses stay below 40€ per contract for both products during the whole period, whereby they increase over time in MTPL and decrease over time in OD (Figure 2(d)).

Direct insurance In our paper a company is defined as direct insurance company if the corporate sales strategy is to distribute insurance products mainly via the internet, the phone, the fax, letters or emails. Table 2 shows selected indicators for pure direct insurance companies. For them, the percentage increase in premium and contract volume from 2002 to 2014 is higher for both products. The third indicator, average premiums per contract, is lower for direct companies from the year 2006 onwards in MTPL and for all analyzed years in OD.

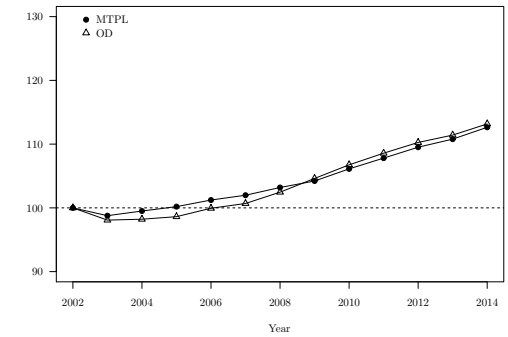
Table 3 shows the development of direct companies in Germany from 1977 to 2014. The development of the market began in 1977, when the company DA Deutsche Allgemeine Versicherung AG started its business with offerings via letter and telephone. Cosmos Versicherung AG was the second direct insurance company on the German market and started its business in 1982. After years of moderate growth in the nineties, the development of direct insurance was mainly pushed by the increase of the internet usage. Already existing direct insurance companies like Cosmos Versicherung AG started offering their products also via the internet and new pure direct subsidiaries were launched or acquired by established companies. For example, HUK-Coburg launched HUK24 AG in 2000 and Generali took over Cosmos Versicherung AG in



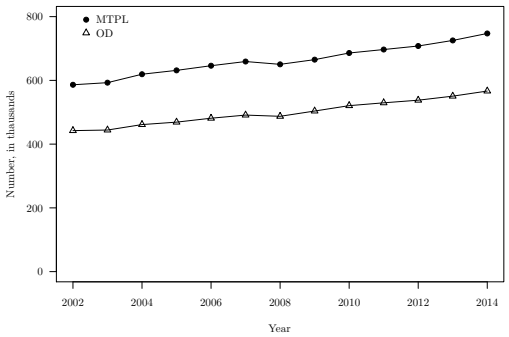
(a) Number of companies from 2002 to 2014.



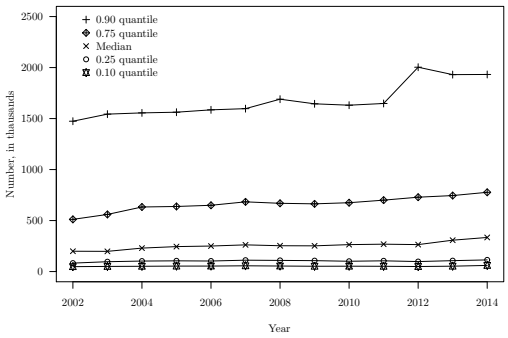
(b) Market volume of motor insurance premiums (GEP) from 2002 to 2014 (index 100 in 2002).



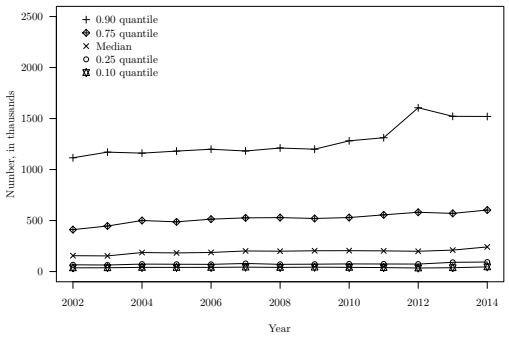
(c) Total number of motor insurance contracts in the market from 2002 to 2014 (index 100 in 2002).



(d) Average number of contracts per company from 2002 to 2014.

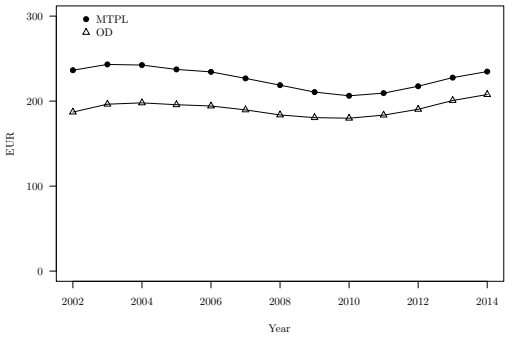


(e) Number of contracts (quantiles) per MTPL company from 2002 to 2014.

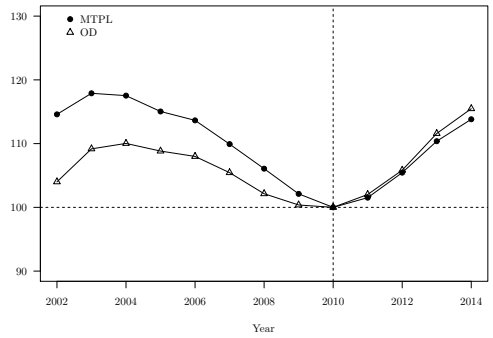


(f) Number of contracts (quantiles) per OD company from 2002 to 2014.

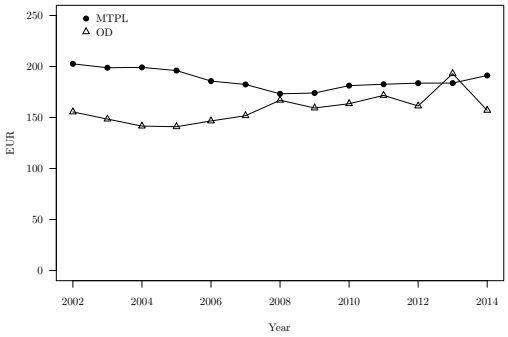
Figure 1: Development of the number of companies, market premium volume and number of insurance contracts from 2002 to 2014.



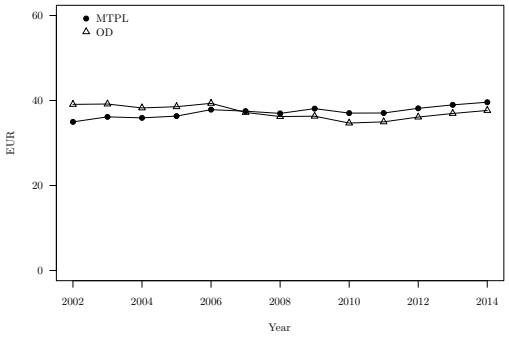
(a) Development of average gross earned premiums (in €) per MTPL and OD contract from 2002 to 2014.



(b) Development of average gross earned premiums (in €) per MTPL and OD contract from 2002 to 2014 (index 100 in 2010).



(c) Development of average gross total claims costs (in €) per MTPL and OD contract from 2002 to 2014.



(d) Development of average gross operating expenses (in €) per MTPL and OD contract from 2002 to 2014.

Figure 2: Development of premiums, total claims costs and operating expenses per contract from 2002 to 2014.

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Motor Third Party Liability														
Market premium volume	€mn	472.9	521.9	577.9	659.1	665.5	687.5	709.8	745.3	756.1	938.7	1057.6	1232.1	1410.5
Number of contracts	mn	1.9	2.1	2.4	2.8	3.0	3.3	3.6	3.8	4.1	4.9	5.3	5.9	6.5
Avg. premiums per contract	€	245.2	243.2	244.6	238.4	225.3	211.3	195.4	193.9	186.4	190.8	200.1	208.2	216.5
Own Damage														
Market premium volume	€mn	240.0	270.1	302.1	356.8	364.1	379.6	399.7	439.5	452.8	561.6	620.9	723.3	840.9
Number of contracts	mn	1.4	1.6	1.8	2.1	2.2	2.5	2.8	3.1	3.2	3.8	4.1	4.6	5.0
Avg. premiums per contract	€	169.2	170.1	172.3	171.1	162.6	152.9	142.4	144.1	141.4	147.4	152.3	158.4	166.8

Table 2: Market overview of the direct motor insurance companies for the years from 2002 to 2014.

