The Effect of Regulatory Lags on Underwriting Cycles: 
the Case of Germany

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1. Introduction

The existence of an insurance underwriting cycle, wherein industry performance is characterized by repeated “hard” and “soft” markets, is well documented in the United States and in many other countries.\(^1\) While there is no generally accepted theory of the causes of this phenomenon, researchers have examined the role of many potential internal and external factors, including internal rate-making processes, myopic pricing decisions, interest rates, and regulatory lags. Some theories have suggested irrational behaviour on the part of insurers, while others have demonstrated that cycles can arise from rational responses by insurers to exogenous factors.\(^2\) Within this line of thought, referred to as the rational expectations/institutional intervention hypothesis, are four driving forces: data collection lags, policy renewal lags, regulatory lags, and accounting lags. One approach to testing this theory has been to evaluate cycles across different countries to identify the market and institutional features that are significantly related to cycle parameters.

In this paper, we test the rational expectations/institutional intervention hypothesis in an analysis of one industry, one in which the market and institutional features have changed dramatically in the past decade: the Germany property and casualty insurance industry. The German insurance market was highly regulated before July 29, 1994. On this day the legislation incorporating the third generation of European directives into German law went into effect. Since the founding of the European Community in 1957, its member states have been working on the creation of an integrated economic market. The framework for a single European insurance market was finally completed in July 1994. The accompanying harmonization of regulatory systems was designed to create a level playing field for all insurance companies within the European Union.

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\(^1\) The cycle is observable in price, profitability, and supply data. See for example Venezian, 1985; Cummins and Outreville, 1987; Lamm-Tennant and Weiss, 1997; Chen, Wong and Lee, 1999.

\(^2\) Cummins and Outreville, 1987; Lamm-Tennant and Weiss, 1997; Chen, Wong and Lee, 1999
(EU). To comply with the third EU directive on direct non-life insurance, Germany had to abolish the prior approval of policy conditions and apply some other deregulation measures. This change from a prior approval system to free product competition was a dramatic change for the German insurance industry. The implementation of the prior approval by the German Insurance Authority (BAV) and collusion among the German insurers has led to a situation where property and casualty insurance products were identical across firms. Thus, the deregulation of the national market as well as the creation of the Single European Market changed the operating environment for German insurers, completely. A clear delineation between before and after regulation offers a natural experiment for testing the effects of regulatory lags on the performance of the industry.

While our primary objective is to test the rational expectations/institutional intervention hypothesis, we begin by assessing whether deregulation has had an effect on underwriting profitability. Studies of the effect of regulation on insurer performance generally find that, for various reasons, regulations have a negative influence on underwriting profitability. Prior to deregulation, loss ratios in most lines were low. Insurers operating in this regulated environment may have benefited from some forms of regulation, such as restrictions on product differentiation, which restricted competition. A more competitive environment could presumably erode underwriting profits. At the same time, deregulation offers insurers more flexibility in underwriting activities, and could result in more innovative loss control as well as more selective underwriting, potentially improving underwriting performance.

Then we turn to our test of the cycles theory. While empirical analysis of German insurance industry data is limited, an underwriting cycle in the period before deregulation has been documented. Still, little is known about the factors influencing cycles in Germany, or whether this cyclical behaviour has persisted since deregulation. We posit that regulatory and institutional

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3 Personal lines contracts were exactly identical, commercial lines were less so.
4 Cummins and Outreville (1987) and Lamm-Tennant and Weiss (1997) find the German cycle to be x years and 6.5 years, respectively. Our analysis of the autoregressive process suggests a cycle of 7 years before 1994, and about 9 years after that. Meier and Outreville (2003) are unable to estimate a cycle in Germany for the period 1982-2001.
changes in the Germany, deregulation specifically, would affect cyclical performance if insurance cycles are the result of institutional and regulatory lags. Since there is a clear delineation of institutional and regulatory practices in the periods before and after deregulation, we propose that an analysis of pre- and post-deregulation behaviour could provide evidence to support the rational expectations/institutional intervention model. Furthermore, we attempt to characterize the respective contribution of different lag types (e.g., regulatory vs. accounting) through a comparison of the factors that are most influential in the pre-deregulation cycle to those that are most influential in the post-deregulation cycle.

We include in our analysis consideration of the effect that the Schwankungsrückstellung, a claims equalization reserve, has on underwriting cycles. The Schwankungsrückstellung is a mandatory reserve, and is designed to smooth reported earnings of insurance companies over time. We evaluate whether the role of this reserve has changed following the deregulation of the industry. Currently slated to be removed by 2007, the Schwankungsrückstellung may continue to be an important industry stabilizer, even in the deregulation era.

We use by-line data of property and casualty insurance companies supervised by the German insurance authority (BaFin). Our data set covers the period 1983-2004 for 27 lines of business, and is supplemented with data on catastrophic losses, interest rates, the German stock index and GDP. We first apply a weighted OLS regression model to evaluate the effect of the deregulation on the level of insurer losses. In the second part of our analysis, we employ the model of Lamm-Tennant and Weiss (1997) to examine factors associated with premium changes in the pre- and post-deregulation periods. Analysing the causes of underwriting cycles in two different regulatory regimes allows us to separate the effects of lags caused by regulation. In this analysis, we also evaluate the extent to which the Schwankungsrückstellung works to smooth premium changes.

The results of this research have numerous implications for our understanding of insurance cycles. Most importantly, it offers a clean test of the rational expectations/institutional intervention
hypothesis, because the Germany deregulation was an absolute change in regulatory regime, while the industry participants remained fixed, for the most part. This allows us to also test whether factors affecting the premium process are related to regulatory regime. For example, we find that insurers incorporate more line-specific performance measures into the premium process after deregulation. Consequently, the paper provides a description of the German insurance industry and a history of regulatory events that is not elsewhere available in English. It proceeds as follows. In the next section we describe regulation in the German property and casualty insurance industry, and the particular form of deregulation that followed the transition to the EU Single Economy. In this section we provide a detailed discussion of regulation in the German insurance industry and present our hypotheses regarding the performance of insurers following deregulation. In Section 3, we present the data and discuss the variables of interest. Section 4 contains the results of our empirical analysis of the effect of deregulation on by-line underwriting performance. We find that loss levels have increased following deregulation, supporting our theory of increased competition and higher underwriting costs. Section 5 contains our analysis of premium changes, and considers the role of the Schwankungsrückschstellung, including the objectives and the specific mechanisms for calculating required reserve amounts. We find evidence that the premium process has changed following deregulation, thus supporting a regulatory lag view of underwriting cycles. Interestingly, we find that the factors that influence the premium process in the pre- and post-deregulation eras are substantially different. Section 6 concludes.

2. The German Insurance Market and its Regulation

The Germany insurance industry is the largest, in terms of premium revenue, of all insurance markets in the European Union. As in the United States, most insurers are organized as stock companies (75 percent) or mutual associations (20 percent). The remaining firms are organized as insurance companies under public law, created by a public decree to serve a public purpose. See Maurer and Somova, 2005).
does not allow one legal entity to write both life and health insurance and property-casualty
business; holding companies contain separate, fully owned legal entities for the different forms of
business. Foreign insurers are allowed to write business in Germany if they have established a
legal entity in the German market, and they are supervised by the German Federal Supervisory
Authority (Bundesanstalt für Finanzdienstleistungsaufsicht or BaFin). Since the completion of the
Single Market, Insurers from the European Union may conduct business in Germany without
setting up a German entity, but they fall under the supervision of their domestic supervisory body.
Currently, European insurers not subject to German regulation account for less than 3 percent of
the market.\textsuperscript{6}

In 2003, the property and casualty sector in Germany contained 251 firms. While the
number of insurers has dropped only slightly since 1995 (281 firms), the market is significantly
more concentrated than it was in 1990, when there were 346 property and casualty insurers in
operation. Automobile insurance is the largest single line, representing 41 percent of total
premiums. Other major lines include property insurance (27 percent), general liability (12 percent),
and private accident insurance (11 percent).\textsuperscript{7}

\textbf{Insurance Regulation before July 1994}

Modern insurance regulation in Germany developed to channel the rapid growth of the
insurance industry in the mid 19\textsuperscript{th} century. Although insurance regulation was seen as an area under
the responsibility of the federal government, the individual states were first in designing some
regulatory statutes. As a federal regulatory law was finally passed in 1901,\textsuperscript{8} it established a federal

\textsuperscript{6} Data on market shares is from the 2004 yearbook of the Federal Supervisory Authority (BaFin).
\textsuperscript{7} See Maurer and Somova, 2005.
\textsuperscript{8} Reichsgesetz über die private Versicherungsunternehmung, May 12, 1901, in: Reichsgesetzblatt 139.
Today's Gesetz über die Beaufsichtigung der Versicherungsunternehmen (or Versicherungskaufsichtsgesetz) is
based on this law with only modest changes.
regulatory authority with comprehensive power to control insurance companies and their business.\textsuperscript{9} State regulators only kept control over small local mutual insurers and public law institutions. In addition to the regulatory law, an Insurance Contract Law was passed in 1908 creating rules for all sorts of insurance except reinsurance and ocean marine.\textsuperscript{10} Kimball and Pfennigstorf (1964) describe the German Insurance Contract Law as “one of the most liberal of all systems on the [European] continent” (p.728), and argue that this is because it was developed with an effective administrative control machinery already in place.