Year	Mother company	Direct insurer
1977	Zurich Insurance Group	DA Deutsche Allgemeine Versicherung AG[1]
1982	Generali (since 1998)	Cosmos Versicherung AG[2]
1983	Continentale	Europa Versicherung AG[3]
1984	ERGO (since 2002)	KarstadtQuelleversicherungen (later ERGO Direkt Versicherung AG in 2010)[4]
1989	RheinLand	Ontos Versicherung AG[5]
1996	Provinzial Rheinland	S DirektVersicherung AG[6]
2000	HUK-Coburg	HUK24 AG[7]
2001	Continentale	Deutsche Internet Versicherung AG[8]
2001	Royal Bank of Scotland	Allstate Direct (later Direct Line Versicherung AG)[9]
2005	Allianz	Allianz 24 (renamed Allsecur Deutschland AG)[10]
2007	Zurich Insurance Group	Zurich Connect in Germany[11]
2007	Admiral Group	Admiral Direkt[12]
2007	VHV	Hannoversche Direkt AG[13]
2008	Royal Bank of Scotland	Takeover of Ontos Versicherung AG (merged into Direct Line Versicherung AG)[14]
2008	R+V	R+V Direktversicherung AG[15]
2011	AXA	AXA Easy Versicherung AG[16]
2011	Itzehoer	Takeover of Admiral Direkt as direct sales channel, no own risk carrier[17,18]
2012	Volkswagen	Volkswagen Autoversicherung AG[19]
2014	Continentale	Integration of Deutsche Internet Versicherung AG into Europa Versicherung AG under the name Europa-go[20]

Table 3: Development of direct insurance subsidiaries in Germany from 1977 to 2014.

1998. Figure 3 illustrates the market share of direct insurance subsidiaries in motor insurance.[2] From 2002 to 2014, the share more than doubled.

The development of direct insurance was also supported by the rise of aggregator platforms. Customers access these platforms to compare quotes from multiple insurance companies online (Swiss Re Sigma, 2014). The main actors in the German aggregator market for insurance products are shown in Table 4.

Based on a study amongst German insurance companies, representing about 80% of market premiums in Germany, Towers Watson (2014) estimates a 15%-share of aggregator motor insurance sales in 2013. Regarding the future development, 87% of the participants anticipate a growing relevance of aggregator platforms for insurance sales in the future. In 2016, the two main German aggregator web pages are Verivox and Check24. They are registered as insurance brokers receiving commissions from insurance companies when a product is sold.[21,22] The attempt of HUK-Coburg, HDI and WGV to operate their own platform named Transparo failed. The history of the recent trend of aggregators is still short and data are scarce (e.g., premiums and commissions are not disclosed neither by aggregators nor by insurers). In our dataset (see below), insurance bought through aggregator platforms appears in the accounts of the underlying insurance companies and does not allow for a separate quantitative analysis.

[2]Newly established companies are included in the graph from the first year after foundation. WGV-Versicherung AG is included because they don't have an agents network and were one of the founders of the aggregator platform aspect online.

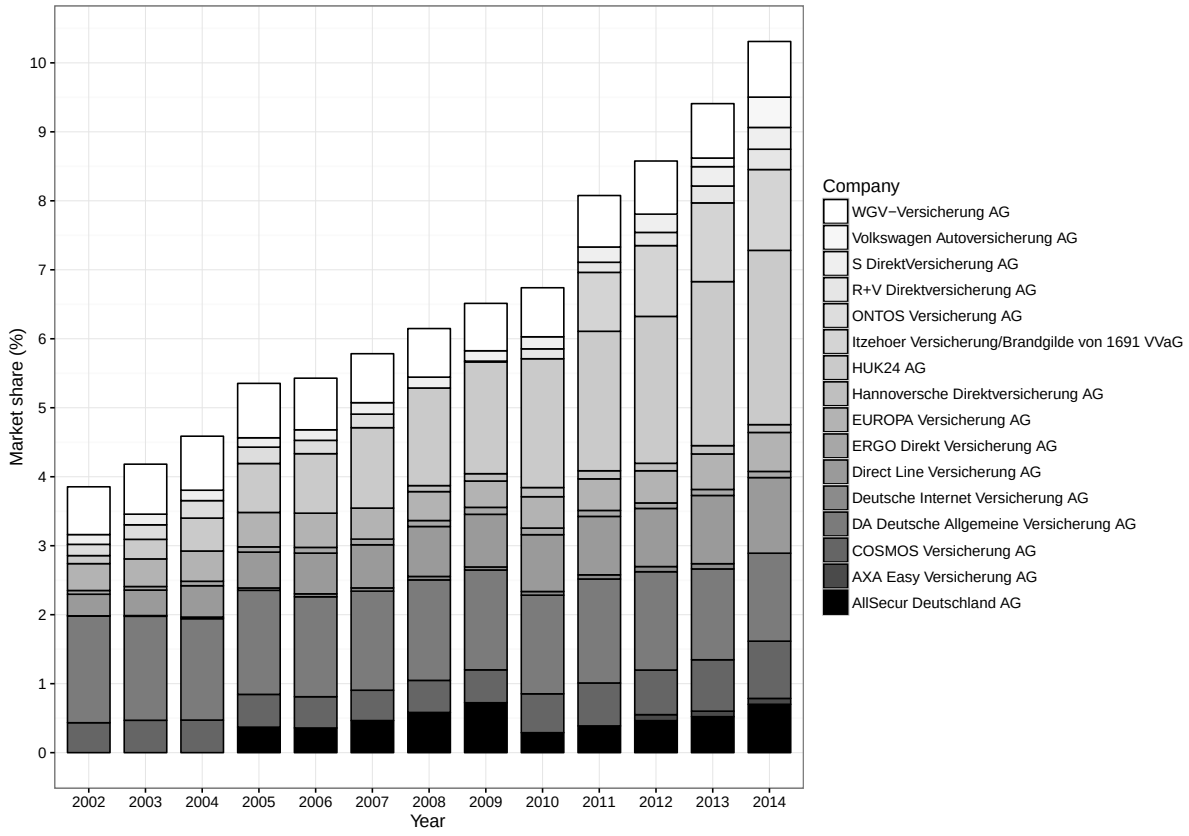


Figure 3: Developments of the market shares of direct insurance companies in motor insurance.

3 Model framework and dataset

3.1 Development of hypotheses

In the following, we develop hypotheses on the effect that selected variables have on the premiums per contract $PR^p_{i,t}$, the total claims costs per contract $CL^p_{i,t}$ and the operating expenses per contract $EX^p_{i,t}$. In the regression model notations, i stands for the company, t the calendar year and p for the product line (MTPL, OD). We first introduce these quantities in detail.

Insurance premiums per contract We introduce the first dependent variable $PR^p_{i,t}$ for both products MTPL and OD as gross earned premiums per contract. The variable can also be described as the insurance premiums per contract, paid by the customer, excluding insurance tax. The price of insurance is the research topic of a variety of papers. For example, Eling and Luhnen (2008) analyze price competition in the German motor market, Guelman and Guillén (2014) focus on price elasticity and Hartmann et al. (2014) on pricing strategies.

Total claims costs per contract The second dependent variable $CL^p_{i,t}$ for both products MTPL and OD represents the gross claims per contract, as stated in § 41(1)-(2) RechVersV (German Federal Ministry of Justice, 2015b). Different approaches are used in practice to measure claims, for example number of claims per policy years, claims cost as a percentage of the sum insured (Ajne, 1975) or total insured losses (Thomas, 2008). In our analysis, we stick to the total claims costs per contract.

Year	Aggregator	Description
1995	Transparo	Founded under the name aspect online. It was the first insurance online comparison web page in Germany[23]
2011		Acquired by UK-Coburg, HDI and WGV[24]
2014		HUK Coburg took over full ownership[25]
2014		Acquired by Verivox[26]
1998	Verivox	Founded with a focus on telecommunication products
2012		Extended product range to banking and insurance
2014		Acquired Transparo's name and internet address
2014		Acquired TopTarif24's name and internet address[27]
1999	Check24	Founded for price and performance comparisons including the areas insurance, and banking[28]
2007	TopTarif24	Founded
2014		Acquired by Verivox[29]

Table 4: Development of the aggregator platforms for insurance products in Germany.

Operating expenses per contract The gross operating expenses per contract for both products MTPL and OD are our third dependent variable $EX^p_{i,t}$. We define the operating costs as stated in § 43(5) RechVersV. They include all costs for setting up a contract, see § 43(2) RechVersV and managing the contract, see § 43(3) RechVersV (German Federal Ministry of Justice, 2015b).

We now introduce several variables describing the characteristics of insurance companies. For each one we hypothesize on the impact on the dependent variables. We state eight different hypotheses. A summary of the three dependent and the eight explaining variables used in our framework is provided in Table 5 at the end of this section.

Direct insurance We have discussed the rise of direct companies and their influence on the German market in Section 2. In our study, we include the status of a company as direct insurance company with the binary variable $DI_{i,t}$ (value 1). Direct companies are defined as follows: they sell exclusively via a direct channel and not via agents and brokers. In the literature, direct companies are discussed, e.g., by Hartmann et al. (2014). The paper states that policies acquired via online channels, often relate to short policy durations and do often not lead to additional contracts with the client. The broader topic of digitization is widely discussed in the insurance industry, see for example McKinsey & Company (2014), Bain & Company (2013), Hocking et al. (2014) and Allianz (2016). Based on their higher internet affinity, users of direct insurance companies are mainly younger people (Swiss Re Sigma, 2012, 2014). This has an influence on the claim and premium levels. Using the classification of the German federal statistical office, the age group 18-21 has the highest rate of being the main responsible party for accidents, and the age group 22-25 the third highest after the seniors aged 65+ (Statistisches Bundesamt, 2016). According to the GDV (2015), a premium supplement is added for young drivers up to the age of 25. Regarding the influence of direct companies on the premiums per contract, it is interesting to study if the increasing effect of the premium supplements will balance out the decreasing effect of direct offerings. In fact, prices can be more easily and quickly compared than classical offerings via an insurance agent or broker and thus are often lower. Direct insurance companies communicate mainly online or via the phone, so their expenses are supposed to be

lower since they do not operate a network of agencies. We suspect:

H1a: Direct insurers relate to *lower* insurance premiums per contract than traditional insurers.

H1b: Direct insurers relate to *higher* total claims costs per contract than traditional insurers.

H1c: Direct insurers relate to *lower* operating expenses per contract than traditional insurers.

Motor dominance in non-life The explaining variable $NL_{i,t}$ stands for the dominance of the motor insurance product in the total non-life business of the company. It is measured by the ratio of motor insurance premiums over total non-life premiums. This variable shows if the motor product is the main product or only a by-product. If motor insurance is a by-product, it is often used as door-opener for cross-selling (Hoffmann, 2011; Staudt and Wagner, 2017). It is used to attract clients with low prices for a compulsory product like MTPL insurance. Once a client relationship is established the insurers try to sell higher worth products to the clients. In contrast, companies with a focus on motor insurance cannot compensate for losses in the motor business with other lines of business and must be profitable within motor insurance. In our panel companies with a high motor share tend to be smaller players, based on the total non-life premiums. Mahlow et al. (2015) analyze in their study on claims management in Germany and Switzerland, that smaller companies do not put as much emphasis on loss prevention, advanced fraud detection and automatized and connected claims management processes than big companies. In our data, companies with a motor dominance also go along with a higher rate of direct insurance sales; thus, we suspect their operating expenses to be lower (see above). In summary, we suspect:

H2a: Companies with a focus on motor insurance relate to *higher* insurance premiums per contract than companies where motor is only a by-product.

H2b: Companies with a focus on motor insurance relate to *higher* total claims costs per contract than companies where motor is only a by-product.

H2c: Companies with a focus on motor insurance relate to *lower* operating expenses per contract than companies where motor is only a by-product.

Multiline The binary variable $MU_{i,t}$ stands for a multiline product offering, which means that the corporate family is also selling life insurance products via another subsidiary (value 1). Being a multiline insurer increases the possibility for cross-selling. If the client has multiple policies with one insurance company he is less likely to cancel his policy and thus less sensitive to higher prices. According to Capgemini (2011) cross-selling contributes to deepen the client relationship and thus to lower attrition rates. In our data, insurance companies that classify as multiliners relate to larger companies in terms of premiums. We expect these companies to be more efficient. Eling and Luhnen (2010) find that larger companies are in general more efficient than smaller companies and Schwarz et al. (2008) claim that a large market size can foster growth by producing economies of scale which may lead to lower prices. We further expect larger companies (in terms of non-life premiums) to put a higher emphasis on fraud prevention and loss prevention schemes (Mahlow et al., 2015; Mahlow and Wagner, 2016). Thus, we suspect:

H3a: Companies with a multiline product offering relate to *higher* insurance premiums per contract.

H3b: Companies with a multiline product offering relate to *lower* total claims costs per contract.

H3c: Companies with a multiline product offering relate to *lower* operating expenses per contract.

Market share We aim to include the market share (based on premiums) for both products MTPL and OD as explaining variables in our model. The market share is used to measure the relative size of a company's motor insurance business. The size of the companies is also in the focus of other papers. Hartmann et al. (2014) present the results of their survey according to the size of the companies. When a company was able to develop a high market share, we suspect the price policy of this company to aim for acquiring new and binding existing customers. Regarding the operating expenses, we expect companies with a higher market share to be more efficient (Eling and Luhnen, 2010; Schwarz et al., 2008). Regarding the claims, Mahlow et al. (2015) show in their study, that large non-life companies put a greater emphasis on loss prevention and automation of management processes. Thus, we make the hypotheses that:

H4a: Companies with a higher market share relate to *lower* insurance premiums per contract.

H4b: Companies with a higher market share relate to *lower* total claims costs per contract.

H4c: Companies with a higher market share relate to *lower* operating expenses per contract.

Growth The year-on-year percentage growth rates for both products MTPL and OD are included in our model. Since the premium levels for both products are undergoing cycles and vary from year to year, as seen for premiums per contract in Figures 2(a) and 2(b), we take the growth rates of the number of insurance contracts to get a better idea on the "real" growth. The importance of the growth rates in the insurance industry can be observed at the yearly annual press conferences of the German insurance association, where the results are always compared to the last year results and the yearly changes are pointed out (GDV, 2016). When a company manages to grow, we suspect that this goes along with lower-priced contracts than for companies with lower growth. In fact, for a product that is highly standardized and similar in its benefits, we suspect one of the main selling criteria to be the price. However, when a company is growing quickly, the back office might encounter problems to handle the growth and stay efficient, which influences the claim and expense levels.

H5a: Companies with a higher growth rate relate to *lower* insurance premiums per contract.

H5b: Companies with a higher growth rate relate to *higher* total claims costs per contract.

H5c: Companies with a higher growth rate relate to *higher* operating expenses per contract.

Legal status For the German insurance market it is important to consider the legal status of the companies. There are three types: mutual, listed and public companies. They differ mainly in terms of the legal basis, the ownership of the company and the accounting (Farny, 2011). The legal form is also taken into account as explaining variable by Lorson and Wagner (2014) for their analysis on the drivers for sales success in the German life insurance market. Since the insurance customers of a mutual are at the same time the owners of the company we suppose that there is less pressure on profitability than within listed or public companies where external parties like shareholders and the public sector are present. We also suppose that there is lower moral hazard within a mutual because the insureds would harm themselves. Referring to an analysis of Nemson (2014), we assess mutuals to be more cost efficient than listed companies. Nemson (2014) takes the operating costs as a measure for the cost efficiency of an insurer and shows that mutuals have lower operating expense levels than listed companies for all company sizes. Based on the above, we state the following hypotheses:

H6a: Mutual companies relate to *lower* insurance premiums per contract than listed companies.