The German regulatory law is based on the principal that insurance regulation has to protect the interest of the insured, and, hence, requires prior approval of insurance contract terms by the Federal Insurance Department. In German practice, the insurance contracts consists of two (or more) documents: the \textit{Police} which is basically a certificate of insurance containing only basic information, and the general terms of the insurance contract (\textit{Allgemeine Versicherungsbedingungen} or AVB) printed as a separate document. These AVB are subject to prior approval by the department, and the department has to reject such a request, if the interests of the insured are not sufficiently secured, or if the insurer cannot ensure the continual fulfilment of the obligations assumed.\textsuperscript{11} A special case is compulsory auto liability insurance where all insurance contracts have to have uniform contract terms (AVB) approved by the Federal Insurance Department.\textsuperscript{12} In this business line, rates are also subject to approval. Since the Minister of Economics released an official directive with a detailed description on how rates in auto liability

\textsuperscript{9} Kaiserliches Aufsichtsamt für Privatversicherung, later named Reichsaufsichtsamt für Privatversicherung. After World War II the occupation forces created supervisory agencies. In 1951 the new Bundesaufsichtsamt für das Versicherungswesen (BAV) was established. Since many staff members of the old Reichsaufsichtsamt worked for the British Zone agency, and the BAV took over most of their staff, there was some continuity in regulation (Kimball and Pfennigstorf, 1965)

\textsuperscript{10} Reichsgesetzt über den Versicherungsvertrag, May 30, 1908, in: Reichsgesetzblatt 263. Todays Gesetz über den Versicherungsvertrag (or Versicherungsvertragsgesetzt) is based on this law with only minor changes.

\textsuperscript{11} “... die Belange der Versicherten nicht ausreichend gewahrt oder die Verpflichtungen aus den Versicherungen nicht genügend aus dauernd erfüllbar dargetan sind.” (§8 Abs. 1 Ziff. 2, VAG)

\textsuperscript{12} Gesetz über die Einführung der Pflichtversicherung für Kraftfahrzeughalter und zur Änderung des Gesetzes über den Verkehr mit Kraftfahrzeugen sowie des Gesetzes über den Versicherungsvertrag, November 7, 1939, in: Reichsgesetzblatt I:2223.
insurance have to be calculated in order to be approved, there is hardly any variation of rates across insurance companies.

If an insurer submits new AVB to the Federal Insurance Department for approval, the department is, in theory, bound to give it, if the requirements of the regulatory law are satisfied. In practice, however, the department has considerable discretion in determining whether the interests of the insured are adequately secured. It took up the position that AVB have to fulfil the principles of completeness, clarity, and uniformity (Angerer, 1975). Therefore, AVB have to provide a complete description of the coverage and its limitations, as well as the obligations of the insured. The contracts have to be written clearly enabling consumers to know what they are buying. Furthermore, the department attaches importance to the uniformity of the terms of insurance contracts across the insurance companies. The principle of uniformity results from the point of view that market transparency is a necessary condition to ensure the interests of the insured. The crucial philosophical assumptions underlying the following argumentation is that first, an ordinary consumer is not capable of comparing different insurance contracts and making a rational buying decisions, and second, insurance regulation has to protect consumers from buying inadequate insurance coverage. Therefore, all insurance products should have a minimum quality, and as little variation in contract terms as possible. In such a “transparent market” consumers can rely on the quality of the products, and only have to compare the prices.

To achieve uniformity, the department declares certain AVB as standard (Musterbedingungen). Contract terms deviating from the standard do not have a chance of getting approval unless the department thinks this deviation stands for real progress (Angerer, 1985). It is a corollary of this line of thought that not new AVB deviating from the standard Musterbedingungen should be approved for individual insurers, but rather the standard itself should be revised and improved. Approval of the standard AVB for use by individual insurers is only a matter of routine. This provides a strong incentive to use standard contract terms, especially since it is not possible to

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13 Verordnung über die Tarife in der Kraftfahrtversicherung.
gain a competitive advantage through the development of a new product; the department usually publishes approved AVB (Eggerstedt, 1987). Another disincentive for individual companies to alter standard AVB is the approach of the department to consult all parties which may be interested in such a new product within the approval process. These interested parties include the associations of insurance companies, the associations of insurance buyers, the trade associations, academics, and other associations expressing their interest. Kimball and Pfennigstorf (1965) describe two examples of the tedious process of rearranging AVB. The revision of the AVB for business interruption coverage (Feuerbetriebsunterbrechungsversicherung) started in 1947, and was completed in 1955 as the new AVB were approved. During these years, conferences were held, many comments submitted, two expert opinions prepared, and four different drafts of the AVB discussed. The resulting AVB can be described as a consensus between all interested parties. The approval of new AVB for dwelling replacement cost coverage against fire, tapwater, and storm damage (Neuwertversicherung von Wohngebäuden gegen Feuer-, Leitungswasser und Sturmschäden) started in 1951 and took 10 years. Kimball and Pfennigstorf (1965) point out that the speed of the process “depends on the complexity and urgency of the task and the number of persons or associations interested in the result” (p. 191). The development of standard contract terms for health insurance, for example, starting in 1949 took only 15 months to finish.

The approach of the Federal Insurance Department (BAV) to hold consultations with all interested parties, results in a bargaining-process which gives the BAV extensive influence on insurance product design. Since associations representing multiple companies have more bargaining power, all German insurers belong to associations which are organized according to the types of insurance business. These associations usually took the lead in the negotiations with the BAV or other parties. The BAV in turn preferred to negotiate with one association instead of multiple insurers which explains the importance of the associations in the development of contract terms, and, hence, in the development of new products. Furthermore, associations play an important role in the pricing of insurance coverage. They collect loss data from their members and
generate aggregated statistics. But they also calculate rates which are based on the aggregated 
statistics, and recommend these rates for use by their members. Such rate recommendations are 
possible because §102 of the German Cartel Law exempts insurers from most anti-trust regulation.

In the personal lines, the BAV has reached nearly complete uniformity of AVB. In the 
commercial lines, however, the situation differs slightly from the one described so far. There are a 
lot of additional contract clauses approved by the BAV, and these clauses can be used as a tool 
box to put together individualized insurance contracts. In addition to that, there is a backdoor for 
insurers to avoid the approval of AVB and offer insurance contracts tailored to the demand of their 
commercial customers. In the legal sense all contract terms used in multiple insurance contracts are 
AVB and subject to approval. However, special contract terms (Besondere Bedingungen) 
customized for use in a single individual contract are not subject to approval. Therefore big 
corporations usually hire a broker to help them negotiate an individual contract with an insurance 
company. Since insurers cannot differentially rephrase contract clauses describing the same content 
for every single contract, there is a grey area of “special contract terms” used in multiple insurance 
contracts. The BAV tolerates this behaviour because it does not have the personnel to inspect 
insurers frequently, and it does not want to discriminate individual insurers through sanctions 
(Eggerstedt, 1987). The worst that can happen to an insurer is that it loses its competitive 
advantage because the BAV will publish the insurer’s contract terms for use by the industry.

Therefore, there is product and price competition in commercial lines for big corporations willing 
to negotiate individual contracts or willing to hire a broker negotiating for them.

On June 28, 1990 the legislature incorporating the second EU directive on direct non-life 
insurance into German law went into effect. From this day on no contract terms or rates for 

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14 Second Council Directive on the coordination of laws, regulations and administrative provisions relating to 
direct insurance other than life assurance and laying down provisions to facilitate the effective exercise of 
freedom to provide services and amending Directive 73/239/EEC, June 22, 1988, in: Official Journal L 172, 

“large risks” have to be approved from the BAV before their use. The definition of “large risks” in the second EU directive basically covers insurance contracts with large commercial customers.\textsuperscript{16}

But such customers could get customized insurance coverage before June 28, 1990 as well. Therefore, we argue that the abolishment of the prior approval system for large commercial risks did not change anything. It just legitimated the existing regulatory practice.

The premium volume of commercial lines did account for less than 30% of the overall premiums written in 1990 (CITES); personal lines dominated the insurance industry. Thus, overall, the behaviour of German insurance companies in that time can be described as a convoy led by the BAV and the associations (Farny, 1999). Given the limited possibilities for product competition and strong incentives for collusion in pricing, management activity was focused on the distribution system, marketing activity, customer service, and the improvement of business processes.

\textbf{Deregulation of the Insurance Industry}

The deregulation of the German insurance is a result of the creation of the European Single Market. Since the founding of the European Community (EC) in 1957, its member states have been working on the creation of an integrated economic market. The framework for a single European insurance market was finally completed in July 1994. The accompanying harmonization of regulatory systems was designed to create a level playing field for all insurance companies within the European Union (EU). Since complete harmonization could not be reached, the EC combined a minimum level of harmonization with open cross border competition. The idea behind this approach is that market competition will force the member states to adopt the most effective

\textsuperscript{16} In the second EU directive on direct non-life insurance “large risks” are defined as (1) risks belonging to one of the following risk classes: railway rolling stock, aircraft, ships, goods in transit, aircraft liability, liability for ships, or (2) credit and suretyship risks if the policy holder is engaged professionally in an industrial or commercial activity or is in one of the liberal professions, and the risk is related to such activity, or (3) risks from fire and natural forces, other damage to property, general liability, or miscellaneous financial loss if the policy holder exceeds the limits of at least two of the following three criteria: first stage: until December 31, 1992: 1) balance-sheet total: 12.4 million ECU 2) net turnover: 24 million ECU 3) average number of employees during the fiscal year: 500; second stage: from January 1, 1993: 1) balance-sheet total: 6.2 million ECU 2) net turnover: 12.8 million ECU 3) average number of employees during the fiscal year: 500.
regulatory system. To create the single European insurance market the EC adopted twenty-one directives.\textsuperscript{17} Directives require the member states to incorporate the adopted provisions into their national legislature within a specified timeframe.

There are four directives that specifically address the property-liability business. The first Direct Non-life Insurance Directive was adopted on July 24, 1973.\textsuperscript{18} It set minimum regulatory standards among the member states by requiring the supervision of all types of property-liability business by the regulators, a licensing process for insurance companies, and minimum solvency margins. The Liberalization Directive of July 24, 1973 allowed insurers to set up branches in all member states but these branches are subject to regulation by the host member state.\textsuperscript{19}

The Second Non-life Insurance Directive of June 22, 1988 started to introduce competition between the different regulatory regimes. This directive allows insurers to write business with large commercial customers in all member states without having to establish branches in all these states before. Thus, an insurance company is only subject to regulation in its country of origin concerning such cross border commercial business. However, the insurance contract law and the tax law of the host country do still apply to such business acting as barriers to entry. In addition to the liberalization of most commercial business, the second directive required all member states to abolish prior approval of insurance rates and contract terms for business with large commercial customers. But this change in the regulatory law did not affect the business of the German insurance industry; it just legitimated the existing regulatory practice.

According to this directive, insurance companies do only need a single licence from their state of origin to write all types of insurance business in all member states, and they are only subject to regulation in their state of origin. Since the insurance contract law and the tax law of the host country do still apply, insurers have to develop different products for different countries making cross-border services a difficult task. Thus, the market share of cross-border business from European insurers in Germany is negligible: it was only 0.9% in 2003. Even the market share of European insurers establishing branches in Germany is very small (1.5% in 2003) indicating that the creation of the European single market did not increase competition significantly. But the side effect of the single market, the requirement of the third direct non-life insurance directive to abolish prior approval of insurance contract terms (AVB) and rates, changed the German market dramatically. This change can be tied to July 29, 1994, the date when the legislature incorporating the third non-life insurance directive into German law went into effect. The deregulation of insurance contract terms and rates resulted in product and price competition among the insurers licensed in Germany and operating under the German regulatory regime.

Effects of Deregulation on Insurers

In the U.S., regulations governing rate setting vary across lines and across states. This variation has motivated numerous studies of the effects of these regulations, holding all else equal, on insurer performance. In contract, the German insurance market is marked by little variability. There is one environment, and, until deregulation, only one set of regulations governing how insurers do business. The clear delineation between before and after regulation offers a natural experiment for testing the effects of regulatory lags on the performance of the industry.

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21 Data on market shares is from the 2005 yearbook of the insurance supervisory authority (BaFin).
22 See, for example, Cummins and Harrington, 1987; Harrington, 1984.
Empirical analysis of German insurance industry data and the effect of deregulation is limited. Existing studies have documented the existence of an underwriting cycle,23 focused on operations in a particular line,24 assessed the results of mergers and acquisitions in the industry,25 and analyzed insurer efficiency. An early assessment of the German insurance market in the nineties suggests that the average productivity of insurers increased dramatically.26 Studies of insurance market performance in other EU countries following deregulation concur.27 The efficiency enhancements are linked to increased market competition, as well as subsequent consolidation activity and changes in organizational structure. Analysis of the corresponding effect on insurance premiums indicates sluggish responses by insurers, but may be premature.28

Studies of the effect of regulation on insurer performance generally find that, for various reasons, restrictions have a negative influence on insurer profitability. For example, restrictive rate regulation, such as a prior approval law, is associated with lower underwriting profitability because insurers are not able to adapt their prices quickly in response to unfavourable experience.29 Insurers operating in a regulated environment may, however, benefit from forms of regulation that restrict competition. Barriers to entry and restrictions on product differentiation, for example, may work in an insurer’s favor, serving as a form of collusion among firms.

The Germany industry was quite stable in the years preceding deregulation. To our knowledge, there have not been any insurance company insolvencies since World War II, and although the number of firms has declined since 1990, this consolidation has not significantly changed the level of competition, as these mergers and acquisitions were mostly the result of the

26 Mahlberg and Url (2000).
28 Mahlberg and Url (2000); Wein (2002).
29 See, for example, Tennyson, 1991; Harrington 2002; Leadbetter, Voll and Wieder, 2004. These studies show that premium volatility is greater in regulated environments.
restructuring of conglomerates. It is possible that the restrictive regulations were, in fact, maintaining a form of stability in the industry. While innovation in the form of rating, or new products, was basically unseen, we find that insurers were financially comfortable, reporting loss ratios consistently below one.

The deregulation measures opened up new opportunities for German insurers. With more flexibility to choose how to operate on a number of different dimensions, we might expect profitability to improve. However, to the extent that the regulated regime was characterized by low competition, the influence of deregulation on profitability in a newly competitive environment would presumable accrue only to those firms who make successful choices. Thus, we expect that while underwriting performance may improve on the whole, this performance may become more volatile across firms and over time in the deregulation era.

The Schwankungsrückstellung

German regulation requires that insurers keep a claims equalization fund, called the Schwankungsrückstellung, as a form of reserve against catastrophic losses. The mechanism of this reserve is quite simple. In years of below average losses the difference between the actual losses and the average is used to build up a fund, and in years of above average losses the insurer uses the fund to cover the excess loss. The goal of this fund is to spread the loss of an irregularly occurring event evenly over several years and, hence, to smooth the reported earnings of the insurance companies. Thus, its value may be an important determinant of insurer performance and it is included in our analysis.