H6b: Mutual companies relate to *lower* total claims costs per contract than listed companies.

H6c: Mutual companies relate to *lower* operating expenses per contract than listed companies.

Year of data The year of the data is taken into account because we have seen developments over time in the dependent variables illustrated in Figure 2. Cycles play an important role in non-life insurance. This is highlighted by Meier and Outreville (2006) who examine the existence of cycles for property and liability prices and profits. Pricing cycles in motor insurance are the focus of Eling and Luhnen (2008). In most European countries, the motor premium rates follow a cycle, with the countries experiencing times of increasing, stable and decreasing premium rates (Marsh and McLennan, 2015, 2016). Based on the analysis of the developments of $PR^p_{i,t}$, $CL^p_{i,t}$ and $EX^p_{i,t}$ over time in Figure 2 we make the following hypotheses:

H7a: The insurance premiums per contract are *subject* to time cycles.

H7b: The total claims costs per contract are *not subject* to time cycles.

H7c: The operating expenses per contract are *not subject* to time cycles.

Total claims costs We also consider the total claims costs per contract from the previous year in our model. When the claims are high in the previous business year a company must increase the premiums per contract charged in the following year to account for that. Thus, we make the hypothesis that:

H8: Companies with higher previous year's claims relate to *higher* insurance premiums per contract in the current year.

In Table 5 we recapitulate the different variables introduced above and give a summary of definitions.

Variable	Description
$PR_{i,t}^{\text{MTPL}}$	Gross earned insurance premiums per contract in MTPL.
$PR_{i,t}^{\text{OD}}$	Gross earned insurance premiums per contract in OD.
$CL_{i,t}^{\text{MTPL}}$	Gross total claims costs per contract in MTPL.
$CL_{i,t}^{\text{OD}}$	Gross total claims costs per contract in OD.
$EX_{i,t}^{\text{MTPL}}$	Gross operating expenses (acquisition and management expenses) per contract in MTPL.
$EX_{i,t}^{\text{OD}}$	Gross operating expenses (acquisition and management expenses) per contract in OD.
$DI_{i,t}$	The company is defined as being a direct insurance company if the corporate strategy is to sell insurance products via the internet, the phone, the fax, letters or emails. $DI_{i,t}$ can take the value 1 for being and 0 for not being a direct company.
$NL_{i,t}$	Dominance of the motor insurance product, measured by the ratio of motor insurance premiums over total non-life premiums.
$MU_{i,t}$	The company is defined as having a multiline offer if the corporate family also offers life insurance products via another subsidiary. $MU_{i,t}$ can take the value 1 for having and 0 for not having a multiline offer.
$MS_{i,t}^{\text{MTPL}}$	Market share based on MTPL premiums.
$MS_{i,t}^{\text{OD}}$	Market share based on OD premiums.
$GR_{i,t}^{\text{MTPL}}$	Year-on-year percentage growth in MTPL contracts.
$GR_{i,t}^{\text{OD}}$	Year-on-year percentage growth in OD contracts.
$LG_{i,t}$	The legal form can take one of the three values listed, mutual or public.
$YR_{i,t}$	Year of data. The dataset includes data from 2002 to 2014. We use the year 2010 as reference year.

Table 5: Description of the variables used in the regression models.

3.2 Available data and regression models

In our analysis we focus on insurance companies mainly doing business in the private motor insurance sector. That is, we exclude pure commercial insurance companies. The dataset includes the years 2002 to 2014 and comprises 1034 company-years. A complete list of the companies used in our analysis is included in Table 11 in the Appendix. Available figures are premiums, contract numbers, claims and expenses data as well as information on the legal status, the sales channels and the corporate family. The data is based on information from the annual reports of insurance companies.

In order to test the hypotheses introduced in Section 3.1 we define a regression model for each of the dependent variables $PR_{i,t}^{p}$, $CL_{i,t}^{p}$ and $EX_{i,t}^{p}$, including each of the explaining variables. The models are defined as follows:

$$PR_{i,t}^{p} = RHS_{i,t}^{p} + \beta_8 \cdot CL_{i,t-1}^{p} + \epsilon_{i,t}, \tag{R1}$$

$$CL_{i,t}^{p} = RHS_{i,t}^{p} + \epsilon_{i,t}, \tag{R2}$$

$$EX_{i,t}^{p} = RHS_{i,t}^{p} + \epsilon_{i,t}, \tag{R3}$$

$\epsilon_{i,t}$ stands for the error term. $RHS_{i,t}^{p}$ stands for the set of explaining variables used in all our regression analysis and is defined as follows:

$$RHS_{i,t}^{p} = \beta_0 + \beta_1 \cdot DI_{i,t} + \beta_2 \cdot NL_{i,t} + \beta_3 \cdot MU_{i,t} + \beta_4 \cdot MS_{i,t}^{p} + \beta_5 \cdot GR_{i,t}^{p} + \sum_k \gamma_6^k \cdot LG_{i,t}^{k} + \sum_k \gamma_7^k \cdot YR_{i,t}^{k}.$$

In regression (R1) $CL^p_{i,t-1}$ stands for the previous year's total claims costs per contract. The times t correspond to the years from 2002 to 2014. Product p can take the values MTPL or OD and i stands for companies. The results of the regression analyses are reported in Table 6 for MTPL and in Table 7 for OD in Section 4.

4 Results and discussion

4.1 MTPL regression analysis

The results of the regression analysis for MTPL are shown in Table 6 and are analyzed below. For each of the regressions and variables we report the coefficients, their significance and the standardized regression coefficient. In each regression, we base our analysis on $N = 1021$ observations. Finally, the adjusted R^2 and the Akaike information criterion (AIC) are indicated.

Regression models		(R1) Premiums $PR^p_{i,t}$		(R2) Claims $CL^p_{i,t}$		(R3) Expenses $EX^p_{i,t}$	
Intercept	β_0	101.2 ***		190.4 ***		38.1 ***	
Direct $DI_{i,t}$	β_1	−22.0 ***	(−0.612)	−6.7	(−0.025)	−9.1 ***	(−0.110)
Dominance $NL_{i,t}$	β_2	29.5 ***	(2.162)	27.6 **	(0.209)	17.8 ***	(0.443)
Multiline $MU_{i,t}$	β_3	16.3 ***	(0.007)	22.7 ***	(0.578)	4.1 *	(0.005)
Market share $MS_{i,t}$	β_4	−134.4 **	(−0.607)	−463.1 ***	(−31.009)	−66.8 **	(−1.271)
Growth $GR_{i,t}$	β_5	−1.2 .	(−0.543)	0.4	(0.002)	0.6 .	(0.137)
Claims $CL_{i,t-1}$	β_8	0.6 ***	(0.004)				
Legal status $LG_{i,t}$	γ_6						
Listed		baseline		baseline		baseline	
Mutual		−39.8 ***	(−0.240)	−50.1 ***	(−0.317)	−20.1 ***	(−0.418)
Public		−10.4 ***	(−0.072)	−10.5 **	(−0.004)	−4.1 ***	(−0.342)
Time $YR_{i,t}$	γ_7						
2002		15.6 **	(1.143)	29.4 ***	(1.968)	0.4	(0.079)
2003		22.8 ***	(0.144)	18.7 *	(0.108)	−1.0	(−0.019)
2004		30.2 ***	(0.250)	22.9 **	(0.173)	−1.5	(−0.038)
2005		19.0 ***	(0.115)	18.1 *	(0.100)	−1.3	(−0.023)
2006		10.5 *	(0.072)	0.6	(0.004)	−2.8	(−0.058)
2007		11.6 *	(0.005)	−2.3	(−0.001)	−2.0	(−0.171)
2008		6.8	(0.189)	−9.0	(−0.230)	−1.1	(−0.001)
2009		−1.0	(−0.004)	−11.9	(−0.044)	−1.0	(−0.013)
2010		baseline		baseline		baseline	
2011		−4.6	(−5.177)	−5.8	(−0.386)	−0.9	(−0.204)
2012		4.3	(0.313)	−11.1	(−0.064)	−1.3	(−0.024)
2013		15.6 **	(0.099)	−9.1	(−0.069)	−0.0	(−0.001)
2014		23.4 ***	(0.193)	−1.8	(−0.010)	2.0	(0.036)
N		1021		1021		1021	
Adj.R^2		0.661		0.162		0.144	
AIC		9853		10957		8546	

The reported values show the regression coefficients.
The standardized coefficients are displayed in brackets.
Significance codes: *** $p < 0.001$, ** $p < 0.01$, * $p < .05$, . $p < 0.1$.