The mandate for establishing such a fund dates back to the 1930s, but the specific calculations and regulatory issues were made clearer in 1978. Since then, insurers have been required to maintain a reserve fund for each line of insurance if this line meets any of the following three conditions: (1) if the average of the premiums earned in the last 3 years exceeded 125,000€, 30 Lier, 2003.
(2) if the standard deviation of the loss ratios in the past 15 years\(^1\) was greater than or equal to 5 percent, and (3) if the combined ratio was greater than 100 percent for one of the past 15 years. Additional details about the reserving process are provided in the Appendix.

3. Data and Methodology

In our assessment of the German insurers, we use by-line data of property and casualty insurance companies supervised by the German insurance authority (BaFin). The data is obtained from the yearbooks of the German insurance authority.\(^{31}\) Specifically, we use measures of premiums earned, losses incurred, number of contracts and the value of the Schwankungsrückstellung for each year, for the period 1983-2004 for 24 lines of business. For the analysis, we include additional variables that might influence the premium process, including annual catastrophic loss amounts, interest rates, stock index, and GDP. Table 1 contains summary statistics for our dataset, for the period 1983-1994, 1995-2004, and the entire sample period, 1983-2004. Premium growth was larger in the first part of our sample than in the post 1995 period, as was the corresponding change losses. Premium growth was still positive for the 1995-2004 period, the change in losses, however, was negative indicating a better underwriting of insurance companies. The absolute value of the Schwankungsrückstellung was smaller for the 1983-1994 period than for the 1995-2004 period. This can be attributed to a volume effect.

There are two major components determining the size of the Schwankungsrückstellung: the volatility of the loss ratio and the premium volume. Since the industry premium volume was higher in the 1995-2004 period than in the 1983-1994 period, the Schwankungsrückstellung was higher in this period, too. While the aggregate industry loss ratio did not change significantly from the 1983-

\(^{31}\) The German insurance authority (Bundesaufsichtsamt für das Versicherungswesen) merged on May, 1 2002 with the German banking authority (Bundesaufsichtsamt für das Kreditwesen) and the authority responsible for the stock exchanges (Bundesaufsichtsamt für den Wertpapierhandel). The new supervisory authority is called Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin). Therefore, we use the yearbooks of the Bundesaufsichtsamt für das Versicherungswesen for the years 1983-2001 and the yearbooks of the BaFin for the years 2002-2004.
1994 period to the 1995-2004 period, the standard deviation of the loss ratio increased significantly. This effect carries through to the standard deviation of the Schwankungsrückstellung; in the 1995-2004 period the standard deviation was 3.5 times the size of the standard deviation in the 1983-1994 period.

Figure 1 illustrates the variability, across lines, in underwriting performance through our sample period, for the five lines with the highest total gross premiums in 2004: Auto liability, Personal Liability, Auto Physical Damage, Personal Accident, and Residential/Commercial Building Damage. The figure shows the annual by-line loss ratio, defined as total net losses incurred divided by total net premiums written. The data indicate that the liability lines have historically been less volatile than the casualty lines. Also, Personal Accident coverage has consistently been the most profitable line.

4. Deregulation Influence on Losses

Given the nature of the deregulation in Germany, we might expect a change in insurer performance in the post-regulated environment. For example, the removal of restrictions on pricing and the corresponding increase in price competition among insurers would likely be associated with increased market and firm-specific volatility. Profitability may initially increase if prices were previously constrained, but this effect would likely be eroded over time with entrants to the market and increase product competition. On the other hand, given the cartel-like behavior of insurers in the regulated environment, we might expect deregulation to lead to a reduction in profitability as the market no longer contains an enforcement mechanism for discouraging insurers from lowering prices.\(^{32}\)

We consider first the level of losses associated with a given volume of premiums, and ask, what is the effect of deregulation, holding all else equal? We are particularly interested in whether insurers’ opportunities for managing risk were affected by the deregulation in 1994. For example,

\(^{32}\) Wein, 2002.
if deregulation resulted in a general improvement in underwriting (i.e., premiums more accurately reflect expected losses), then we expect losses in the deregulation era to be lower than before deregulation, for a given volume of premiums.

We first apply a weighted ordinary least squares methodology to evaluate the effect of the deregulation on the level of insurer losses. We estimate the following three models:

\[
\begin{align*}
    \text{Losses} &= \beta_1 \text{PremiumsEarned}_t + \beta_2 \text{Dereg}_t + \beta_3 \text{RealIntRate}_t + \beta_4 \text{RealDAX}_t + \beta_5 \text{RealGDP}_t \\
    &\quad + \beta_6 \text{RealCatLosses}_t + \beta_7 \text{RealCatLosses}_{t-1} + \beta_8 \text{RealCatLosses}_{t-2} \\
    &\quad + \beta_9 \text{ChgSrst}_{t-1} + \beta_{10} \text{ChgSrst}_{t-2} + \beta_{11} \text{PersAccident}_t + \beta_{12} \text{AutoLiab}_t + \varepsilon_t
    \end{align*}
\] (1)

\[
\begin{align*}
    \text{Losses} &= \beta_1 \text{PremiumsEarned}_t + \beta_2 \text{Dereg}_t + \beta_3 \text{RealIntRate}_t + \beta_4 \text{RealDAX}_t + \beta_5 \text{RealGDP}_t \\
    &\quad + \beta_6 \text{RealCatLosses}_t + \beta_7 \text{RealCatLosses}_{t-1} + \beta_8 \text{RealCatLosses}_{t-2} \\
    &\quad + \beta_9 \text{ChgSrst}_{t-1} + \beta_{10} \text{PersAccident}_t + \beta_{11} \text{AutoLiab}_t + \varepsilon_t
    \end{align*}
\] (2)

\[
\begin{align*}
    \text{Losses} &= \beta_1 \text{PremiumsEarned}_t + \beta_2 \text{Dereg}_t + \beta_3 \text{RealIntRate}_t + \beta_4 \text{RealDAX}_t + \beta_5 \text{RealGDP}_t \\
    &\quad + \beta_6 \text{RealCatLosses}_{t-1} + \beta_7 \text{ChgSrst}_{t-1} + \beta_8 \text{PersAccident}_t + \beta_{10} \text{AutoLiab}_t + \varepsilon_t
    \end{align*}
\] (3)

where the dependent variable is real gross losses incurred, \( \text{Dereg} \) is a dummy variable equal to 0 for the period 1983-1994, and 1 thereafter. We also include a series of variables designed to capture the effects of catastrophic events on insurer performance. The first series of variables, \( \text{RealCatLosses} \), is the sum of industry-wide catastrophic events, which we include on a contemporaneous and lagged basis. We also include a variable that captures line-specific changes in reserves that are linked to past performance (i.e., loss ratios), the value of the Schwankungsruckstellung, \( \text{Srst} \).

The remaining variables are included to control for general economic conditions that may affect the level of losses. To the extent that the values of these variables are anticipated at the time insurance policies are sold, we expect that their influence is already absorbed in premiums. Thus, we include these variables to capture the effects of unanticipated changes in the economy on the level of losses. Descriptions of these variables, and the results, are shown in Table 3. Since the
differences in our three models (i.e., the inclusion of different lagged values of catastrophe losses and changes in reserves) appear to have little effect on the magnitude of the significant variables, we will restrict our discussion to the results of estimating Model 1.

As shown in the table, loss levels are strongly related to premiums, as expected. We find that the deregulation dummy variable is significant and positive, which supports the view that the regulated period was characterized by cartel-like behavior among insurers. If insurers’ opportunities for managing risk were improved following deregulation, the beneficial effects were outweighed by the general effects of introducing competition in the market. For a given level of premiums, losses proxy the \textit{ex post} cost of coverage. Although we cannot evaluate whether insurers are selling different products (i.e., with different policy provisions) in the deregulated era, the results suggest that costs associated with underwriting may have increased.

Many of the control variables are significantly related to the level of losses, as expected. Higher losses are associated with higher real interest rates, a higher real DAX index, and lower levels of real GDP. Interestingly, the previous year’s catastrophe loss is a significant determinant. The negative sign suggests that insurers may have been able to increase premiums immediately following a catastrophic event, which serves to reduce the shortfall of losses for a given level of premiums in the subsequent year. We also find that the prior year’s change in the value of the Schwankungsrückstellung is related to lower losses in the current year. This result suggests that the reserve plays a significant role in smoothing performance over time. For this reason, we also expect that the Schwankungsrückstellung will be an important factor in the premium process as it appears to attenuate the cyclical behavior.

We included dummy variables to control for two lines that, for reasons discussed previously, may perform differently than the rest. Both variables are significantly related to losses. Controlling for premiums, we expect that the “cash cow” Personal Accident line would have lower losses, on average. Conversely, since the Automobile Liability is compulsory and the market is
very competitive. Therefore, for a given volume of premiums, we expect losses to be higher, on average, than in other lines, indicating lower profitability.

5. Deregulation and Premiums

In the previous section, we show that German insurers’ underwriting performance has been affected by deregulation. The analysis captures only the contemporaneous relationship between premiums and losses, ignoring changes in premiums that occur over time. The cyclical nature of underwriting performance in property and casualty lines is widely illustrated and accepted, although researchers posit several theories of the causes of the cyclical behavior. Thus, we find it appropriate and necessary to evaluate the effects of the German deregulation using a model that assumes a more dynamic process of premium changes.

Existing studies suggest that a variety of factors influence insurance premiums over time. Analyses of annual premium changes in the U.S. reveal that annual changes in losses, as well as lagged values of annual changes in losses, are most influential. These studies confirm the effects of institutional lags and reporting periods on the cyclical pattern of performance in the property-casualty insurance industry. This rational expectations/institutional intervention hypothesis predicts that premiums adjust slowly to loss experience because lags in reporting and regulatory barriers prohibit more timely changes.

Several studies have shown that regulatory lags, in particular, have serious consequences for rate setting, and hence, underwriting profitability. If existing regulations, such as prior approval for rates, restrict insurers from adapting premiums to loss experience in a timely manner, then deregulation that loosens these restrictions would presumably facilitate underwriting success.

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33 See, for example, Venezian, 1985; Doherty and Garven, 1992; Gron, 1994; Cummins and Outreville, 1987.
34 See Lamm-Tennant and Weiss, 1997; Cummins and Outreville, 1987.
For these reasons, premiums might likewise be less volatile following deregulation.\textsuperscript{36} Our earlier findings from the analysis of losses provide preliminary evidence that performance might be more volatile after deregulation, as insurers are forced out of their comfortable cartel-like environment.

The German deregulation of the insurance industry offers a natural experiment in which to test the rational expectations/institutional intervention hypothesis. We follow the approach of Lamm-Tennant and Weiss (1997), which models the premium process as a function of past loss experience and other economic factors. The authors note that changes in premiums are related to capital market results and changes in expected losses which, in turn, are related to expectations in interest rates. Lags due to regulation, data reporting, and internal accrual accounting will influence premiums through their impact on prior losses.

In our application of cycles theory to the German insurance industry, we test whether the premium process was affected by the deregulation in 1994. In particular, we test the rational expectations/institutional intervention hypothesis with an emphasis on whether the theorized influential variables are, in fact, associated with the premium process in Germany. We evaluate the effects of these variables across our complete time period, and then for the periods before and after deregulation. A comparison of the causal factors in the pre- and post-deregulation models provides a natural test of the theory.

We estimate a pooled cross-section time series model that includes 24 lines for the period 1983-2004. Our model is estimated using a weighted generalized least squares (GLS) model that allows for autocorrelation within a line of insurance and a heteroscedastic error structure. Specifically, we estimate:

\[
\Delta\text{Premiums}_{it} = \alpha_t + \beta_1 \Delta\text{Losses}_{i,t-1} + \beta_2 \Delta\text{Losses}_{i,t-2} + \beta_3 \Delta\text{Losses}_{i,t-3} \\
+ \beta_4 \Delta\text{Dereg}_{i,t} + \beta_5 \Delta\text{RealIntRate}_{i,t} + \beta_6 \Delta\text{RealDAX}_{i,t} + \beta_7 \Delta\text{RealGDP}_{i,t} \\
+ \beta_8 \Delta\text{RealCatLosses}_{i,t-1} + \beta_9 \Delta\text{RealCatLosses}_{i,t-2} \\
+ \beta_{10} \Delta\text{Srst}_{i,t-1} + \beta_{11} \Delta\text{Srst}_{i,t-2} + \beta_{12} \Delta\text{Srst}_{i,t-3} + \epsilon_{it},
\]

\text{(4)}

\textsuperscript{36} Tennyson, 1991; Harrington, 2002; Leadbetter et al., 2004.
where $\Delta \text{Premiums}_i$ is the change in log premiums earned from the prior period, $\Delta \text{Loss}_{i,t-1}$, $\Delta \text{Loss}_{i,t-2}$, $\Delta \text{Loss}_{i,t-3}$, are the 1-, 2-, and 3-year lagged changes in log losses for line $i$, $\text{Dereg}$, is a Dummy variable equal to 1 for the 1995-2004 period and 0 otherwise, $\Delta \text{RealCatLosses}_{i,t-1}$ and $\Delta \text{RealCatLosses}_{i,t-2}$ are the 1- and 2-year lagged changes in the log total industry catastrophic losses, $\Delta \text{Srst}_{i,t-1}$, $\Delta \text{Srst}_{i,t-2}$, and $\Delta \text{Srst}_{i,t-3}$ are the 1-, 2- and 3-year lagged changes in the log value of the line-specific Schwankungsrückstellung. The remaining variables, described earlier, are included to control for general economic conditions that may affect the level of the premium change. Table 4 provides more detailed definitions of the variables used in the model.

The results of our estimation of equation (4), and several variations of the model, are shown in Table 5. In the first columns (Models 1 and 2) we show the results of estimating Equation 4 for the complete sample, from 1983-2004. We find that changes in premiums are strongly related to lagged losses and the general economic condition of the national economy. Most importantly, we find that the $\text{Dereg}$ variable is significant and negative, which confirms our hypothesis that there is more competition in the deregulated era compared to the pre-1994 period. Two lags of the $\Delta \text{Srst}$ are significant and negative indicating the Schwankungsrückstellung is a tool which, as intended, reduces the amplitude of the underwriting cycles. We find changes in total catastrophic losses lagged only one year to have a significant positive influence on premium changes, a result that is consistent with our findings with regard to losses: catastrophic losses lead to premium increases, which reduce subsequent shortfalls in premiums relative to losses. Lamm-Tennant and Weiss (1997) found two year lagged catastrophic losses to also influence premium changes, but it was not significant in our model.

The remaining columns in Table 5 present the results from estimating Equation 4 on two subsamples of our dataset: the period 1983-1994 (Models 3-4) and the period 1995-2004 (Models

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37 Several alternate models were estimated, and are shown in Table 5. We chose at this time to leave all models in the paper as we continue to flesh out the theory.
5-6). A comparison of the results of the models estimated for these two periods can be used to test the rational expectations/institutional intervention hypothesis. The two periods contain virtually the same set of insurers operating in both a regulated and deregulated environment.

The results for the pre-deregulation period suggest that the most important factors in the pricing process are the two year’s prior change in losses, the prior year’s change in total catastrophe losses, and the prior years’ change in the claims equalization reserve. This pattern may reflect the regulatory process and its impact on ratemaking in this regime, and suggests a one to two year lag between losses and changes in premiums.

Most striking is that the results for the deregulated era suggest a much wider range of factors that influence changes in premiums. All three lags of losses are important determinants, as are both lagged values of total catastrophe losses and the three lagged values of the changes in the Schwankungsrückstellung. The significance of additional lagged values suggests that deregulation has had a significant effect on the premium setting process in Germany – and provides strong support of the rational expectations/institutional intervention hypothesis.

6. Discussion and Conclusion

The cyclical pattern of underwriting returns in the U.S. property-liability insurance industry has been the subject of discussion for many years. There are studies showing the existence of the underwriting cycle in the United States property-liability insurance market,\(^{38}\) as well as in other countries, including Germany.\(^ {39}\) These studies find that the underwriting cycle in the United States is about six years long while the cycle in Germany is somewhat longer, averaging 7.8 years. A number of different causes for this phenomenon have been suggested, including interest rate fluctuations and institutional lags.