Table 6: Results of the MTPL regression analysis.

Premiums Starting with the first dependent variable $PR^p_{i,t}$, the model (R1) can explain 66% of the premiums per contract. The adjusted R^2 is 0.661 on $N = 1021$ observations. Several variables have a significant impact on the premiums per contract, whereby $CL_{i,t-1}$ has the highest influence. However, it must be paid attention to multicollinearity since several of the explaining variables are correlated. For example, in our data companies with a motor dominance also go along with a higher rate of direct insurance sales (as stated in Section 3.1). Thus, it is important to also look at the single variable regressions provided in the Appendix.[3] Within our first group of variables direct company $DI_{i,t}$, dominance of the motor product in non-life $NL_{i,t}$, multiline $MU_{i,t}$ and the claims per contract of the previous year $CL_{i,t-1}$ are significant at the 0.1% level. At a 1% level of significance, we identify the variable market share $MS_{i,t}$ and at a 10% level of significance the variable growth in contracts $GR_{i,t}$. For the variable legal status $LG_{i,t}$, both forms mutual and public yield significant differences. For our variable year of data, the years 2002 to 2007 and 2013 to 2014 are significantly different to the reference year 2010.

Being a direct insurer and having a high market share in motor insurance comes along with lower premiums per contract for a MTPL insurance policy. Thus, our first (H1a) and fourth (H4a) hypotheses can be confirmed. The negative impact of both direct insurance $DI_{i,t}$ (std. coeff. $= -0.612$) and market share $MS_{i,t}$ (std. coeff. $= -0.607$) variables is equally important. The results for the variable $GR_{i,t}$ confirm our fifth hypothesis (H5a) (std. coeff. $= -0.543$) because having a high year-on-year growth rate relates to lower insurance premiums per contract. Having a dominance in motor insurance within the non-life business $NL_{i,t}$ and having a multiline offer $MU_{i,t}$ relates to higher premiums per contract, whereby the variable $NL_{i,t}$ (std. coeff. $= 2.162$) has the second highest influence and $MU_{i,t}$ (std. coeff. $= 0.007$) one of the lowest. Hereby we confirm our second (H2a) and third hypothesis (H3a). Our sixth hypothesis (H6a) is validated because, for the legal status mutual, the premiums per contract are lower compared to listed companies (std. coeff. $= -0.240$). The results for the variable $YR_{i,t}$ confirm our hypothesis of price cycles (H7a). Compared to the base year 2010 the early years had higher premiums, which then decreased and finally recovered over the last years. The eighth hypothesis (H8) is also validated since higher previous year's claims per contract $CL_{i,t-1}$ (std. coeff. $= 0.004$) go along with higher premiums per contract for the current year's insurance.

Total claims costs For our second dependent variable $CL^p_{i,t}$, the adjusted R^2 is only 0.162. This means that the model (R2) can only explain 16.2% of the variance. In fact, for the total claims costs, other external factors, which are not included in our analysis and dataset, are relevant. One example is the number and the severity of car accidents, two quantities that are well known to significantly drive the claims costs. However, our analysis includes several variables that are highly significant. The variables multiline $MU_{i,t}$ and market share $MS_{i,t}$ are significant at the 0.1% level. The variable dominance of the motor product in non-life $NL_{i,t}$ is significant at the 1% level. The variables direct company and growth in contracts $GR_{i,t}$ have no explanatory power. For the variable legal status $LG_{i,t}$, both forms mutual and public are again significant. For the variable year of data, the period from 2002 to 2005 is significant.

Having a dominance in motor insurance within the non-life business relates to higher total

[3]For more details on the explanatory power of each single variable see Tables 9 and 10 in the Appendix, where we have included the single regressions for each variable. In the results, we see the relevance of each of the variables. However, as can be expected the R^2 values of the single variable models are very low. In fact, one single variable will not be able to explain $PR^p_{i,t}$, $CL^p_{i,t}$ or $EX^p_{i,t}$.

claims costs per contract (std. coeff. = 0.209); thus, our second hypothesis (H2b) is validated. Our findings regarding multiline insurer $MU_{i,t}$ are not in line with the initial hypothesis (H3b). Having a multiline offer relates to higher claims per contract (std. coeff. = 0.578). Our reasoning of better loss-prevention schemes and more efficient claims management processes cannot be confirmed. A higher market share in motor insurance goes along with lower claims per MTPL policy. Thus, our fourth hypothesis (H4b) can be confirmed, whereby the influence of $MS_{i,t}$ (std. coeff. = −31.009) is the highest of all variables. Our sixth hypothesis (H6b) is validated because claims in mutual companies are significantly lower compared to listed companies (std. coeff. = −0.317). We can verify our seventh hypothesis (H7b), since we observe no time cycles. The results only show significantly higher claims in the years 2002 to 2006 and lower claims since the year 2007, when compared to the base year 2010.

Operating expenses For our third dependent variable $EX^p_{i,t}$, the adjusted R^2 is low, similar to the one above. The model (R3) can only explain 14.4% of the variance. Compared to the first two dependent variables $PR^p_{i,t}$ and $CL^p_{i,t}$ we find less variables with significant impact. The variables direct company $DI_{i,t}$ and dominance of the motor product in non-life $NL_{i,t}$ are significant at the 0.1% level. At a 1% level of significance, we identify the variable market share $MS_{i,t}$ and at a 5% level multiline $MU_{i,t}$. The growth in contracts $GR_{i,t}$ has only explanatory power at a 10% level of significance. As for the premiums and the claims, the legal status $LG_{i,t}$ is significant. The results for the variable $YR_{i,t}$ have no explanatory power.

Being a direct insurer and having a high market share in motor insurance relates to lower expenses for a MTPL insurance policy. Thus, our first (H1c) and fourth hypotheses (H4c) can be confirmed whereby the variable $MS_{i,t}$ (std. coeff. = −1.271) has the highest influence of all variables. The impact of $DI_{i,t}$ (std. coeff. = −0.110) is negative and so direct insurers related to lower expenses for acquiring and managing a MTPL contract. Having a dominance in motor insurance within the non-life business comes along with higher expenses (std. coeff. = 0.443), so the hypothesis (H2c) regarding the variable $NL_{i,t}$ cannot be validated. Contrary to our hypothesis (H3c) being a multiline insurer increases the expenses (std. coeff. = 0.005). A possible explanation could be the higher complexity of a bigger product portfolio. A recent study by V.E.R.S. Leipzig and zeb (2016) states that next to regulatory aspects and the distribution system, the size of the product portfolio is the main complexity driver. A growth in motor insurance contracts increases the expenses (std. coeff. = 0.137), so our initial hypothesis (H5c) can be validated. For the legal status "mutual", the expenses are lower compared to listed companies (std. coeff. = −0.418), so we can validate hypothesis (H6c).

4.2 OD regression analysis

The results of the total regressions for OD are shown in Table 7. We discuss our findings for premiums, claims and expenses in the following paragraphs.

Premiums Starting with the first dependent variable $PR^p_{i,t}$, the model (R1) can explain 76% of the premiums per contract. The adjusted R^2 is 0.758 on $N = 1021$ observations. As in MTPL, the previous year claims $CL_{i,t-1}$ have the highest influence.[4] We have several variables, which have a significant impact on the premiums. The variables direct company $DI_{i,t}$, dominance of the motor product in non-life $NL_{i,t}$, multiline $MU_{i,t}$, growth in contracts $GR_{i,t}$ and the claims

[4] Also for OD, it must be paid attention to multicollinearity. The explanatory power of each single variable is displayed in Tables 9 and 10 in the Appendix, where we have included the single regressions for each variable.