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\(^{39}\) Cummins and Outreville 1987; Lamm-Tennant and Weiss 1997; Chen, Wong and Lee 1999.
We acknowledge the existence of an underwriting cycle in Germany and attempt to evaluate whether a dramatic shift in a regulatory regime – from a regulated to a deregulated environment – affects this cycle. We propose that to the extent that the insurer premium process is affected by deregulation, our findings support the rational expectations/institutional lags hypothesis of cycles in property and casualty lines. Our analysis first shows that the 1994 deregulation of the insurance industry has significantly affected German insurer performance. Recognizing that the German unification and development of the European Union presented challenges as well as opportunities for German insurers, we focus on broad indicators of market performance in this initial assessment of the industry. First, we assess the deregulation effect on insurer performance through an analysis of losses. We find reason to believe that insurers were relatively comfortable in the regulated era, which other evidence of cartel-like behaviour supports. Specifically, for a given volume of premiums, we find that losses are somewhat higher in the deregulated period.

Next, we evaluate the premium process in Germany and find that deregulation has had a marked effect on the cyclical performance of the industry. The factors influencing the process have changed, whereby insurers now incorporate a much wider range of past experience than previously. Our results show that the pre- and post-deregulation premium processes are significantly different, thus confirming that cycles are affected by regulatory intervention.

We find that premium changes are smaller in the period following deregulation, and that Schwankungsrückstellung, which reduces variability in losses, has a similar moderating effect on premiums. Our initial results motivate further study of the insurer performance in the deregulated environment and the changing role of the Schwankungsrückstellung in smoothing performance across the industry.

References


Harrington, Scott E., 2002, “Effects of Prior Approval Regulation of Automobile Insurance” in De-
regulating Property-Liability Insurance: Restoring Competition and Increasing Market
Regulatory Studies.


Kimball, Spencer L. and Werner Pfennigstorf, 1964, “Legislative and Judicial Control of the Terms
of Insurance Contracts: A Comparative Study of American and European Practice,” Indiana
Law Journal, 39, 675-731.

Kimball, Spencer L. and Werner Pfennigstorf, 1965, “Administrative Control of the Terms of


Leadbetter, D., J. Voll, and E. Wieder, 2004, “The Effects of Rate Regulation on the Volatility of
Auto Insurance Prices: Evidence from Canada,” working paper, presented at the 38th Annual
Meeting of the Canadian Economics Association, June 2004, Ryerson University, Toronto,
Ontario.


Mahlberg, Benhard and Thomas Url, 2000, “The Transition to the Single Market in the German
Insurance Industry,” working paper, Vienna University of Economics and Business
Administration, Vienna, Austria.

Industry,” working paper, Vienna University of Economics and Business Administration,
Vienna, Austria.


Figure 1. Loss Ratios in Five Largest Lines, 1983-2004
Table 1. Summary Statistics and univariate differences (industry aggregates)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Dev.</td>
<td>Mean</td>
<td>Std. Dev.</td>
</tr>
<tr>
<td>Real Gross Premiums Earned</td>
<td>50,380</td>
<td>8,723</td>
<td>44,595</td>
<td>7,951</td>
</tr>
<tr>
<td>Change in ln(Premiums Earned)</td>
<td>0.027</td>
<td>0.030</td>
<td>0.049</td>
<td>0.018</td>
</tr>
<tr>
<td>Real Gross Losses Incurred</td>
<td>40,194</td>
<td>7,040</td>
<td>35,722</td>
<td>6,555</td>
</tr>
<tr>
<td>Change in ln(Losses Incurred)</td>
<td>0.020</td>
<td>0.052</td>
<td>0.045</td>
<td>0.032</td>
</tr>
<tr>
<td>Real Schwankungsrückstellung</td>
<td>5,375</td>
<td>2,948</td>
<td>3,423</td>
<td>804</td>
</tr>
<tr>
<td>Change in ln(SchwRst)</td>
<td>-0.351</td>
<td>1.998</td>
<td>0.077</td>
<td>0.143</td>
</tr>
<tr>
<td>Loss Ratio</td>
<td>0.798</td>
<td>0.035</td>
<td>0.801</td>
<td>0.020</td>
</tr>
<tr>
<td>Number of Contracts</td>
<td>314</td>
<td>72.5</td>
<td>272</td>
<td>76.4</td>
</tr>
<tr>
<td>Change in ln(Number of Contracts)</td>
<td>0.032</td>
<td>0.083</td>
<td>0.063</td>
<td>0.100</td>
</tr>
<tr>
<td>Real Average Price</td>
<td>163.64</td>
<td>15.63</td>
<td>168.21</td>
<td>19.53</td>
</tr>
<tr>
<td>Change in ln(Price)</td>
<td>-0.005</td>
<td>0.081</td>
<td>-0.013</td>
<td>0.102</td>
</tr>
<tr>
<td>Real Average Interest Rate</td>
<td>2.997</td>
<td>1.335</td>
<td>3.854</td>
<td>1.075</td>
</tr>
<tr>
<td>Real Average DAX Index</td>
<td>3,077</td>
<td>1,747</td>
<td>1,852</td>
<td>434</td>
</tr>
<tr>
<td>Real GDP</td>
<td>1,758</td>
<td>234</td>
<td>1,743</td>
<td>257</td>
</tr>
<tr>
<td>Real Catastrophe Losses</td>
<td>687</td>
<td>505</td>
<td>682</td>
<td>557</td>
</tr>
</tbody>
</table>

Note: Gross Premiums Earned, Gross Losses Incurred, and Schwankungsrückstellung, are industry aggregates and reported in millions of euros. The Loss Ratio variable is calculated as (Gross Losses Incurred) / (Gross Premiums Earned). Number of Contracts represents the industry aggregate and is reported in millions. Average Price is calculated as (Gross Premiums Earned) / (Number of Contracts) and is reported in euros. Average Interest Rate is the average of the 3-months FIBOR rates in per cent. GDP is limited to former Western Germany, and reported in billions of euros. Catastrophe Losses is defined as the sum of all losses due to catastrophic events in Germany, and is reported in millions of euros. Aggregated industry data is from the yearbooks of the German Insurance Authority (BaFin). Interest rate data, stock index data, GDP and CPI data, and data on catastrophic events are from the Deutsche Bundesbank, the Frankfurt Stock Exchange, the Statistisches Bundesamt, and Swiss Re’s sigma publication, respectively. All euro values are inflation adjusted with 2004 as the basis year. ***,**, and * denotes statistical significance at the 1, 5, and 10 percent levels respectively. Statistical significance of difference in means is based on a t-test. Statistical significance of difference in the standard deviation is based on a F-test.
Table 2. Effects of the German Reunification (univariate differences)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Dev.</td>
</tr>
<tr>
<td>Real Gross Premiums Earned</td>
<td>14,058***</td>
<td>-1,269</td>
</tr>
<tr>
<td>Change in ln(Premiums Earned)</td>
<td>0.014</td>
<td>0.016**</td>
</tr>
<tr>
<td>Real Gross Losses Incurred</td>
<td>11,790***</td>
<td>-1,342</td>
</tr>
<tr>
<td>Change in ln(Losses Incurred)</td>
<td>-0.002</td>
<td>0.000</td>
</tr>
<tr>
<td>Real Schwankungsrückstellung</td>
<td>664</td>
<td>-362</td>
</tr>
<tr>
<td>Change in ln(SchwRst)</td>
<td>-0.062</td>
<td>0.065</td>
</tr>
<tr>
<td>Loss Ratio</td>
<td>0.011</td>
<td>-0.002</td>
</tr>
<tr>
<td>Number of Contracts</td>
<td>137***</td>
<td>-16.5</td>
</tr>
<tr>
<td>Change in ln(Number of Contracts)</td>
<td>0.016</td>
<td>0.006</td>
</tr>
<tr>
<td>Real Average Price</td>
<td>-29.48***</td>
<td>-8.74</td>
</tr>
<tr>
<td>Change in ln(Price)</td>
<td>0.042</td>
<td>-0.036</td>
</tr>
<tr>
<td>Real Catastrophe Losses</td>
<td>62.7</td>
<td>-143</td>
</tr>
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</table>

Note: Gross Premiums Earned, Gross Losses Incurred, and Schwankungsrückstellung, are industry aggregates and reported in millions of euros. The Loss Ratio variable is calculated as (Gross Losses Incurred) / (Gross Premiums Earned). Number of Contracts represents the industry aggregate and is reported in millions. Average Price is calculated as (Gross Premiums Earned) / (Number of Contracts) and is reported in euros. Catastrophe Losses is defined as the sum of all losses due to catastrophic events in Germany, and is reported in millions of euros. Aggregated industry data are from the yearbooks of the German Insurance Authority (BaFin), data on catastrophic events is from Swiss Re’s sigma publication. All euro values are inflation adjusted with 2004 as the basis year. ***. **, and * denotes statistical significance at the 1, 5, and 10 percent levels respectively. Statistical significance of difference in means is based on a t-test. Statistical significance of difference in the standard deviation is based on a F-test.
Table 3. Weighted OLS Regression of Losses on Premiums, Deregulation and controls

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Gross Premiums Earned_{it}</td>
<td>0.863***</td>
<td>0.867***</td>
<td>0.867***</td>
</tr>
<tr>
<td></td>
<td>(65.6)</td>
<td>(67.7)</td>
<td>(67.7)</td>
</tr>
<tr>
<td>Deregulation Dummy</td>
<td>198*</td>
<td>201*</td>
<td>196*</td>
</tr>
<tr>
<td></td>
<td>(1.81)</td>
<td>(1.88)</td>
<td>(1.84)</td>
</tr>
<tr>
<td>Real Average Interest Rate_{i}</td>
<td>45.1*</td>
<td>47.5*</td>
<td>45.3*</td>
</tr>
<tr>
<td></td>
<td>(1.72)</td>
<td>(1.84)</td>
<td>(1.76)</td>
</tr>
<tr>
<td>Real Average DAX Index_{t}</td>
<td>0.093***</td>
<td>0.094***</td>
<td>0.098***</td>
</tr>
<tr>
<td></td>
<td>(4.00)</td>
<td>(4.13)</td>
<td>(4.39)</td>
</tr>
<tr>
<td>Real GDP_{t}</td>
<td>-0.301***</td>
<td>-0.307***</td>
<td>-0.368***</td>
</tr>
<tr>
<td></td>
<td>(-3.72)</td>
<td>(-3.86)</td>
<td>(-5.26)</td>
</tr>
<tr>
<td>Real Catastrophe Losses_{it}</td>
<td>-0.077</td>
<td>-0.077</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.49)</td>
<td>(-1.52)</td>
<td></td>
</tr>
<tr>
<td>Real Catastrophe Losses_{it-1}</td>
<td>-0.179***</td>
<td>-0.188***</td>
<td>-0.166***</td>
</tr>
<tr>
<td></td>
<td>(-3.36)</td>
<td>(-3.79)</td>
<td>(-3.46)</td>
</tr>
<tr>
<td>Real Catastrophe Losses_{it-2}</td>
<td>-0.053</td>
<td>-0.055</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.03)</td>
<td>(-1.09)</td>
<td></td>
</tr>
<tr>
<td>Change in Schwankungsrückstellung_{it-1}</td>
<td>-0.942***</td>
<td>-0.903***</td>
<td>-0.895***</td>
</tr>
<tr>
<td></td>
<td>(-5.01)</td>
<td>(-6.37)</td>
<td>(-6.32)</td>
</tr>
<tr>
<td>Change in Schwankungsrückstellung_{it-2}</td>
<td>0.041</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Accident Dummy</td>
<td>-1.523***</td>
<td>-1.516***</td>
<td>-1.513***</td>
</tr>
<tr>
<td></td>
<td>(-18.1)</td>
<td>(-18.6)</td>
<td>(-18.5)</td>
</tr>
<tr>
<td>Auto Liability Dummy</td>
<td>2.146***</td>
<td>2.064***</td>
<td>2.074***</td>
</tr>
<tr>
<td></td>
<td>(15.1)</td>
<td>(15.03)</td>
<td>(15.1)</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.996</td>
<td>0.996</td>
<td>0.996</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>455</td>
<td>482</td>
<td>482</td>
</tr>
</tbody>
</table>

Note: The dependent variable is Real Gross Losses Incurred in business line i in year t. Deregulation Dummy is equal to one for the years 1995 to 2004, zero otherwise. Average Interest Rate is the average of the 3-months FIBOR rates in per cent. GDP is limited to former Western Germany. Catastrophe Losses is defined as the sum of all losses due to catastrophic events in Germany in year t. Change in Schwankungsrückstellung in line i is the difference of the (t-1) and (t-2) values, and the (t-2) and (t-3) values, respectively. Personal Accident Dummy is equal to one for the personal accident business line, and Auto Liability Dummy is equal to one for the auto liability business line. By-line data is from the yearbooks of the German Insurance Authority (BaFin). Interest rate data, stock index data, GDP data and CPI data, and data on catastrophic events are from the Deutsche Bundesbank, the Frankfurt Stock Exchange, the Statistisches Bundesamt, and Swiss Re's sigma publication, respectively. All euro values are inflation adjusted with 2004 as the basis year. Real Gross Premiums Earned are used as weights. The regression is estimated without a constant. T-statistics appear in parentheses. ***, **, and * denotes statistical significance at the 1, 5, and 10 percent levels respectively.
Table 4. Specification of the weighted GLS regression model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔPremiums_{i,t}</td>
<td>Ln (Real Gross Premiums Earned_i_t) – Ln (Real Gross Premiums Earned_i_t-1)</td>
</tr>
<tr>
<td>ΔLosses_{i,t-1}</td>
<td>Ln (Real Gross Premiums Earned_i_t-1) – Ln (Real Gross Premiums Earned_i_t-2)</td>
</tr>
<tr>
<td>ΔLosses_{i,t-2}</td>
<td>Ln (Real Gross Premiums Earned_i_t-2) – Ln (Real Gross Premiums Earned_i_t-3)</td>
</tr>
<tr>
<td>ΔLosses_{i,t-3}</td>
<td>Ln (Real Gross Premiums Earned_i_t-3) – Ln (Real Gross Premiums Earned_i_t-4)</td>
</tr>
<tr>
<td>Deregulation</td>
<td>Dummy variable equal to 1 for the years 1995-2004 and 0 otherwise</td>
</tr>
<tr>
<td>ΔIntRate_t</td>
<td>Ln (Real Average Interest Rate_t) – Ln (Real Average Interest Rate_t-1)</td>
</tr>
<tr>
<td>ΔDAX_t</td>
<td>Ln (Real Average DAX Index_t) – Ln (Real Average DAX Index_t-1)</td>
</tr>
<tr>
<td>ΔGDP_t</td>
<td>Ln (Real GDP_t) – Ln (Real GDP_t-1)</td>
</tr>
<tr>
<td>ΔCatastrophe_t-1</td>
<td>Ln (Real Catastrophic Losses_t-1) – Ln (Real Catastrophic Losses_t-2)</td>
</tr>
<tr>
<td>ΔCatastrophe_t-2</td>
<td>Ln (Real Catastrophic Losses_t-2) – Ln (Real Catastrophic Losses_t-3)</td>
</tr>
<tr>
<td>ΔSchwRst_i,t-1</td>
<td>Ln (Real Schwankungsrückstellung_i_t-1) – Ln (Real Schwankungsrückstellung_i_t-2)</td>
</tr>
<tr>
<td>ΔSchwRst_i,t-2</td>
<td>Ln (Real Schwankungsrückstellung_i_t-2) – Ln (Real Schwankungsrückstellung_i_t-3)</td>
</tr>
<tr>
<td>ΔSchwRst_i,t-3</td>
<td>Ln (Real Schwankungsrückstellung_i_t-3) – Ln (Real Schwankungsrückstellung_i_t-4)</td>
</tr>
</tbody>
</table>

Note: The indices i and t denote the business line and the year, respectively. Average Interest Rate is the average of the 3-months FIBOR rates in per cent. GDP is limited to former Western Germany. Catastrophe Losses is defined as the sum of all losses due to catastrophic events in Germany in year t. By-line premium, loss and reserve data is from the yearbooks of the German Insurance Authority (BaFin). Interest rate data, stock index data, GDP data and CPI data, and data on catastrophic events are from the Deutsche Bundesbank, the Frankfurt Stock Exchange, the Statistisches Bundesamt, and Swiss Re’s sigma publication, respectively. All euro values are inflation adjusted with 2004 as the basis year.
Table 5. Weighted GLS regression of Changes in Premiums on Deregulation and controls