Regression models		(R1) Premiums $PR^p_{i,t}$		(R2) Claims $CL^p_{i,t}$		(R3) Expenses $EX^p_{i,t}$	
Intercept	β_0	20.7 ***		178.4 ***		32.2 ***	
Direct $DI_{i,t}$	β_1	−19.0 ***	(−0.520)	−44.7 ***	(−0.230)	−12.3 ***	(−0.146)
Dominance $NL_{i,t}$	β_2	16.5 ***	(1.301)	11.5 *	(0.121)	15.2 ***	(0.370)
Multiline $MU_{i,t}$	β_3	6.4 *	(0.003)	9.2 *	(0.296)	9.8 ***	(0.729)
Market share $MS_{i,t}$	β_4	48.2	(0.210)	−293.3 ***	(−27.336)	−89.0 ***	(−19.144)
Growth $GR_{i,t}$	β_5	1.1 .	(0.917)	1.0	(0.008)	0.7 .	(0.013)
Claims $CL_{i,t-1}$	β_8	0.9 ***	(0.006)				
Legal status $LG_{i,t}$	γ_6						
Listed		baseline		baseline		baseline	
Mutual		−12.7 ***	(−0.083)	−35.6 ***	(−0.314)	−20.5 ***	(−0.417)
Public		0.7	(0.005)	−9.5 ***	(−0.005)	−0.7	(−0.001)
Time $YR_{i,t}$	γ_7						
2002		26.3 ***	(2.079)	1.5	(0.143)	5.7 *	(1.231)
2003		17.6 ***	(0.120)	−12.5 *	(−0.101)	3.7	(0.069)
2004		33.4 ***	(0.298)	−16.9 **	(−0.178)	2.4	(0.060)
2005		33.3 ***	(0.217)	−17.4 **	(−0.134)	3.0	(0.053)
2006		25.9 ***	(0.193)	−16.9 **	(−0.149)	1.8	(0.036)
2007		20.6 ***	(0.010)	−12.8 *	(−0.007)	1.2	(0.001)
2008		12.1 **	(0.331)	4.0	(0.129)	1.1	(0.082)
2009		−6.1	(−0.027)	−5.0	(−0.026)	1.0	(0.011)
2010		baseline		baseline		baseline	
2011		1.2	(0.990)	7.5	(0.698)	−0.8	(−0.169)
2012		2.8	(0.222)	−1.5	(−0.012)	−0.3	(−0.006)
2013		21.1 ***	(0.144)	28.6 ***	(0.301)	0.8	(0.021)
2014		4.8	(0.043)	−3.9	(−0.030)	3.6	(0.064)
N		1021		1021		1021	
Adj.R^2		0.758		0.274		0.210	
AIC		9350		10134		8513	

The reported values show the regression coefficients.
The standardized coefficients are displayed in brackets.
Significance codes: *** $p < 0.001$, ** $p < 0.01$, * $p < .05$, . $p < 0.1$.

Table 7: Results of the OD regression analysis.

per contract of the prior year $CL_{i,t-1}$ are significant. The variable market share $MS_{i,t}$ has no explanatory power. With regards to the legal status $LG_{i,t}$, mutuals differ significantly from listed companies (0.1% level). For the variable year of data, the years 2002 to 2008 and 2013 are significantly different compared to the base year 2010.

Being a direct insurer goes along with lower premiums per contract for an OD insurance policy, $DI_{i,t}$ (std. coeff. $= -0.520$). Thus, our first hypothesis (H1a) can be confirmed. Having a dominance in motor insurance within the non-life business $NL_{i,t}$ and having a multiline offer $MU_{i,t}$ relates to higher premiums per contract, whereby the variable $NL_{i,t}$ (std. coeff. $= 1.301$) has the second highest influence and $MU_{i,t}$ (std. coeff. $= 0.003$) the lowest. Hereby we confirm our second (H2a) and third hypotheses (H3a). The fifth hypothesis (H5a) cannot be validated since higher growth in contracts $GR_{i,t}$ goes along with higher premiums per contract. Our sixth hypothesis (H6a) is validated because for mutuals the premiums per contract are significantly lower compared to listed companies (std. coeff. $= -0.083$). The results for the variable $YR_{i,t}$ confirm our hypothesis of price cycles (H7a). Compared to the base year 2010 the early years have higher premiums, then falling to the lowest level in 2009 and recovering over the last years.

The eighth hypothesis (H8) is validated since higher previous year's claims per contract $CL_{i,t-1}$ go along with higher premiums per contract for the current year's insurance.

Total claims costs For our second dependent variable $CL^p_{i,t}$, the model (R2) yields an adjusted R^2 of 0.274. The variables direct company $DI_{i,t}$ and market share $MS_{i,t}$ are significant at the 0.1% level. The influence of multiline $MU_{i,t}$ and dominance of the motor product in non-life $NL_{i,t}$ are significant at the 5% level. The variable growth in contracts $GR_{i,t}$ has no explanatory power. For the legal status $LG_{i,t}$ both forms mutual and public are significant claims drivers when compared to listed companies. For our variable year of data $YR_{i,t}$, the period from 2003 to 2007 and the year 2013 yield significantly different claims compared to the base year 2010.

Having a dominance in motor insurance within the non-life business relates to higher total claims costs per contract (std. coeff. $= 0.121$), so we can validate our second hypothesis (H2b). What is surprising is that being a direct insurer relates to lower total claims costs per policy (std. coeff. $= -0.230$). This is contrary to our first hypothesis (H1b). A possible explanation could be that young people, which mainly use direct insurance companies, can afford only smaller economy cars. When an accident happens the resulting claims might be lower than the claims resulting from accidents with luxury cars. This could be a topic of future research.[5] Our findings on $MU_{i,t}$ are also in contrast to our initial hypothesis (H3b). Having a multiline offer relates to higher total claims costs per contract (std. coeff. $= 0.296$). As for MTPL, our reasoning of higher efficiency in claims management processes cannot be confirmed. Having a high market share in motor insurance lowers the total claims costs per OD policy. Thus, our fourth hypothesis (H4b) can be confirmed, whereby the influence of $MS_{i,t}$ (std. coeff. $= -27.336$) is the highest of all variables. Our sixth hypothesis (H6b) is validated because for mutuals the total claims costs per policy are lower compared to listed companies (std. coeff. $= -0.314$). The results for $YR_{i,t}$ indicate claims peaks for certain years but no cycle. Based on the reference year 2010, the years 2003 to 2007 go along with significantly lower claims per contract, while in 2013 the claims are significantly higher.

Operating expenses Our third model (R3) tries to explain the expenses $EX^p_{i,t}$. It explains about 21% of the variance.

We find the following variables to be significant: direct company $DI_{i,t}$, dominance of the motor product in non-life $NL_{i,t}$, multiline $MU_{i,t}$, market share $MS_{i,t}$ and growth in contracts $GR_{i,t}$ (with a 10% level of confidence). As for the other two dependent variables $PR^p_{i,t}$ and $CL^p_{i,t}$, the legal status $LG_{i,t}$ is significant. However, we find the year of data $YR_{i,t}$ to have less significant impact. Except for the year 2002, the results for the variable $YR_{i,t}$ have no significant explanatory power.

Being a direct insurer and having a high market share in motor insurance relates to lower expenses for a OD insurance policy. Thus, our first (H1c) and fourth hypotheses (H4c) can be confirmed whereby the variable $MS_{i,t}$ (std. coeff. $= -19.144$) has the highest influence. The impact of $DI_{i,t}$ (std. coeff. $= -0.146$) is negative and so direct insurers relate to lower expenses for acquiring and managing an OD contract. Having a dominance in motor insur-

[5] A possible explanation could also result from the contract deductibles. Because of the smaller budgets of younger drivers, they could be more willing to sign a lower-priced own damage insurance policy with a relatively high deductible. This would have a weakening effect on premiums and on claims costs. Due to limitations in our dataset we cannot include deductibles in our analysis. The effect of deductibles could also be a topic of future research.

ance within the non-life business comes along with higher expenses, so the hypothesis (H2c) regarding the variable $NL_{i,t}$ (std. coeff. $= 0.370$) cannot be validated. Also the results for multiline are contrary to our hypothesis (H3c). Being a multiline insurer goes along with higher expenses (std. coeff. $= 0.729$). A growth in motor insurance contracts increases the expenses (std. coeff. $= 0.013$), so our initial hypothesis (H5c) can be validated. For the legal status "mutual", the expenses are lower compared to listed companies (std. coeff. $= -0.417$), so we can validate hypothesis (H6c).

5 Conclusion

The German motor insurance market has become the largest market in Europe. We give an overview of the market consisting of the competitive landscape, the premiums, the total claims costs and the operating expenses. In addition, we discuss the rise of direct insurance companies in a dedicated section.

Throughout the paper, we analyze to which extend the characteristics of insurance companies can explain three key performance indicators in the insurance industry, namely the premiums, the total claims costs and the operating expenses per contract. The analysis is done for the two main products in Germany, compulsory MTPL and voluntary OD. We define a model framework with three dependent and eight explaining variables and develop and test hypothesis using panel data of insurance companies for the years 2002 to 2014. An overview of the regression results and the hypothesis testing is shown below in Table 8.

	Companies with ...	... relate to	Premiums	Claims	Expenses
MTPL	... a direct distribution strategy		**lower** (✓)	n.s.	**lower** (✓)
	... a focus on motor insurance		**higher** (✓)	**higher** (✓)	**higher** (×)
	... a multiline product offer		**higher** (✓)	**higher** (×)	higher (×)
	... a higher market share		**lower** (✓)	**lower** (✓)	**lower** (✓)
	... a higher growth		lower (✓)	n.s.	higher (✓)
	... the legal form of a mutual		**lower** (✓)	**lower** (✓)	**lower** (✓)
	... higher claims in the previous year		**higher** (✓)		
OD	... a direct distribution strategy		**lower** (✓)	**lower** (×)	**lower** (✓)
	... a focus on motor insurance		**higher** (✓)	higher (✓)	**higher** (×)
	... a multiline product offer		higher (✓)	higher (×)	**higher** (×)
	... a higher market share		n.s.	**lower** (✓)	**lower** (✓)
	... a higher growth		higher (×)	n.s.	higher (✓)
	... the legal form of a mutual		**lower** (✓)	**lower** (✓)	**lower** (✓)
	... higher claims in the previous year		**higher** (✓)		

Bold text for significance levels *** $p < 0.001$ and ** $p < 0.01$, normal text for significance levels * $p < .05$ and . $p < 0.1$ and n.s. stands for not significant.
Results of hypotheses testing (✓ = hypothesis is verified, × = hypothesis is rejected).

Table 8: Summary of the regression results and hypotheses tests.

Our main findings are that companies with the legal status of a mutual relate to lower premiums, lower total claims costs as well as lower operating expenses per contract compared to listed companies. In addition, companies with a higher market share in motor insurance relate to lower premiums in MTPL, lower total claims costs as well as lower operating expenses per contract compared to companies with a lower market share. Furthermore, direct insurance

companies go along with lower premiums and lower operating expenses per contract compared to traditional companies selling via agents or brokers. It is surprising, that direct insurers also relate to lower total claims costs in OD. We argue that direct companies are mainly used by younger people with higher claims risks but cheaper cars and claims. It is also surprising to observe that companies with a multiproduct offering, which are usually larger companies, cannot benefit from their size in terms of a higher efficiency in acquiring and managing contracts and in terms of better claims management processes. A possible explanation could be the rise in complexity that goes along with a larger product portfolio. A study by V.E.R.S. Leipzig and zeb (2016) states that next to regulatory aspects and the distribution system, the size of the product portfolio is the main complexity driver. This would be an interesting aspect for future research. Further, our analysis shows that companies with a focus on the motor product within their non-life business relates to higher premiums, higher total claims costs and contrary to our hypothesis higher operating expenses per contract. Additionally, higher previous year's claims per contract go along with higher premiums per contract for the current year's insurance. Regarding the year of data our results show that only the insurance premiums per contract $PR^p_{i,t}$ are subject to time cycles.

Given our findings on the German motor insurance market, a study on other sizable European markets and a comparison of the factors driving their development could be insightful. Finally, at the end of Section 2, we have introduced the concept of aggregator platforms. For future research, it could be interesting to see if the participation on an aggregator page can help to explain the premiums, total claims costs and operating expenses per contract. Since only little history is available on the participation of insurers on aggregator pages and commission revenues are not disclosed (Handelsblatt, 2016), a quantitative analysis is still difficult.

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Notes

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Appendix

Single variable regressions

Single variable regression models show the influence of individual variables. We define single regressions as follows:

$$Y = \beta_0 + \beta_1 \cdot X + \epsilon_{i,t}$$

Here Y stands for the dependent variables $PR^p_{i,t}$, $CL^p_{i,t}$ and $EX^p_{i,t}$ and X stands for the explaining variables $MU_{i,t}$, $DI_{i,t}$, $NL_{i,t}$, $MS^p_{i,t}$, $GR^p_{i,t}$, $CL^p_{i,t-1}$, $LG_{i,t}$ and $YR_{i,t}$. Tables 9 and 10 show the results for MTPL and OD.

		MTPL				OD			
	X	β_0	β_1	Std. β_1	R^2	β_0	β_1	Std. β_1	R^2
Premiums	$DI_{i,t}$	242.6	−18.2***	−0.126	0.016	207.1	−53.1***	−0.398	0.158
	$NL^p_{i,t}$	241.6	−8.2	−0.033	0.001	199.7	−2.2	−0.009	0.000
	$MU_{i,t}$	208.2	35.5***	0.214	0.046	181.0	20.4***	0.133	0.018
	$MS_{i,t}$	242.2	−184.3*	−0.077	0.006	199.5	−22.9	−0.011	0.000
	$GR^p_{i,t}$	240.0	0.5	0.015	0.000	199.7	0.1	0.002	0.000
	$CL^p_{i,t-1}$	102.6	0.7***	0.746	0.557	39.3	1.0***	0.810	0.657
Claims	$DI_{i,t}$	204.8	1.2	0.008	0.000	173.9	−35.1***	−0.312	0.097
	$NL^p_{i,t}$	209.0	−18.4*	−0.068	0.005	171.3	−12.2*	−0.063	0.004
	$MU_{i,t}$	180.2	27.8***	0.153	0.023	157.7	12.3**	0.095	0.009
	$MS_{i,t}$	209.4	−348.0***	−0.132	0.017	170.5	−141.9*	−0.078	0.006
	$GR^p_{i,t}$	204.7	1.3	0.034	0.001	168.8	0.6	0.021	0.000
Expenses	$DI_{i,t}$	40.3	−3.0.	−0.056	0.003	42.0	−7.3***	−0.139	0.019
	$NL^p_{i,t}$	39.2	2.9	0.031	0.001	41.4	−2.2	−0.025	0.001
	$MU_{i,t}$	35.7	4.6*	0.074	0.005	31.7	10.3***	0.170	0.029
	$MS_{i,t}$	40.0	−14.3	−0.016	0.000	41.3	−34.7	−0.041	0.002
	$GR^p_{i,t}$	39.2	0.6.	0.054	0.003	40.5	0.8.	0.056	0.003

Significance codes: *** p<0.001, ** p<0.01, * p<.05, . p<0.1
The number of observations is $N = 1034$, except for $GR^p_{i,t}$ and $CL^p_{i,t-1}$ where $N = 1021$.

Table 9: Single variable regressions (part I).