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.031***</td>
<td>0.029***</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>(5.57)</td>
<td>(5.48)</td>
<td>(0.67)</td>
</tr>
<tr>
<td>ΔΔLosses <em>i,t-1</em></td>
<td>0.049***</td>
<td>0.052***</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>(4.09)</td>
<td>(4.40)</td>
<td>(0.61)</td>
</tr>
<tr>
<td>ΔΔLosses <em>i,t-2</em></td>
<td>0.052***</td>
<td>0.054***</td>
<td>0.057***</td>
</tr>
<tr>
<td></td>
<td>(3.68)</td>
<td>(3.84)</td>
<td>(2.65)</td>
</tr>
<tr>
<td>ΔΔLosses <em>i,t-3</em></td>
<td>0.027**</td>
<td>0.026**</td>
<td>0.021</td>
</tr>
<tr>
<td></td>
<td>(2.47)</td>
<td>(2.50)</td>
<td>(1.20)</td>
</tr>
<tr>
<td>ΔΔDeregulation</td>
<td>-0.026***</td>
<td>-0.025***</td>
<td>-0.065</td>
</tr>
<tr>
<td></td>
<td>(-4.99)</td>
<td>(-4.95)</td>
<td>(-0.84)</td>
</tr>
<tr>
<td>ΔΔIntRate <em>t</em></td>
<td>-0.013***</td>
<td>-0.013***</td>
<td>-0.035</td>
</tr>
<tr>
<td></td>
<td>(-2.55)</td>
<td>(-2.55)</td>
<td>(-0.84)</td>
</tr>
<tr>
<td>ΔΔDAX <em>t</em></td>
<td>-0.024***</td>
<td>-0.026***</td>
<td>0.299**</td>
</tr>
<tr>
<td></td>
<td>(-2.90)</td>
<td>(-3.11)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>ΔΔGDP <em>t</em></td>
<td>0.299**</td>
<td>0.320***</td>
<td>0.614</td>
</tr>
<tr>
<td></td>
<td>(2.37)</td>
<td>(2.69)</td>
<td>(0.96)</td>
</tr>
<tr>
<td>ΔΔCatastrophe <em>i,t-1</em></td>
<td>0.006***</td>
<td>0.005***</td>
<td>0.019***</td>
</tr>
<tr>
<td></td>
<td>(2.88)</td>
<td>(3.18)</td>
<td>(3.10)</td>
</tr>
<tr>
<td>ΔΔCatastrophe <em>i,t-2</em></td>
<td>0.001</td>
<td>-0.001</td>
<td>-0.013*</td>
</tr>
<tr>
<td></td>
<td>(0.79)</td>
<td>(-0.23)</td>
<td>(1.82)</td>
</tr>
<tr>
<td>ΔΔSchwRst <em>i,t-1</em></td>
<td>-0.020***</td>
<td>-0.019***</td>
<td>-0.046***</td>
</tr>
<tr>
<td></td>
<td>(-2.99)</td>
<td>(-2.85)</td>
<td>(-3.48)</td>
</tr>
<tr>
<td>ΔΔSchwRst <em>i,t-2</em></td>
<td>-0.017***</td>
<td>-0.017***</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(-2.59)</td>
<td>(-2.62)</td>
<td>(-0.47)</td>
</tr>
<tr>
<td>ΔΔSchwRst <em>i,t-3</em></td>
<td>-0.001</td>
<td>0.013</td>
<td>-0.013***</td>
</tr>
<tr>
<td></td>
<td>(-0.17)</td>
<td>(1.10)</td>
<td>(-2.73)</td>
</tr>
<tr>
<td>Wald χ-squared</td>
<td>165</td>
<td>159</td>
<td>78.6</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>428</td>
<td>429</td>
<td>175</td>
</tr>
</tbody>
</table>

Note: The dependent variable is Real Gross Losses Incurred in business line i in year t. Real Gross Premiums Earned are used as weights. Z-statistics appear in parentheses. ***, **, and * denotes statistical significance at the 1, 5, and 10 percent levels respectively.
Appendix: The Schwankungsrückstellung

Annual flows into (and out of) the fund depend on the insurer’s loss experience in that year, subject to a cap on the fund value. This cap reflects the principle that taxed equity capital should bear the ultimate business risk of the insurance company. The goal of the reserve is to change the random realizations of yearly losses to its inter-temporal average in 95% of all possible scenarios. The remaining 5% of catastrophic loss scenarios are not covered by the Schwankungsrückstellung. The maximum value of the reserve gets further reduced for business lines with high safety loadings in their premiums. Policy makers in Germany defined a target combined ratio as one minus the average loss ratios of the last three years minus five percent. Since the loss ratio does only include costs which can be directly attributed to selling insurance, this additional five percent are subtracted to account for other costs. If a business line has an average loss ratio \( q^* \) below the target loss ratio \( q^* \), the maximum value of the fund gets reduced linearly by three times the difference between the target loss ratio and the average loss ratio of the business lines. The specific formula for calculating the maximum value \( M_t \) of the Schwankungsrückstellung in year \( t \) is given by

\[
M_t = \begin{cases} 
4.5 \sigma_q \pi_t & \text{for } q^* < \bar{q} \\
4.5 \sigma_q \pi_t - 3(q^* - \bar{q}) \pi_t & \text{for } q^* > \bar{q}
\end{cases}
\]

with \( q^* = 1 - \frac{1}{3}(c_1 + c_2 + c_3) - 0.05 \)

where \( \bar{q} \) is the average loss ratio of the last 15 years, \( \sigma_q \) the standard deviation of the loss ratio, \( \pi_t \) the net premiums earned, \( q^* \) the target loss ratio, and \( c_1, c_2, \) and \( c_3 \) are the cost ratios of the past three years.\(^{41}\) Note, \(^{40}\) For the hail storm damage line, the credit and collateral line, and the infidelity line the average of the loss ratios is calculated over the past 30 years.

\(^{41}\) The factor of 4.5 in the formula reflects the safety level of 95%, the length of the period under consideration, the skewness of the distribution, and a discount factor. Since simulations showed that a factor aggregating these effects stays within the range of 4.2 to 5.1, policy makers agreed on the number 4.5 for most business lines (Nies, 1979). For the hail storm damage line, the credit and collateral line, and the infidelity line a factor of 6.0 is used to calculate the maximum value of the Schwankungsrückstellung.
that all variables are specific to a given business line of a given insurance company. There are no industry aggregates used in the calculation.

Cash-flows in and out of the reserve are calculated according to a fixed formula. These flows only depend on the cap amount \( M_t \), the current loss ratio \( q_t \), the average loss ratio \( \bar{q} \), the target loss ratio \( q^* \), and the current premium income \( \pi_t \). Thus, the value of the Schwankungsrückstellung \( SR_t \) in year \( t \) can be described recursively as previous years value \( SR_{t-1} \) plus inflows minus outflows:

\[
SR_t = \min \left\{ M_t, SR_{t-1} + 0.035 \cdot M_t, \quad + \max \left[ 0, (\bar{q} - q_t)\pi_t \right], \quad - \max \left[ 0, (q_t - \bar{q})\pi_t - 0.6 \cdot \max \left[ 0, (q^* - \bar{q})\pi_t \right] \right] \right\}
\]

The actual amount in the fund for year \( t \) is therefore the smaller of the cap amount, \( M_t \), or last year’s reserve plus a negligible small term compensating for inflation, and most importantly plus or minus an amount that depends on the business line’s current performance. If the loss ratio in the current year is below the average loss ratio in that business line, the insurer has to increase the reserve by the difference of the two multiplied by net premiums earned. If the loss ratio is below average, the insurer has to take the difference of the loss ratio and its average multiplied by net premiums earned out of the reserve. But for business lines with high safety loadings in their premiums, this outflow of the reserve gets reduced. The intuition here is that the safety loadings already cover the deviation of the incurred losses from its expected value, and the insurer does not need the funds from the reserve. The safety loadings of a business line are measured by the extent the average loss ratio \( \bar{q} \) is smaller than the target loss ratio \( q^* \), and the outflow of the reserve is reduced in proportion to this difference. Since there is no cap on the amount the insurer can take out of the reserve in a bad year, the Schwankungsrückstellung helps insurance companies to absorb catastrophic losses in a given year. The maximum value of the fund, however, is not designed for catastrophic events.