			Premiums		Claims		Expenses	
			β_1	Std. β_1	β_1	Std. β_1	β_1	Std. β_1
MTPL	$X = LG_{i,t}$	Listed	baseline		baseline		baseline	
		Mutual	−60.2***	−0.377	−49.1***	−0.281	−16.5***	−0.277
		Public	−11.5**	−0.095	−8.9*	−0.067	−3.7**	−0.081
		β_0	249.6		212.9		42.6	
		R^2	0.136		0.76		0.074	
	$X = YR_{i,t}$	2002	44.2***	3.216	30.7***	2.036	1.1	0.205
		2003	48.9***	3.559	20.5*	1.364	0.0	0.009
		2004	49.7***	3.615	24.2**	1.607	−0.8	−0.162
		2005	41.0***	2.985	19.3*	1.280	−0.9	−0.182
		2006	28.3***	2.061	4.7	0.310	−1.5	−0.299
		2007	22.1**	1.609	−0.9	−0.058	−1.3	−0.257
		2008	15.2*	1.105	−6.2	−0.413	0.1	0.023
		2009	2.2	0.158	−12.0	−0.800	2.5	0.489
		2010	baseline		baseline		baseline	
		2011	3.0	0.220	−5.5	−0.363	−0.9	−0.173
		2012	9.7	0.708	−9.6	−0.640	−0.4	−0.069
		2013	16.1*	1.169	−10.4	−0.691	1.3	0.257
		2014	24.6**	1.788	−1.9	−0.124	2.0	0.386
		β_0	216.0		200.6		39.7	
		R^2	0.114		0.063		0.004	
OD	$X = LG_{i,t}$	Listed	baseline		baseline		baseline	
		Mutual	−34.2***	−0.231	−28.1***	−0.225	−18.1***	−0.312
		Public	0.8	0.007	−1.2	−0.013	0.3	0.007
		β_0	203.0		172.3		42.9	
		R^2	0.054		0.050		0.098	
	$X = YR_{i,t}$	2002	21.3**	1.677	4.1	0.378	6.7*	1.336
		2003	26.2***	2.060	−9.5	−0.890	4.9.	0.979
		2004	28.8***	2.267	−14.8*	−1.384	3.2	0.641
		2005	24.4**	1.918	−16.2**	−1.513	3.3	0.651
		2006	14.9*	1.175	−15.1*	−1.407	2.4	0.484
		2007	11.4	0.895	−11.4.	−1.066	1.7	0.339
		2008	4.8	0.376	4.3	0.403	1.4	0.285
		2009	1.8	0.139	−4.8	−0.445	3.9	0.778
		2010	baseline		baseline		baseline	
		2011	5.5	0.436	7.3	0.678	−0.8	−0.167
		2012	13.0.	1.022	−1.5	−0.142	−0.4	−0.074
		2013	23.6**	1.853	26.4***	2.463	1.9	0.389
		2014	34.6***	2.718	−5.1	−0.479	3.3	0.663
		β_0	183.0		171.6		38.4	
		R^2	0.050		0.079		0.012	

Significance codes: *** p<0.001, ** p<0.01, * p<.05, . p<0.1
The number of observations is $N = 1034$.

Table 10: Single variable regressions (part II).

Companies included in the analysis

AachenMuenchener Versicherung AG
ADAC Autoversicherung AG
ADLER Versicherung AG
Allianz Versicherungs-AG
AllSecur Deutschland AG
Alte Leipziger Versicherung AG
ARAG Allgemeine Versicherungs-AG
Auto Direkt Versicherungs-AG
Avetas Versicherungs-AG
AXA die Alternative Versicherung AG
AXA easy Versicherung AG
AXA Versicherung AG
Badische Allgemeine Versicherung AG
Badischer Gemeinde-Versicherungs-Verband BGV
Basler Sachversicherungs-AG
Basler Securitas Versicherungs-AG
Basler Versicherung AG Direktion fuer Deutschland
Bayerische Beamten Versicherung AG
Bayerischer Versicherungsverband VersicherungsAG
Berlin-Koelnische Sachversicherung AG
BGV-Versicherung AG
Bruderhilfe Sachversicherung AG im Raum der Kirchen
Condor Allgemeine Versicherungs-AG
Continentale Sachversicherung AG
Cosmos Versicherung AG
D.A.S. Deutscher Automobil Schutz Versicherungs-AG
DA Deutsche Allgemeine Versicherung AG
DBV Deutsche Beamtenversicherung AG
DBV-WinSelect Versicherung AG
DBV-Winterthur Versicherung AG
Debeka Allgemeine Versicherung AG
Deutsche internet versicherung AG
Deutscher Ring Sachversicherungs-AG
DEVK Allgemeine Versicherungs-AG
DEVK Deutsche Eisenbahn Versicherung a.G.
Direct Line Versicherung AG
ERGO Direkt Versicherung AG
ERGO Versicherung AG
Europa Versicherung AG
Fahrlehrerversicherung Verein auf Gegenseitigkeit
Feuersozietaet Berlin Brandenburg Versicherung AG
Garanta Versicherungs-AG
Generali Lloyd Versicherung AG
Generali Versicherung AG
Gerling-Konzern Allgemeine Versicherungs-AG
Gothaer Allgemeine Versicherung AG
Gothaer Allgemeine Versicherung AG
Gothaer Versicherungsbank VVaG
GVV-Kommunalversicherung VVaG
GVV-Privatversicherung AG
Hamburg-Mannheimer Sachversicherungs-AG
Hannoversche Direktversicherung AG
HDI Versicherung AG
HDI-Gerling Firmen und Privat Versicherung AG
Helvetia Schweizerische Versicherungsgesellschaft AG
Helvetia Versicherungs-AG
HUK24 AG
HUK-COBURG a.G.
HUK-COBURG-Allgemeine Versicherung AG
Itzehoer Versicherung/Brandgilde von 1691 VVaG
Janitos Versicherung AG
Karlsruher Beamten-Versicherung AG
Karlsruher Versicherung AG
Kravag Allgemeine Versicherungs-AG
Landesschadenhilfe Versicherung VaG
Landschaftliche Brandkasse Hannover
Lippische Landes-Brandversicherungsanstalt
LVM a.G.
Mannheimer Versicherung AG
Mecklenburgische Versicherungs-Gesellschaft a.G.
Muenchener Verein Allgemeine Versicherungs-AG
Neckura Versicherungs-AG
Nova Allgemeine Versicherung AG
Nuernberger Allgemeine Versicherungs-AG
Nuernberger Beamten Allgemeine Versicherung AG
Oeffentliche Feuerversicherung Sachsen-Anhalt
Oeffentliche Sachversicherung Braunschweig
Oldenburgische Landesbrandkasse
Ontos Versicherung AG
Optima Versicherungs-AG
Ovag Ostdeutsche Versicherung AG
Provinzial Nord Brandkasse AG
Provinzial NordWest Holding AG
Provinzial Rheinland Holding
Provinzial Rheinland Versicherung AG
R+V Allgemeine Versicherung AG
R+V Direktversicherung AG
RheinLand Versicherungs AG
S DirektVersicherung AG
Saarland Feuerversicherung AG
Savag Saarbruecker Versicherungs-AG
Schweizer - National Versicherungs-AG
SECURITAS Bremer Allgemeine Versicherungs-AG
Sicher Direct Versicherung AG
Signal Iduna Allgemeine Versicherung AG
SIGNAL Unfallversicherung a.G.
Sparkassen-Versicherung Sachsen AG
Sun Direct Versicherungs-AG
SV SparkassenVersicherung AG
SV Hessen-Nassau-Thuerigen AG
telcon Allgemeine Versicherung AG
Transatlantische Allgemeine Versicherung AG
Vereinte Versicherung AG
Versicherungskammer Bayern
VHV Allgemeine Versicherung AG
VHV Autoversicherung AG
Volkswagen Autoversicherung AG
Volkswohlbund Sachversicherungen AG
Westfaelische Provinzial Versicherung AG
WGV-Versicherung AG
Wuerttembergische Gemeinde-Versicherung a.G.
Wuerttembergische Versicherung AG
Zenith Versicherung AG

All companies operating under a public mother company are assigned to the group of public companies. Companies operating under a listed or mutual mother company are assigned to the group of mutual or listed companies according to their individual legal status.

Table 11: List of companies included in the data panel.